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Development And Validation Of A Measurement Scale To Analyze The Environment For Evidence-Based Medicine Learning And Practice By Medical Residents

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DEVELOPMENT AND VALIDATION OF A MEASUREMENT SCALE TO ANALYZE THE ENVIRONMENT FOR EVIDENCE-BASED MEDICINE LEARNING AND PRACTICE BY MEDICAL RESIDENTS

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DEDICATION

I dedicate this dissertation to my husband, Zhong, and my son, Peter.

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CHAPTER 1

INTRODUCTION

Evidence-based medicine (EBM) requires the integration of the current best research evidence with clinical expertise and a patient's unique values and circumstances (Straus, Richardson, Glasziou, & Haynes, 2005). The development of medical residents' competency in EBM through the adoption of evidence-based practice depends on many factors, among which is an effective EBM training program integrated into a residency training program.

However, instructional design, development, and implementation of a successful training program must hinge on contextual analysis of various factors that interact to affect learning and transfer in a health care environment. Tessmer and Richey (1997) state, "context is a pervasive and potent force in any learning event….Context has a complex and powerful influence upon successful performance-based learning" (p. 85). It is the context that helps determine an individual resident's capacity to learn in a health care institution (Argyris, 1999; Schein, 1992). Hoff, Pohl, and Bartfield (2004) maintain that it is the responsibility of residency programs and health care organizations to create the right environment for residents to acquire core competencies. The purpose of the study was to develop and validate a measurement scale that could be used to analyze the environment surrounding EBM learning and practice by medical residents in health care settings. It was hoped that the validated EBM environment scale could help program directors and medical educators better understand the EBM environment and make informed decisions on how to change or improve the environment essential for maximizing EBM learning process and learning outcomes.

Background

Evidence-based medicine (EBM) has emerged as a new paradigm for or approach to the practice of medicine. EBM requires the integration of the current best research evidence with a clinician's expertise and a patient's unique values, preferences, and circumstances. The practice of EBM demands acquisition of a set of skills to help clinicians locate, interpret, appraise, and apply the evidence to an individual or a group of patients (Straus, et al., 2005). As part of the Accreditation Council for Graduate Medical Education's (ACGME) practice-based learning and improvement competency requirements, residents (physicians-in-training) need to demonstrate their skills in "locating, appraising, and assimilating evidence from scientific studies related to their patients' problems and apply knowledge of study designs and statistical methods to the appraisal of clinical studies" (Accreditation Council of Graduate Medical Education, 2007). The EBM paradigm is well aligned with the ACGME's skill requirement for medical residents. Despite the exponential increase of literature on clinical research and the promise of EBM to improve health care outcomes, a physician's medical practice or knowledge-to-practice gap continues to impede progress in improving health care (Robert, 2006).

An increasing number of medical schools and residency programs are instituting curricula and programs for teaching the EBM principles and practice (Hatala & Guyatt, 2002). These curricula and programs are becoming increasingly popular in specialties such as family medicine, internal medicine, pediatrics, and surgery. Various instructional interventions through faculty-led lectures, workshops and journal clubs are implemented to help residents meet the EBM competency requirement. However, there is little evidence about the effectiveness of different methods of teaching EBM (Hatala & Guyatt, 2002; Kersten, Randis, & Giardino, 2005) and few validated tools have been designed to measure residents' ability to practice EBM and the effect of EBM training on patient outcomes (Christakis, Davis, & Rivara, 2000; Green, 2000a; Shaneyfelt, Baum, Bell, Feldstein, Houston, Kaatz, Whelan, & Green, 2006). Research shows that residents face an array of barriers to learning and practicing EBM, including lack of personal time (Green & Ruff, 2005), lack of support and mentoring, lack of trained EBM faculty teachers, limited access to EBM resources, and difficulty with statistical concepts (Kersten, et al., 2005). There are also unique barriers that residents face including institutional culture and team dynamics (Green & Ruff, 2005) and an unsupportive learning environment (Sahu, 2007). "The hospital institutional culture may represent the most formidable barrier" (Green & Ruff, 2005, p. 181) that could exert a powerful influence on residents' EBM learning and practice in clinical settings. To medical educators who provide EBM training, the focus may be on teaching discrete EBM skills or delivering EBM content rather than attending to the influence of contextual factors on trainees' learning process, learning transfer, or behavior change in patient care settings. A comprehensive literature review reveal little attention to what these factors are and how they interact to form the learning condition for residents. The purpose of the study was to develop and validate a scale for contextual analysis of the environment in which medical residents learn and practice EBM.

Graduate medical education is primarily outcome-based; residents' performance in a patient care setting constitutes a more opportunistic nature in their education. The development of competence during residency is impacted by the relationship or interaction among residents, the given task, and the context in which they work. In designing curricula and assessment strategies, it is essential to consider their ability and prior experience, the given task, and the contextual characteristics of their learning environment (Ringsted, Skaarup, Henriksen, & Davis, 2006). While embracing systems thinking as an approach to a more complex view of medical practice, Hoff, Pohl, and Bartfield (2004) stress the role of the residency culture and work context in helping residents achieve the ACGME required competencies. The establishment of a supportive, learning oriented culture and favorable work conditions is of utmost importance in training competent physicians and it should be a high priority for residency programs and health care institutions. Hoff et al. (2004) argue,

> Identifying and prioritizing the components of a desired working environment for promoting a learning-oriented culture, in addition to assessing the presence and absence of both the components and learning best practices within residency programs, should become normal activities that complement the process of assessing competencies (p. 534).

Residents are trained to work in a health care environment. They learn on the job and successful transfer of their learning to their practice of patient care is dependent on the interaction of many observable and objective factors in their environment with perceptions of the environment by organizational members—residents, attending physicians or preceptors, administrators, nursing and ancillary staff.

The EBM approach is the continuity of the learning and transfer process. It comprises the commonly accepted steps: asking a relevant clinical question based on a clinical case, acquiring evidence by selecting appropriate resources and conducting a medical literature search, appraising the evidence for its validity and applicability, applying the evidence by integrating the evidence with clinical expertise and the patient's preferences, and assessing the clinician's performance with the patient (Sackett, Straus, Richardson, & Rosenberg, 2000; Schardt, 2001). Research on the influence of the work environment on the transfer of newly trained skills demonstrates the influence of the organizational climate and culture on the adoption of trained skills among employees in the corporate world (Tracey, Tannenbaum, & Kavanagh, 1995). For some employees, their environment limits their ability to transfer what they learned.

Health care providers' professional development depends to a great extent on the attributes of the environment in which they work (Rotem, Youngblood, Harris, & Godwin, 1996). For residents in health care settings, their training-work environment warrants investigation for the purpose of understanding their application of trained skills and behaviors to patient care. "The cultures and everyday work contexts of residency programs are important factors that inevitably will contribute to some level of variation in the acquisition of competencies across residents and residency programs" (Hoff, et al., 2004, p. 533). The analysis of the environment—contexts surrounding learners—is is part of a total system perspective of instructional design and it is essential to the success of an instructional project (Tessmer, 1990).

According to the general system theory, the environment is made of many components, parts, elements, or processes. Each component is interrelated and connected with others to form a complete whole (Richey, 1986). Tessmer and Richey (1997) support the use of contextual analysis as an approach in accommodating contextual elements for the purpose of improving learning and transfer. The contextual analysis model they proposed reflects the application of the general system theory in contextual analysis—an essential step for effective instructional design (Table 1 below). From Tessmer and Richey's (1997) point of view, contextual analysis is concerned with the "multilevel body of factors in which learning and performance are embedded" (p. 85). These factors can be related to learner characteristics (orienting context), immediate environment (instructional context), and organizational environment (transfer context) that can either facilitate or constrain instruction.

Table 1

Context Analysis Model

	Orienting Context	Instructional Context	Transfer Context
Learner factors	• Learner profile • Goal setting • Perceived utility • Perceived accountably	• Learner role perception • Learner task perception	• Utility perceptions • Perceived resources • Transfer coping strategy • Experiential background
Immediate Environment Factors	• Social Support	• Sensory conditions • Seating • Instructor role perception • Learning schedules • Content culture	• Transfer opportunities • Social support • Situational cues
Organizational Factors	• Incentives • Learning culture	• Rewards & values • Learning supports • Teaching supports	• Transfer culture • Incentives

Note: From "The role of context in learning and instructional design," by M. Tessmer and R. C. Richey, 1997, *Educational Technology Research and Development*, *45*, p. 92.

Thus, in designing and implementing any EBM training program or educational event for residents, it is important to examine these factors to determine what changes are needed to facilitate EBM learning and adoption and what targeted interventions could be designed to remove obstacles or barriers in the process of learning and transfer.

Problem Statement

Contextual factors make a unique learning environment and interact with residents' EBM learning and adoption. Gilbert (1996) argued that modifying people's performance couldn't occur in isolation from its context. Any performance improvement effort entails consideration and analysis of environmental support factors as well as individual factors. Learning EBM principles and processes and adopting them contribute to the improvement of residents' performance in caring for patients and help them reach the ultimate goal of becoming competent physicians. The analysis of contextual factors as important variables, however, has been largely ignored in a growing body of medical literature related to EBM training design, implementation, and evaluation. An extensive review of literature reveals little attention to any measurement tool used to analyze contextual factors in the design of EBM programs and curricula for medical residents and the impact of the factors on effective EBM learning and adoption. A thorough context analysis is needed to identify what factors or components in residents' training and work environment interact to form the conditions that can affect EBM learning and practice.

Purpose of the Study

Environment analysis is used to analyze the contexts of instructional systems and the physical and psychosocial constructs that can affect learning and transfer. A given context may have different aspects and is a multilevel body of physical, social, and instructional factors which interplay to influence learning and performance (Tessmer & Harris, 1992; Tessmer & Richey, 1997). The environment for EBM learning and practice is considered as a broader conceptual system that comprises many factors at different levels. The purpose of this study was to develop and validate an EBM environmental scale that was intended to measure residents' perceptions of the environment in which EBM learning and adoption occur.

Research Questions

The study was conducted to answer the following research questions:

1. What are the psychometric properties of the newly developed EBM Environment Scale?
2. Are there any differences among residents grouped by gender in reference to scores on the EBM Environment Scale?

3. Are there any differences among residents grouped by country of medical school attended in reference to scores on the EBM Environment Scale?
4. Are there any differences among residents grouped by level of residency training in reference to scores on the EBM Environment Scale?
5. Are there any differences among residents across residency programs in reference to scores on the EBM Environment Scale?
6. Are there any differences among residents grouped by level of prior EBM training in medical school in reference to scores on the EBM Environment Scale?
7. Are there any differences among residents grouped by level of prior EBM training during residency in reference to scores on the EBM Environment Scale?
8. How well does level of residency training predict scores on the EBM Environment Scale?
9. How well does level of prior EBM training in medical school predict scores on the EBM Environment Scale?
10. How well does level of prior EBM training during residency predict scores on the EBM Environment Scale?

Definitions of Terms

Academic medical center. Academic medical center is a partnership between a medical school and its affiliated teaching hospitals and clinics. In the academic medical center, faculties of medicine have direct responsibility for educating future physicians and for biomedical and health services research (Lewis & Sheps, 1983). The primary responsibility of affiliated teaching hospitals is to provide patient services and settings for clinical medical education, research, and associated professional medical services. Medical education, research, and medical services are thus linked within the medical center that serves as a resource for patient care in the community, district and region (Valberg, Gonyea, Sinclair, & Wade, 1994).

Community-based hospital. Community-based hospital is a health care organization or institution with permanent facilities and organized medical staff which provide a full range of hospital services primarily to the community and surrounding neighborhood area.

Environment. Environment refers to a conceptual system of conditions, elements, or factors that may affect both the acquisition and application of newly acquired knowledge and skills. It is largely identical with the term *climate* which Genn and Harden (1986) used to refer to the overall atmosphere and characteristics of the classroom and school. In Richey and Tessmer's (1995) words, "that environment is composed of physical, psychological, and social factors; at the instructional and organizational levels, all learning is affected by its environment" (p. 191). Environmental factors impact learning and performance and exist at different levels of contexts (Tessmer & Richey, 1997) and they contribute to the environment that the EBM Environment Scale was intended to measure. In this study, the EBM environment was characterized by different factors: learner factors, immediate environment factors, and organizational factors, existing at three levels of context--orienting context, instructional context, and transfer context.

Evidence-Based Medicine. Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients (Rotem, et al., 1996; Sackett, et al., 2000). It is the integration of a clinician's tacit knowledge and expertise with the best available external clinical evidence and patients' values and preferences. It requires acquisition and development of skill sets related to constructing answerable clinical questions, locating the evidence, appraising the evidence, and applying it to an individual or a group of patients. How the skills are acquired and practiced is influenced by the interaction of many contextual factors exiting in residents' training and patient care environment. In taking the steps of learning and practicing EBM, medical residents can face different types of barriers.

Focus group. Focus group usually involves eight to twelve individuals in a group who discuss a particular issue or topic under the direction of a moderator. In this study, a focus group of chief residents was conducted online through a survey due to the fact that the residents were scattered over several states in the country. The group was homogeneous with regard to characteristics relevant to the types of data being sought (Guerra-López, 2008) and representative of the target population which the scale was intended for. Among many research-based uses of focus groups, one particular use is to elicit opinions and views, and identify attitudes about services, policies, and institutions in order to identify customer and user perception. Focus group was described as "a useful way of securing information of informing the development of the questionnaire prior to its implementation" (Rea & Parker, 2005, p. 74).

Instructional context. Instructional context includes those factors in the environments that are directly involved in the instructional delivery, the immediate physical, social and symbolic resources outside the learner (Perkins as cited in Tessmer & Richey, 1997).

Learners. In the study, learners refer to clinical learners or medical residents (physicians-in-training) who are pursuing graduate medical education in an ACGME-accredited medical education program. Learner factors constitute what learners bring to a learning environment. "Each individual resident is part of a larger health care delivery work context and culture" (Hoff, et al., 2004, p. 539). These learner factors influence the prospective learners' motivation and cognitive preparation to learn (Tessmer & Richey, 1997) and shape their perceptions of what will occur during and after learning. These learner factors include, but are not limited to, residents' prior EBM knowledge, training experience, personal learning goals, learner role, expectations, and perceived utility and accountability about training.

Medical residency training. Medical residency training is required for any graduate with the degree of doctor in medicine who wants to practice as a physician in the United States, even for physicians who are fully licensed to practice medicine in other countries. Residency programs vary in length depending on specialty but can last three years for primary care physicians and up to five or seven years for some specialties or subspecialties (Mallon & Vernon, 2008). The programs are accredited by the Accreditation Council for Graduate Medical Education in a recognized medical specialty (Sultz & Young, 2009). Medical residents are physicians in training, working only under the supervision of an attending physician (senior physician educator), who is ultimately responsible for the patients being treated by the medical residents (American Medical Association, 2009; Santiago, 2009).

Perception. Perception is defined as residents' awareness of and affective responses to environments surrounding their EBM learning and practice in a health care setting. It is measured by perception scores on the EBM Environment Scale. Higher scores indicate a favorable perception of the EBM environment.

Preceptor. Preceptor refers to an experienced physician educator who provides support, guidance, and training experience required for a medical resident to become a certified medical doctor in a medical specialty.

Primary care specialties. Primary care specialties are medical specialties in family medicine (primary care of adults and children), internal medicine (primary care of adults), and pediatrics (primary care of children). These specialties are basically ambulatory in nature, with emphasis on disease prevention and continuing care for patients over a long period of time.

Physicians who practice in the primary care specialties focus on providing general care for individual patients and often coordinate the specialized care that a patient may receive from different medical specialists (Torpy, Burke, & Glass, 2007).

Orienting context. Orienting context is pre-instructional and influences the prospective student's motivation and cognitive preparation to learn. It also affects students' transfer of learning in the post-training context (Tessmer & Richey, 1997).

Transfer context. Transfer context refers to the environment or workplace in which learned skills and knowledge are applied.

Summary

The study was conducted to develop and validate a measurement scale to assess medical residents' perceptions of the environment surrounding their EBM learning and practice in health care settings. For medical residents to learn EBM and transfer learning to their patient care setting, it is important to examine the conditions under which learning and transfer occur. Contextual analysis of the conditions is precursory to the effective implementation of any EBM training program. The validated EBM Environment Scale could be used as a tool to assess the EBM learning environment.

Chapter I provides the background and rationale for the study. It presents an overview of the purpose of the study, problem statement, and research questions. Chapter II provides a context for the study by reviewing literature in relevant areas, identifying the content area or content domain for scale development, and presenting the conceptual framework on which the scale was grounded.

CHAPTER 2

LITERATURE REVIEW

Evidence-Based Medicine and EBM Training

Evidence-based medicine is regarded as an approach to the practice of medicine and signifies a paradigm shift from the traditional medical practice. It is defined as "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). In making decisions about caring for individual patients, the approach calls for the integration of the best available, current, valid, and relevant evidence with clinicians' knowledge and patients' preferences, values, and needs. The practice of EBM is a process of lifelong self-directed learning in which caring for patients creates a need for acquisition of new knowledge about diagnosis, prognosis, treatment, and other health care related issues (Bhandari, Montori, Devereaux, Dosanjh, Sprague, & Guyatt, 2003; Burneo, Jenkins, & Bussiere, 2006). Practicing EBM is not acquired instantly but developed over time (Liu & Stewart, 2007). The process takes place within the context of available resources (Ciliska, Pinelli, DiCenso, & Cullum, 2001; Dawes, Summerskill, Glasziou, Cartabellotta, Martin, Hopayian, Porzsolt, Burls, & Osborne, 2005).

In introducing EBM to clinicians in the seminal work of AMA's *Users' Guides to the Medical Literature: Essentials for Evidence-Based Clinical Practice* (Guyatt & Rennie, 2002), the latter made a valid remark about the end results for clinicians to apply evidence-based literature which is:

> To end their dependence on out-of-date authority. To enable the practitioner to work with the patient and use the literature as a tool to solve the patient's problems. To provide the clinician access to what is relevant and the ability to assess its validity and whether it

> applies to a specific patient. In other words, to put the clinician in charge of the single most powerful resource in medicine (pp. vii-viii).

In addition to inform clinical decisions, EBM represents an approach to lifelong learning in which the patient encounters cue the acquisition of knowledge (Green, 2000b). The evidence-based approach can also inform policy making (Muir Gray, Haynes, Sackett, Cook, & Guyatt, 1997), day-to-day decisions in public health, and systems-level decisions such as those facing hospital administration (Guyatt & Rennie, 2002).

The adoption of EBM in health care has been recognized as an important skill for physicians. The U.S. Accreditation Council of Graduate Medical Education (2007) includes EBM skills among their mandated core competences for residency programs. To provide optimal care, residents must be able to locate, appraise, interpret, and apply the current best evidence to a given clinical situation. Over the past decade, EBM curriculum and programs have been designed as interventions integrated into graduate medical education programs or curriculum to improve residents' competence in practicing EBM in various specialties.

These EBM interventions vary in duration, ranging from one-time training of one to four hours, to a series of stand-alone weekly or monthly lectures or workshops coupled with journal clubs in classrooms away from clinical practice. The emphasis of instructional content tends to be on specific aspects and steps of the EBM process, or "microskills" or discrete skills, such as asking clinical questions, searching for the evidence, and critical appraisal of the evidence. The training content is delivered through workshops, didactic lectures, and journal clubs, mostly unrelated to any individual patient case (Green, 2000b). Brown, Collins, and Duguid (1989) were critical of the methods of didactic education. In their opinion, the problem with didactic methods is to separate knowing from doing and to treat knowledge as an integral, self-sufficient substance, theoretically independent of the situations in which knowledge is learned and used. A systemic review of continuing medical education effectiveness on professional practice also revealed that didactic sessions alone result in no statistically significant change in professional practice (O'Brien, Freemantle, Oxman, Wolf, Davis, & Herrin, 2001). In another review of studies on effects of stand-alone versus clinically integrated EBM on various outcomes in postgraduates, Coomarasamy and Khan (2004) found that stand-alone EBM lectures and workshops did not result in changes in skills, attitudes, or behavior but only improved knowledge while integration of EBM teaching into clinical practice improved attitude about the role of EBM or critical literature appraisal in medicine. To incorporate EBM learning and teaching into clinical practice, it would require a sustained effort well beyond stand-alone instruction. Efforts of teaching EMB should move beyond the immediate learning context to a wider and broader context of clinical practice.

It is important that evaluation of EBM interventions include assessment of environments in which learning, teaching and practice occur. However, EBM learning outcome and effectiveness of EBM training are mainly evaluated through knowledge-based exercises (e.g., pre- and post-tests), tests of EBM skills (Dinkevich, Markinson, Ahsan, & Lawrence, 2006), self-assessment of EBM competencies, survey questionnaires for training participation, confidence, and attitude (Akl, Izuchukwu, El-Dika, Fritsche, Kunz, & Schunemann, 2004; Thom, Haugen, Sommers, & Lovett, 2004). The overall training evaluation practice tends to focus on the individual trainee as the primary unit of analysis and evaluation interests are mostly restricted to training events within the immediate training environment such as workshops or stand-alone lectures.

In spite of efforts to provide residents with EBM interventions of various formats, residents continue to face a wide array of barriers to learning and practicing EBM in health care settings. A survey of EBM training in emergency medicine residency programs revealed that the greatest barriers to integrating EBM in teaching and patient care were lack of time, lack of trained faculty, and lack of familiarity with EBM resources, followed by barriers of insufficient funding and lack of interested faculty (Kuhn, Wyer, Cordell, & Rowe, 2005). In addition to time constraints, residents were also under the pressure of clinical production or heavy workload (Yew & Reid, 2008). Although program directors and residents in many residency programs agreed on the value of EBM and expressed strong interest in EBM, there was still restricted time allotted for teaching EBM and a shortage of EBM trained faculty, mentors, or role models (Bhandari, et al., 2003; Kuhn, et al., 2005). As Bhandari et al. (2003) found out, surgical residents faced several types of barriers which limited their ability to apply EBM in their daily activities. These barriers were personal, staff-surgeon and institutional barriers. Personal barriers included residents' lack of EBM knowledge and motivation, and fear of staff disapproval; staff-surgeons lacked EBM training and were characterized by rigidity; environmental factors or institutional barriers included service demands, lack of EBM resources, staff shortage, and hierarchical structure between staff surgeon and residents.

If behavioral change through skill and knowledge transfer within the organizational context, as opposed to that present at the training site, are the more meaningful benchmarks against which training effectiveness should be evaluated, then knowledge and understanding of various factors and conditions that operate at the organizational level, work group, and individual levels should assume central positions in both training evaluation and training management (Conrad & Roberts-Gray, 1988; McDonald, 1991; Schein, 1986; Scheirer, 1981). However, a comprehensive literature review reveals little research on the impact of these factors and conditions on EBM learning outcomes and transfer at different levels in residency training programs. It is essential to understand and examine the factors and conditions when designing and developing instruments to measure environments necessary for effective EBM learning and practice. From the systemic point of view, these factors and conditions are part of the learning and organizational systems that may facilitate or hinder residents' learning and adoption of evidence-based practice.

Contextual Influences and Graduate Medical Education

Organizational climate can be conceptualized as individual perceptions about salient characteristics of the organizational context. In other words, climate corresponds to the shared pattern of meanings or perceptions among individuals about the major characteristics of an organization context. Therefore, it should be considered as a broad, multidimensional perceptual domain (Schneider as cited in Tracey et al., 1995), which encompasses many factors such as learners, resources, social support, role modeling, feedback, etc. The optimal learning environment is characterized by strong faculty, good educational experiences, exposure to a variety of patients, a positive and nurturing social environment (Thrush, Hicks, Tariq, Johnson, Clardy, O'Sullivan, & Williams, 2007). However, learners also bring to each new educational context their prior knowledge, preconceptions, attitude, and aptitude that influence their learning in a training setting. Their prior knowledge and experiences should largely determine how the educational curriculum is implemented (Bowen, Stearns, Dohner, Blackman, & Simpson, 1997). Learners also have their experiences, models and theories, expectations and even a personal theory of learning which can affect their motivation to learn and ultimately the effectiveness of instruction. These experiences and learner characteristics should be considered for the purpose of facilitating unlearning or relearning and connecting new learning with their experiences.

However, the learner and environment variables have not been significant part of the published literature related to medical education (Shipengrover & James, 1999).

According to Tessmer (1990), the support environment sustains the use of a product (e.g., instructional program) by making the product available and facilitates its implementation. As the environment impacts the production and implementation of the product, it is crucial to consider it in an environmental analysis for instructional design. Resources available to support instruction and independent learning should be evaluated (Bowen, et al., 1997). With respect to learning and practicing EBM, resources may include: computers, the Internet access, any facilities needed for EBM training, EBM clinical information resources readily available and easily accessible locally and remotely, and an interdisciplinary team of EBM trained faculty instructors.

In terms of social support, the social support system in a workplace plays a central role in establishing supportive training and learning environments that facilitate transfer of training. People who commonly interact with each other at work are most likely to share perceptions of their work environment (Tracey, et al., 1995). In measuring instructional quality in community-oriented medical education, Shipengrover and James (1999) stated, "quality principles operate on the premise that all levels and functions in an organization are moving together towards the same goal". A supportive learning environment promotes learners' collaboration with peers and other members of the health care team (Bowen, et al., 1997). The organization of the training experience for residents at a clinical training site is very important (Serwint, Feigelman, Dumont-Driscoll, Collins, Zhan, & Kittredge, 2004). Access to appropriate nursing and ancillary staff support was correlated with residents' satisfaction concerning their continuity experience. Sufficient support would help enhance the efficiency of patient care responsibilities and allow for more time to be devoted to residents' own education mission (Linn, Brook, Clark, Davies, Fink, & Kosecoff, 1985; Serwint, et al., 2004). Therefore, research into the educational climate in ambulatory clinics includes perspectives of the entire patient care team who can contribute to resident training success (Roth, Severson, Probst, Monsur, Markova, Kushner, & Schenk, 2006).

Other contextual factors such as role modeling, mentoring, feedback, and workflow similarly contribute to a supportive learning environment. Brown et al. (1989) proposed the approach of cognitive apprenticeship which honors the situated nature of knowledge. Within the approach, learning and cognition are fundamentally situated and a product of the learning activity, the context, and the culture. While learners are enculturated into authentic practices through activities and social interaction, teachers provide situated modeling by making explicit their tacit knowledge or by modeling their strategies for learners in authentic activities. In medical education, the situated modeling may be achieved through physician preceptors' role modeling during rounds, case discussion, and other authentic activities at a clinical setting. Role modeling is an effective teaching method in graduate medical education (Balmer, Serwint, Ruzek, Ludwig, & Giardino, 2007; Wright & Carrese, 2002; Wright, Kern, Kolodner, Howard, & Brancati, 1998). In investigating factors associated with resident satisfaction with their continuity experience, Serwint and her colleagues (2004) found that the ability of the preceptors to serve as role models was the most important variable among those associated with residents' satisfaction. Role models are not only knowledgeable and competent instructors, but also serve as guides for students' professional development and career decision-making processes (Bowen, et al., 1997). Feedback is another factor in medical education that can lead to positive learning outcomes. In investigating preferred site characteristics and preceptor behaviors for learning in the ambulatory setting, Schultz et al. (2004) noticed that medical students and residents valued constructive feedback by enthusiastic and open preceptors. The pattern of learning schedules cannot be ignored in the analysis of the learning environment. It is important for training directors to evaluate whether or not training sites provide an optimal balance between service and education (Bowen, et al., 1997). Excessive service and workload in the form of patient care may limit residents' chance for learning EBM and reflecting upon their experience.

All the aforementioned factors and others are important when considering improving or changing environments needed for successful graduate medical training experiences. They provided the content area from which items of the EBM Environment Scale were generated.

Contextual Factors Associated with Evidence-Based Practice

Review of medical literature shows a lack of evidence on and attention to the environmental or contextual factors associated with the successful integration of EBM into medical residents' training and practice of patient care. Therefore, a literature search was broadened to include nursing research on contextual factors related to evidence-based practice (EBP) or evidence-based health care. As Guyatt and Rennie (2002) state, the principles of EBM are equally applicable to allied health care workers such as nurses, physical therapists, and others. Terms such as evidence-based health care or EBP are appropriate to cover a full range of clinical applications of the evidence-based approach to patient care. It is believed that the examination of nursing research on the relationship of contextual factors with EBP would lend itself to medical education research, particularly with respect to contextual factors associated with residents' EBM learning and practice. Furthermore, examination of the workplace contextual factors associated with nurses' implementation of evidence-based care would contribute to the understanding of the social support system critical for establishing a favorable training and learning environment to facilitate residents' learning and transfer in a health care setting.

An EBP environment can make the difference between good and excellent care in today's rapidly changing health care system (Hockenberry, Walden, & Brown, 2007). The environment entails essential components of vision, engagement, integration, and evaluation. For EBP to be a successful initiative, its process must be integrated into everyday clinical practice. However, integrating EBP into clinical practice is often regarded as one of the most challenging tasks faced by clinicians and health care leaders (Hockenberry, et al., 2007; Wallin, Ewald, Wikblad, Scott-Findlay, & Arnetz, 2006). Research showed that registered nurses perceived organizational barriers as the greatest barrier to research utilization (Sommer, 2003). Thus, implementation and integration of research evidence into practice require consideration of three key elements: the level and nature of the evidence, the context, and facilitation (method or way in which the evidence is facilitated) (Kitson, Harvey, & McCormack, 1998; McCormack, Kitson, Harvey, Rycroft-Malone, Titchen, & Seers, 2002). Given that no conclusive evidence showing which of the three elements is most important in successful implementation, Kitson et al. (1998) contended that all three elements should have equal standing.

Context as one of the three elements is a concept with multiple definitions depending on the field of study. In health care settings, it can refer to the environment or setting where people receive health care services, medical or nursing training is provided, current research evidence is integrated into practice, or a proposed changed is to be implemented. The environment is viewed as a field with multiple forces that are constantly changing and never remain static. These forces at work "give the physical environment a character and feel" (Kitson, et al., 1998). Thus, studies of context need to focus on the complexity of factors that enable effective practice or the way in which organizational systems and structures interact with each other. These factors include organizational culture, leadership, and measurement. Culture plays a key role in clinical effectiveness, practice development and successful outcome achievement (McCormack, et al., 2002). It is the culture at individual, team and organizational levels that creates context for practice (Manley, 2000). Leadership shapes the nature of human relationship. Effective leadership gives rise to clear roles, effective teamwork, and organizational structures. It promotes the inclusion of all workers at every level of an organization being a leader to ensure commitment and involvement (Kitson, et al., 1998). Regarding the component of measurement in the context for the integration of evidence into practice, McCormack et al. (2002) stated:

> Measurement is a complex but necessary component of the environment that seeks to implement evidence into practice. Measurement is both part of the research process that generates evidence on which to base practice and part of the evaluation or feedback process that demonstrates whether or not changes to practices are effective (pp. 99-100).

The culture of an organization influences how measurement is conducted and how results of the measurement are reported. A strong organizational culture embeds measurement into everyday performance at the individual, team, and systemic level. Measurement is conducted through the use of a variety of sources and multiples methods. In such a culture, the 'hard' outcome data that can inform the efficacy of particular intervention and the 'soft' data of worker experiences are equally valid. The interplay and independence of the contextual components illustrate the need for research on the impact of the context of the practice environment on provider practice and patient outcomes (McCormack, et al., 2002; Wallin, et al., 2006). The potential for health care professionals of using research in practice is linked to workplace contextual factors (Wallin, et al., 2006).

Drawing on the conceptual analysis of context by McCormack and colleagues (Kitson, et al., 1998; McCormack, et al., 2002), Wallin et al. (2006) conducted a repeated survey study to identify contextual factors in connection to the implementation of clinical practice guidelines in neonatal nursing. They focused their study on measurable organizational factors and the opportunities to improve contextual conditions which, they extrapolated, would in turn influence the implementation of evidence-based nursing. The Quality Work Competence questionnaire was used to assess work organizational context perceived by staff on four Swedish neonatal units twice during a one-year study period of 2001 and 2002. Ten different areas or indices comprise the survey scale, including mental energy, work climate, work-related exhaustion, work tempo, performance feedback, participatory management, skills development, goal clarity, organizational efficacy, and leadership. Higher scores on the indices indicate a better work environment. An overall score that is called the Dynamic Focus Score (DFS) suggests the organizational potential for renewal and improvement.

The findings of the study showed significant changes among staff perceptions on various factors both within and between units, although there was no significant change between the two measurement periods on the overall score. Changes in staff perceptions on skills development and participatory management were a major factor in accounting for the variance in DFS. Perceived improvement in skill development and performance feedback predicted improvement in leadership. Another factor associated with the overall level of organizational potential for improvement (DFS) was years of professional experience. Staff who were satisfied with their job were more likely to remain at their workplace. Wallin et al. (2006) concluded that the potential for organizational improvement hinged on developing a learning and supportive professional environment and involving staff at the unit level. The improved organizational environment was important for enhanced use of research in practice and evidence-based nursing. Wallin et al. (2006) maintained that "a better understanding of workplace contextual factors is necessary for improving the organizational potential of getting research into practice and should be considered in future implementation projects" (p. 153).

Estrada (2007) investigated the relationship between the dimensions of a learning organization perceived by registered nurses within an acute care hospital setting and their beliefs about and implementation of evidence-based practice (EBP). Three scales were used for data collection including the Dimensions of Learning Organization Questionnaire (DLOQ), Evidence-Based Practice Beliefs Scale, and the Evidence-Based Practice Implementation Scale. Estrada assumed that registered nurses who rated their organization as higher on the DLOQ would score higher on the EBM beliefs scale, which may directly or indirectly affect implementation of EBP. The DLOQ measured seven variables: continuous learning, inquiry and dialogue, collaboration and team learning, create systems, empower people, connect the organization, and strategic leadership.

The results of the study suggested that nurses who had a higher score on the EBP Beliefs Scale reported a higher frequency of EBP implementation. There was a significant difference on nurses' perception of their organization as a learning organization on all seven dimensions of the DLOQ scale based on their employment in different types of hospitals. However, the findings of the study did not indicate a strong relationship of nurses' belief about EBP and the dimensions of the learning organization. It should be pointed out that the small numbers of respondents from one type of hospitals (veteran hospitals) and missing data from respondents who chose not to complete all three of the research scales may have affected the results of the data analysis in the study.

The examination of nursing research related to contextual factors and concepts associated with EBP integration can inform EBM environment research in graduate medical education. The contextual factors and concepts addressed in the literature of evidence-based nursing practice are complex and at multiple levels; they are equally relevant to examination and analysis of environments related to EBM learning and practice by medical residents.

Empirical Research on Medical Educational Environments

"Education occurs within a context, and measures of instructional quality must be sensitive to that context" (Shipengrover & James, 1999, p. 848). However, research, for example, on ambulatory care education for residents, has focused on teaching effectiveness through the evaluation of students' ratings (Zayas, James, Shipengrover, Schwartz, Osborne, & Graham, 1999). It is the same with research on evaluation of EBM programs in residency programs. This type of evaluation is inadequate to assess the processes and quality of instruction in ambulatory or other clinical settings. Such research may have overlooked the importance of the context of learning and the influence of the practice environment, organization, and resources on student learning since many factors may impact learning in such diverse environments (Zayas, et al., 1999). In examining ambulatory care education, Zayas et al. (1999) argued that the quality of education should be defined by components of an optimal learning environment, positive educational program outcomes, high participant-satisfaction levels, and the lowest possible cost. The learning environment, the context for ambulatory education, includes all of the surrounding conditions and influences that affect student and resident learning.

When evaluating the learning environment, factors such as the educational culture of the site, physical aspects of the site, teacher and learner characteristics, and resources available for learning should be considered (Bowen, et al., 1997). It is essential to understand how organizational environments support or hinder graduate medical education, scholarship, and patient care (Irby & Hekelman, 1997), and how to develop and continually improve the systems and organizations in which clinical educators function (Roth, Schenk, & Bogdewic, 2001).

In response to the call for addressing the teaching workplace related to educational outcomes for residents, Probst, Baxley, Schell, Cleghorn, and Bogdewic (1998) conducted a study investigating the organizational environments of family medicine residents in South Carolina and the relationships between environmental characteristics and perceptions of teaching quality. Faculty were invited to participate in focus groups and responded to an organizational environment questionnaire for the purpose of assessing faculty development needs at all seven family practice residency programs in the state in 1995. Realizing the limitations of only surveying faculty for faculty needs development, the survey also included convenience samples of residents and of nursing and administrative support staff. The residents completed the same questionnaire because they were considered as the primary customers for faculty teaching. The nursing administrative support staffs were recruited because, as part of the teaching environment, they contributed to the teaching environment and observed faculty teaching.

The questionnaire in the study by Probst et al. (1998) examined seven dimensions of variables relevant to organizational environment: teaching quality, job satisfaction, organizational climate, autonomy, commitment to the organization, job-related stress, and goal attainment. Several items comprised each variable, measuring responses on a five-point Likert scale. The item scores were totaled to create summary scales for each variable. For all scales except that measuring stress, a higher value indicated a higher level of the variable; thus, it was more desirable. The only reliability test for the questionnaire was the employment of Cronbach's alpha for items in each individual variable. Multiple regression analysis was used to predict the influences of all of the organizational environment variables on two key variables of teaching quality and job satisfaction.

The findings of the study indicated that organizational environment influenced teaching quality and job satisfaction across all organizational members. Perceptions varied significantly with the respondents' positions, with faculty and residents reporting a more positive environment than the nursing and administrative staffs. Perceptions of teaching quality were influenced by the degree to which the faculty was satisfied with their work environment. Where the faculty was highly satisfied, the residents rated their teachers significantly higher and the staffs perceived better teaching on the teaching-quality scale. The residents and staff who reported to have attained their own goals were more likely to report high teaching quality. The results of the study suggested strong implications for faculty development programs in relation to graduate medical education. To improve the quality of the education provided for residents, faculty development programs which traditionally focus on improving faculty's knowledge, skills, behaviors, should teach faculty how to assess and improve the organizational environment where teaching and learning take place (Probst, et al., 1998).

Another study on physician and staff perceptions of the learning environment further confirmed the influence of environmental variables on perceptions of quality of teaching by physicians, residents, and nursing staff. Building on the organizational environment study by Probst et al. (1998), Roth and her colleagues (2006) explored the influence of organizational and learning environment characteristics on perceptions of teaching quality and family medicine residents' learning. For the purpose of their study, they used Probst et al.'s survey scale--Organizational Environmental Assessment (OEA) in conjunction with another scale—Learning Environment Assessment (LEA) developed at Wayne State University, Detroit, Michigan. By doing so, Roth and colleagues' study went beyond duplicating the study by Probst et al.

concerned with organizational and learning environment associated with perceptions of teaching quality.

The LEA used in Roth et al.'s research encompassed 49 items on a 5-point Likert scale that measured participants' perceptions of several variables related to learning and teaching environment. The variables include physical characteristics and personnel arrangements within each clinic site, structure of learning opportunities within the clinic routines, teaching behaviors of faculty, roles of nursing and administrative staff, and learning organization characteristics recommended for creating quality clinical teaching environments in ambulatory clinics.

The researchers took a step further in their research by exploring the impact of organizational and learning environment measures on residents' learning outcomes. They measured residents' scores mean change in their performance over time (1^{st} and 2^{nd} year) on the American Board of Family Medicine In-training Examination (ITE). They also compared the OEA and LEA scale summary means for the combined employee groups of faculty, residents, and staff at two selected sites during the time of the study.

The results indicated different views from three employee groups on most of the subscales on the OEA and LEA measurements. The summary means across the three groups on two measurements for Site A was consistently greater than Site B. Residents at Site A had a greater mean change in ITE scores than residents at Site B, although the difference did not reach statistical significance. It may be due to the two factors: a small and unequal number of residents at each site; a lower response rate (62%) among residents compared with the rates of 80% for staff and 94 % for faculty. Contrasting with the finding in the study by Probst et al. (1998) that residents and staff's perceptions of teaching quality were related to faculty's job satisfaction, the study by Roth et al. (2006) revealed that faculty, resident, and staff's evaluation of teaching quality was influenced by their level of satisfaction with their own jobs.

The study by Roth et al. (2006) demonstrated the usefulness of the OEA and LEA scale measurements in exploring clinical staff and residents' perspectives of employment and learning environments and in identifying areas of focus for improvement of teaching quality in clinical settings. It sets the stage for future investigation of the educational climate in ambulatory clinics with the perspectives from a full range of personnel who have potential to contribute to learning. In addition, it points to implications for research on interventions designed to improve clinical structures and processes to achieve quality patient care and optimal resident learning outcomes.

Studies by Probst et al. (1998) and Roth el al. (2001) demonstrated the relationship of learning and organizational environments with teaching quality and residents' learning outcomes (Probst, et al., 1998; Roth, et al., 2006) and underscore the value of analyzing characteristics of the organizational climate that influences trainees and employees' perceptions and behaviors. The results of the studies also helped identify important content areas for the EBM Environment Scale.

It should be pointed out that the two studies have more focus on investigation of the predictive functions of environment instruments rather than on the process of scale development and validation. It is necessary to review studies of scale development that would justify for the methodological choice for this study centered on the development and validation of the EBM Environment Scale to measure the environment surrounding residents' EBM learning and practice.

Instruments for Measuring Environments for Medical Education

Educational environments contribute to learning experiences of learners. As Mulrooney pointed out, “the educational environment is an important contributor to the quality of medical training” (2005, p. 341). To optimize learning and maximize the educational potential of each environment, it is vital to identify the many factors that comprise the environments.

To measure the learning environment as perceived by medical students, Pololi and Price (2000) developed a survey instrument with three dimensions, including the teacher-learner relationship, the physician-patient relationship, and self-efficacy. All question items in the instrument were drawn from questionnaire materials regarding the learning environment developed by nationally recognized medical educators. The early draft of the instrument was reviewed and comments were suggested by a group of medical educators at several institutions. The survey was administered to a large sample of 619 medical students in four classes annually for 3 successive years.

Responses from students of each year were gathered and analyzed for test-retest reliability. An exploratory factor analysis (principal components) and a Cronbach’s reliability analysis were performed for the validity and reliability of the instrument across students in different years in medical school. The factor analysis and reliability estimates indicated that the measurement models for the three dimensions were valid and reliable across all groups of students in different years in medical school and for students responding to the survey once or multiple times. The results of the study revealed that the mean scores on each dimension decreased as the students progressed through medical school. The findings led to more attention being paid to the learning environment for the students through the restructuring of some of the teaching programs as well as the design and implementation of faculty development programs with an emphasis on improving medical educators' teaching skills.

A study by Mulrooney's (2005) focused on measuring the practice vocational training environment in Ireland. An instrument was developed and validated in three stages. The first stage involved a focus group of trainees rank-ordering and discussing items relevant to the practice-based learning environment; in the second stage, a nominal group of vocational training graduates ranked the importance of each item in relation to the environment on a five-point Likert scale from highly important to irrelevant; and during the last stage, the inventory of items were administered to 56 practice-based trainees who ranked each item using a five-point Likert scale from strongly disagree to strongly agree.

The three stages of scale development established content validity for the instrument; however, there was not any evidence of internal consistency reliability analyzed for the instrument. Although the responses by trainees in the third stage indicated their level of satisfaction with their educational environment in practice, the lack of reliability would deem the instrument less stable, dependable and predictable if it were used to measure a training environment of a similar nature. Thus, the results of the study would not convincingly carry much weight when used for improving the educational improvement for the trainees.

Roff, McAleer, and Skinner (2005) conducted a development and validation study for an instrument (PHEEM) which measured the postgraduate clinical teaching learning environment for hospital-based junior doctors at the University of Dundee in Scotland. The study was conducted in two phases with the utilization of grounded theory and the Delphi technique. In Phase 1, a group of stakeholders of postgraduate educational administrators and advisors reviewed an initial list of 180 items based on a literature review of articles from the biomedical database MEDLINE, mission statements of their institution, along with the participants' own observations of critical incidents in postgraduate training. After repetitive items were eliminated and some items were consolidated, the initial list was reduced to 150 items that were then critiqued by a second group of reviewers from several educational units at the same institution. Two groups of expert review served the purpose of establishing content validity for the instrument.

After the two panel reviews, the reduced list of 130 items were administered to a selected group of junior doctors (n=109) who were asked to rate the importance of each item on a score of 0-4 for a good learning environment for junior doctors. The analysis of responses to the instrument led to the second version of the instrument with the top ranked 90 items.

Phase 2 of the study was conducted with a focus group of 10 pediatricians from outside the university. They reviewed the 90 items and rated the most relevant items in their perception of a good clinical teaching and learning environment for hospital-based junior doctors. Items which three or four members voted as less relevant were eliminated from the inventory. The whole process of instrument development and validation ended with a nominal group of three researchers dividing the final version of the 40-item instrument into three sub-scales, including perceptions of role autonomy, perceptions of teaching, and perceptions of social support.

Face validity for the PHEEM was achieved by means of the focus group technique in the second phase of the study (Roff, et al., 2005). According to Nunnally (1978), face validity only concerns judgments about an instrument after it is constructed. An instrument has face validity when its potential users like the types of items or the instrument "looks like" it measures what it is intended to measure. Nunnally pointed out that face validity is far from complete to meet the standard for content validity. "When an instrument is used to perform a prediction function, validity depends entirely on how well the instrument correlates with what it is intended to predict (a criterion), and consequently face validity is irrelevant" (Nunnally, 1978, p. 111). Roff et al. (2005) intended to use the PHEEM as a useful quality assessment tool to study hospital-based clinical teaching and learning environment for junior doctors. However, the PHEEM with only face validity has limited use as an instrument for prediction functions. In spite of that, the developed and validated instrument (PHEEM) added to the conceptual and practical knowledge of contextual analysis of the clinical teaching and learning environment for junior doctors in hospital-based training settings.

The influences of the environment climate on medical education have received some attention in the medical educational research. However, a comprehensive review of literature reveals little research on the assessment of environment or context associated with EBM learning and practice by medical residents. As Rudestam and Newton remark, "research that concentrates on instrument development is a valuable enterprise and often makes greater contributions than research that attempts to relate existing measures to each other in some new and yet untried fashion" (2001, p. 98). Instruments to measure the EBM environment are nonexistent. For that reason, the central focus of the study was to develop and validate a new measurement scale to fill the void in medical educational research.

Orientation of Human Performance Technology

Graduate medical education is outcome- and performance-based. Residents learn through formal or on-the job training, and their performance in providing patient care is impacted by many factors in their learning-work environment. Transfer of learning is affected by the transfer context of the organizational environment. Performance analysis for the purpose of performance improvement in their workplace and patient care setting is predicated on the environmental analysis. Van Tiem, Moseley and Dessinger's (2004) state that the environmental analysis as a component of performance analysis is a crucial step for any performance improvement undertaking which would lead to the design and implementation of any intervention (instructional or non-instructional) to close the gaps or needs identified through performance analysis. Thomas Gilbert's Behavior Engineering Model that has been applied in analyzing and improving human performance outlines six basic factors that influence human performance improvement. These factors are grouped under two categories: environmental supports and person's repertory of behavior (e.g., knowledge, skills, capacity, and motives). The category of environment support factors features three aspects with different components (Gilbert, 1996) (Table 2):

Table 2

Category of Environment Support Factors

Data • Relevant and frequent feedback about the adequacy of performance • Descriptions of what is expected of performance • Clear and relevant guides to adequate performance Instruments • Tools and materials • Resources to support work Motivation • Monetary and non-monetary incentives made available • Career-development opportunities

Note: Adapted from "Human Competence: Engineering Worthy Performance" by T. F. Gilbert, 1996, Washington, D.C.: The International Society for Performance Improvement.

These aspects can serve as checking points or a framework for performance analysis in business, educational arena, and health care organizations. Performance analysis requires environmental analysis that is one of the key components in the performance improvement process. Environmental analysis is to associate employees' behaviors with related environmental factors, such as organizational culture, values, and goals (Van Tiem, Moseley, & Dessinger, 2004). Its attention is on elements of organizational environment, work environment, work, and worker. In the analysis of the work environment, performance improvement practitioners examine the internal performance support in terms of resources and tools, feedback, consequences. As far as work is concerned, three elements, workflow, procedures, and responsibilities, are considered as influential factors for a worker's performance. According to Rummler and Brache (1995), performance variables exist at three levels: organization, process, and job, and they exert a cumulative and collective impact on overall worker performance. Thus, it is important to analyze and manage the interrelationships between departments and processes.

Peoples' ability and motivation are critical components of human performance. Situational factors can impact performance (Peterson & Arnn, 2005) in terms of people's ability and motivation to perform and complete a specific task. Examples of these factors include required services and support from others, task preparation and training, time availability, and work environment (Peter & O'Connor, 1980). The factors play a key role in enhancing or hindering human performance and are outside the control of the individual (Campbell & Pritchard, 1976).

Performance improvement, when applying to instruction or on-the-job training, helps trainers see beyond what training can do to bring about optimal performance outcome in employees. Harless (1975) challenged trainers to identify actual causes for a performance problem by using the front-end analysis approach. The performance improvement solution is predicted by the analysis of causes-- behavioral causes (caused by people) and non-behavioral causes (not caused by people). For example, if a process was used that resulted in ineffective instruction, the root cause for "effectiveness" must be identified and subsequently removed by changing the process through a corrective action (Dick, 1993). Harless (1975) contended that multiple remedies rather than one-shot solution of training be considered to overcome the identified deficit in performance. It is not hard to see that environment factors are implied when Harless discussed the analysis of the non-behavioral causes.

In implementing a solution, Mager (1975) provided the concept of objectives as a consistent framework for describing desired performance outcomes. Objective statements should describe what desired performance outcomes the learner or worker is expected to achieve, conditions under which the performance is expected to occur, and criterion of the quality or level of performance that will be considered acceptable. Mager's emphasis of objectives made clear the importance of circumstances required for desired performance outcomes.

To help learners become capable of excellent performance, effective instruction is performance-based. Brethower and Smalley (1998) advocated three basic steps in linking training directly to business results: guided observation, in which learners experience examples or demonstrations through joblike materials and procedures; guided practice, in which learners practice specific processes that help them accomplish specific results; and demonstration of mastery, in which learners transfer their acquired skills by demonstrating their competency in performing tasks, thereby generating the desired products or services. The three steps are suitable for learning and teaching EBM and are in line with the value of problem-based learning, role modeling, feedback, and competency development in medical residents' learning and practicing EBM.

It is clear that the model, concepts, or approaches from the field of human performance technology can provide insight on environmental analysis for performance improvement and, thus, were drawn upon in generating scale items within the learner context, instructional context, and transfer context in the study.

Theoretical and Conceptual Framework for the Study

General System Theory. In discussing and expounding theoretical bases of instruction design, Richey (1986) expressed her support for the use of "general system theory" as an approach to viewing the environment, which is made of many components, parts, elements, and processes. Each component is interrelated and connected with others to form a complete whole. A system was also defined as "a set of objects together with relationships between the objects and between their attributes" (Hall and Fagen as cited in Richey, 1986, p. 35). Senge (1990) defined a system as groups of interdependent components, people, and processes with a common purpose, which interact to produce a product or service. To Richey (1986), an open system stabilizes and reorganizes itself through the use of feedback—information about the products of the system that is collected from the environment of the system. Apparently, there is an emphasis on the connection between the environment and the system product. General system theory as an approach can be applied to a wide range of disciplines including instructional design (Richey, 1986).

The systems approach which is characterized by concurrent consideration of the many aspects of a situation can affect the learning process (Richey, 1995). When applied in instructional design, the approach addresses the importance of component parts in its analysis process. The process includes two distinct phases, one for identifying component parts of the system, and another for determining the relationship among those parts and between the parts and the whole system (Silvern as cited in Richey, 1992). The identified parts encompass persons, objects, processes, external constraints, and resource available (Richey, 1986).

From the perspective of the systems approach, "learning is not an isolated event" (Jonassen, 1999) and it does not occur in a vacuum. The situation, context, or environment, in which learning and transfer occur, is "an influential and inevitable part of every learning experience" (Tessmer & Richey, 1997, p. 88). Environment is directly related to learning (Streibel as cited in Richey, 1992). It influences every aspect of the learning experience, and is a collection of factors that can facilitate or inhibit instruction and learning (Morrison, Ross, & Kemp, 2006).

In graduate medical education, right conditions need to be present within a residency training setting to maintain a learning oriented culture (Hoff, et al., 2004). O'Connor et al. (1984) found that constraints in a working environment interacted with performance and with a measure of personal competence and other personal affective responses such as dissatisfaction and frustration at work. Trainees' perceptions of the work environment are considered as one of several conditions necessary for high motivation to learn and transfer; perceptions of constraints inhibit adoption of knowledge, skills, and behavior to job tasks (Noe, 1986). Within the systems approach, systemic training design needs to reflect adult learners' own backgrounds and their perspectives of the environment in which the training occurs (Richey, 1995) and in which trained skills are transferred to the job. Clearly, the system approach based on the general system theory is applicable to design, implementation, and evaluation of EBM training programs. To achieve effective learning and learning transfer, it is vital to analyze and measure conditions (environments) as part of the whole learning system in EBM program design, development, and evaluation.

Contextual Analysis Model. Tessmer (1990) argued that environmental analysis should be applied to instructional design as a specific stage in the overall design process since the factors and characteristics of the environment constrain and determine objectives, instructional strategies, delivery media, and evaluation methods. The contextual analysis model that Tessmer and Richey (1997) proposed reflects the application of the general system theory in contextual analysis—an essential step for effective instructional design. The model provides a detailed structure for conducting contextual analysis for the purpose of context-based instructional design. For that reason, the model was used as a conceptual framework for establishing boundaries and dimensions of the EBM Environment Scale specifically related to learner factors, immediate environment factors, and organizational environment factors, at different contextual levels.

Summary

A comprehensive review of literature on EBM research and medical education reveals little attention to any possible effects of contextual or environmental factors on EBM learning and practice by medical residents. This study was built on the premise that these factors at different levels play a critical role in affecting successful implementation of any EBM training targeted to residents. The EBM Environment Scale to analyze the environment surrounding residents' EBM learning and practice was developed and validated through several phases of the study which are explained in Chapter 3.

CHAPTER 3

METHODOLOGY

The purpose of the study was to develop and validate an instrument, the EBM Environment Scale, to measure medical residents' perceptions of the environment in which they learn and practice EBM. A self-administered EBM Environment Survey was used to investigate the following research questions regarding the scale development and validation:

1. What are the psychometric properties of the newly developed EBM Environment Scale?
2. Are there any differences among residents grouped by gender in reference to scores on the EBM Environment Scale?
3. Are there any differences among residents grouped by country of medical school attended in reference to scores on the EBM Environment Scale?
4. Are there any differences among residents grouped by level of residency training in reference to scores on the EBM Environment Scale?
5. Are there any differences among residents across residency programs in reference to scores on the EBM Environment Scale?
6. Are there any differences among residents grouped by level of prior EBM training in medical school in reference to scores on the EBM Environment Scale?
7. Are there any differences among residents grouped by level of prior EBM training during residency in reference to scores on the EBM Environment Scale?
8. How well does level of residency training predict scores on the EBM Environment Scale?

9. How well does level of prior EBM training in medical School predict scores on the EBM Environment Scale?

10. How well does level of prior EBM training during residency predict scores on the EBM Environment Scale?

Participants

The population for the study was medical residents who received a medical degree from a medical college or school that is accredited by the American Association of Medical Colleges. They were pursuing their graduate medical education in residency training programs accredited by the Accreditation Council of Graduate Medical Education in the United States. A convenience sample was recruited from the target population to collect data to validate the EBM Environment Scale. Participants were 262 residents recruited from six residency programs in primary care specialties at six training sites (four programs in internal medicine, one in family medicine, and one in pediatrics). For the purpose of data analysis, the programs were named as Programs A-F. These training sites consisted of a variety of settings including academic medical centers and community-based hospitals. The study was conducted with approval of the Wayne State University Human Investigation Committee. Permission to conduct the investigation was obtained from each institution prior to administration of the EBM Environment Survey to residents from the six residency programs.

According to Munro (2001), a sample size of 100-200 subjects is reasonable because Cronbach's Alpha coefficients for item analysis and factor analysis for construct validity are based on correlations. Correlations have standard errors that indicate how trustworthy the results are. The larger the sample size is, the better, because the larger sample size cuts down on statistical error (Kline, 2000). Therefore, the sample size of residents recruited for this study was adequate for the preliminary validation of the EBM Environment Scale.

Participation of the study was voluntary. Respondents were assured that their responses were completely anonymous and there was no personal identification information included with any returned responses.

There was no compensation for participation in the study. But a monetary incentive was created in an attempt to increase the response rate. Zusman and Dubby found that using the monetary incentive improved the overall return rate and the promptness of returns (Zusman & Duby, 1987). When creating the survey, an item was added to the end of the survey for respondents to provide their name and e-mail address if they would like to enter a drawing for a $100 gift card. They were assured that their name and email would not be attached to any data used to validate the scale.

Scale Development

Tessmer and Richey (1997) suggest several contextual analysis tools that can be utilized to gather information on contextual influences. The tools include surveys of context members or stakeholders, interviews, observations of instructors and learners in the context, and depictions of the context for interviews. Tessmer and Harris (1992) comment that "questionnaires may be the best used for environmental information that is not observational nor subject to immediate sensory impression" (p. 148). Among the three main techniques used to collect data, survey research, direct measurement, and observation, Rea and Parker (2005) recommend the sample survey as an appropriate method to collect data when one seeks personal and self-reported information which is not available elsewhere. The sample survey has some advantages over other techniques. "It offers a snapshot of the population.…When implemented properly, it offers an opportunity to reveal the characteristics of institutions and communities by studying individuals and other communities that represent these entities in a relatively unbiased and scientifically rigorous manner" (Rea & Parker, 2005, p. 7).

For the purpose of the study, the method selected for data collection was the sample survey. It was a perceptual measure used to gather information about participants' reactions, attitudes, perceptions, or "personal reality" (Guerra-López, 2007, 2008), of the EBM environment. Fraser and Walberg (1991) outlined some strengths of perceptual measures used to study classroom environment. First, perceptual measures are more economical than observation techniques. It is even more so in a health care setting where medical residents rotate among different inpatient and outpatient settings. Second, perceptual measures are based on learners' experiences over many lessons. In case of graduate medical education, workshops, lectures, rounds, morning reports, clinical rotations, and other educational events, comprise their learning experiences. Third, perceptual measures involve the pooled judgments of all learners. By the same token, perceptual measures are applicable to studying environments in which medical residents learn and apply their learned skills in health care settings.

In the study, a survey questionnaire was created to survey medical residents' opinions and perceptions about environmental issues related to their EBM learning and practice. It included two parts. Part I contained a set of scale items. Part II contained a list of selected questions for demographic information on the year in residency program (level of residency training), specialty, gender, country in which they graduated from a medical school, residency program, previous exposure to or training in EBM. When identifying important learner factors or variables in instructional design, it is important to consider *learner profile* and *experiential background* (Tessmer & Richey, 1997). These demographic questions not only provided information on learner profile and experiential background but also data for validating the EBM Environment Scale. To keep it consistent, the term of international residents is used to refer to those research participants or respondents who reported to attend a medical school from other countries rather than the United Stated.

As a perceptual measure of the EBM Environment, the scale was intended to evaluate certain aspects of the EBM environment as applicable to medical residents' learning and practice of EBM in health care settings. Scale items were grouped under subscales to tap those aspects or factors of the EBM environment. These factors were related to learner, immediate environment, and organizational environment at the levels of orienting context, instructional context, and transfer context (Tessmer & Richey, 1997). Scale items were generated based on multiple sources: models of systemic training design and human performance improvement, a review of literature on EBM learning and practice, studies on medical education environments, and feedback from experts and representatives of the target population.

The Likert-type scale was chosen for the scale. As a very common type of attitude scale, it typically asks for the extent of agreement with an attitude item (DeVellis, 2003; Gall, Borg, & Gall, 1996). It is widely used in instruments measuring opinions, beliefs, and attitudes (DeVellis, 2003) due to the power and simplicity of the format. The scaling procedure is flexible and economical. A major advantage of the scale is its ability to obtain a summated or total value -- an index of attitudes toward the major issue, as a whole (Alreck & Settle, 2004).

Each item in the scale was presented as a declarative statement, followed by response options that were expressed in terms of the following categories: strongly agree, agree, unsure, disagree, and strongly disagree (Anastasi, 1982; DeVellis, 2003). To score the scale, the response options were credited 5, 4, 3, 2, or 1 from the most favorable (*strongly agree*) to the unfavorable end (*strongly disagree*). The sum of item credits represents an individual's total score or overall score (Anastasi, 1982; Netemeyer, Bearden, & Sharma, 2003). Low score on the scale represents unfavorable perceptions and high score represents favorable perceptions of the EBM learning environment.

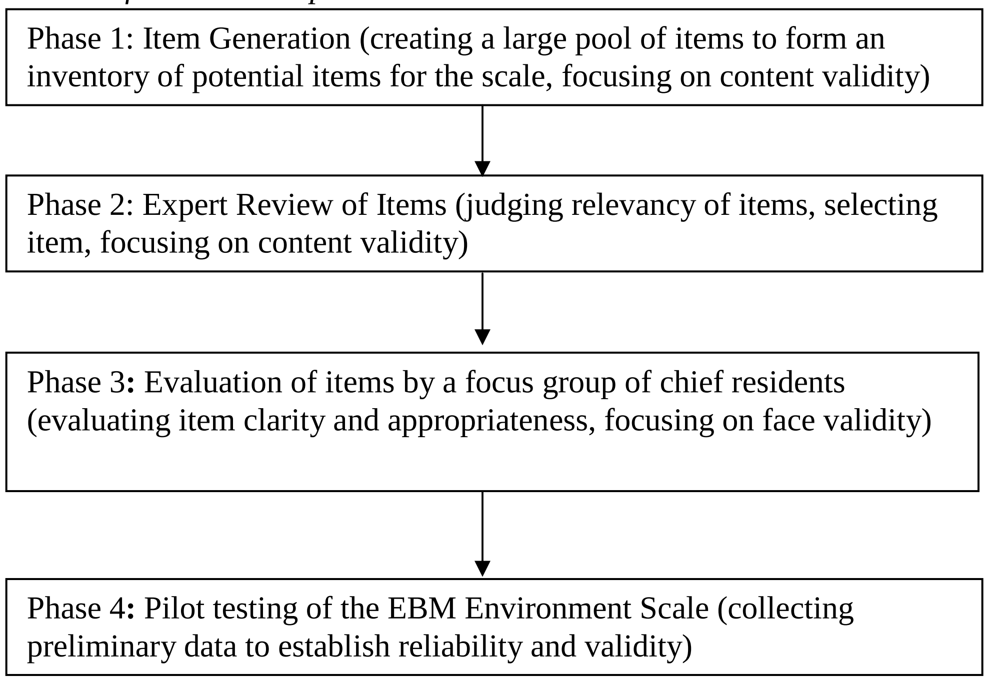
The quality of a measurement can be affected by a variety of response biases such as acquiescence bias that may diminish the reliability and validity of the measurement. The acquiescence bias can occur when an individual respondent agrees with statements without regard for the meaning of those statements keyed in the same direction (all positive) (Furr & Bacharach, 2008). To minimize the existence of the acquiescence bias, the EBM Environment Scale was developed as a balanced scale that included some items that were negatively worded. Therefore, a number of negatively worded items were inserted into the scale of the first version and they were scored reversely in later data analysis for the scale validation.

Procedures

The scale development and validation were conducted based on scale development procedures recommended in the scale development literature (DeVellis, 2003; Netemeyer, et al., 2003; Spector, 1992) as well as in environment research in medical education. Following the content area identified and defined for scale development, items were generated from multiple sources as reviewed in Chapter 2. Figure 1 summarizes several phases undertaken in the scale development process. These phases were also viewed as different steps or mini-studies in the research on scale development.

Figure 1

Phases of Scale Development



Phase 1. The scale was designed as a summated rating scale to analyze the environment perceived by medical residents with respect to their EBM learning and practice. The first step of scale development was to establish content validity of the scale, an essential step that is to determine the content representativeness or content relevance of items in an instrument. The assessment of content validity begins in the earliest development of an instrument through the two-stage process: developmental stage and judgment-quantification (Lynn, 1986). At the developmental stage, items were generated following the definition of the domain content which guided the scale development. The judgment-quantification stage was conducted through expert review and focus group evaluation in phase 2. For the purpose of establishing content validity, a large inventory of items was created based on instructional design and human performance models, a review of literature on environment studies, and research related to EBM teaching and practice. Potential items were selected for eventual inclusion in the scale.

At this stage of the scale development process, DeVellis (2003) suggested redundancy in the item pool development. An attempt was made to include more items than there were in the final scale. Redundancy will capture the phenomenon of interest in different ways. "By using multiple and seemingly redundant items, the content that is common to the items will summate across items while their irrelevant idiosyncrasies will cancel out" (DeVellis, 2003, p. 65). The large pool of items was generated to tap the content domain related to contextual factors in the EBM environment. These factors included learner factors, immediate environment factors, and organizational factors, at multiple levels.

Phase 2. The expert review process served as the judgment-quantification stage of content validity. For Phase 2, a panel of content experts was assembled to review the initial item inventory. The experts were selected based on several criteria including: 1) having knowledge and expertise in EBM; 2) serving as tutors who taught EBM at the International Evidence-Based Clinical Practice Workshop held at McMaster University, Hamilton, Canada, May 31-June 5, 2009; 3) being physicians or clinical faculty who were involved in graduate medical education; and 4) having experience in teaching EBM to medical residents.

A range of three to ten content experts was recommended in the literature for content expert review needed in the content validation (Grant & Davis, 1997; Lynn, 1986; Rubio, Berg-Weger, Tebb, Lee, & Rauch, 2003). "A minimum of five experts would provide a sufficient level of control for chance agreement" (Lynn, 1986, p. 383).

According to Davis (1992), instruments that evolve from a specific theoretical or conceptual framework should be reviewed by experts who are knowledgeable about the study concepts, theory, or problem that governs the topic content of the instrument. Such reviews can serve the purpose of assessing the content validity of the instrument, that is, whether the instrument possesses sufficient number and types of items to represent the desired domain of content (Nunnally, 1978). Therefore, one of the experts who developed the contextual analysis model was approached and invited to serve on the expert panel.

For the expert review process, a total of 11 experts were invited to participate in the review process for content validation of the potential items. The experts were contacted in person or e-mail. Those who agreed to serve on the panel were sent a content validation package with items recommended for expert reviewers (Davis, 1992; Guerra, 2001). These items included a recruitment letter for expert reviewers, an inventory of items, working conceptual definitions of dimensions included in the inventory, a list of questions for expert profiles, and detail instructions on how to participate in the review process for the inventory (Appendix C).

The experts were instructed to review the inventory of items with their perceptions of what environmental factors were the most conducive to successful EBM learning and practice in a residency-training site. In the review process, experts were asked to read and judge how relevant individual items were to the content domain based on a 4-point scale from highly relevant to not relevant. Experts were also asked to indicate the level of clarity for each item, on a four-point scale (1=not clear, 2=needs major revisions to be clear, 3=needs minor revisions to be clear, 4= clear), adopted from instructions for rating items in a measure (Rubio, et al., 2003). They were encouraged to provide comments for each item, to recommend items that should be modified or dropped, and to suggest item content that had perhaps been overlooked. As part of the process, they were also asked to suggest revisions for items that are not consistent with conceptual definitions of dimensions (Lynn, 1986).

Each item on the inventory was reviewed and evaluated according to the criteria of relevancy of items and clarity of items. In analyzing results of the expert review for content validity, a quantitative analytical method, index of content validity (CVI), was applied to quantify the item evaluation process (Davis, 1992; Lynn, 1986; Meurer, Rubio, Counte, & Burroughs, 2002). CVI with a value ranging from 0 to 1, was derived from the rating of the content relevance of the items on an instrument using a 4-point ordinal rating scale, where 1 connotes an irrelevant item and 4 a highly relevant item. To calculate CVI for each item, the number of experts who rated the item as either 3 or 4 was counted and divided by the total number of the experts (Rubio, et al., 2003). Davis (1992) recommends a CVI of at least .80 for new measures. Thus, a decision rule was adopted to retain those items with CVI $\geq$.80. Revision and item selection were finally made based on CVIs of items along with qualitative information--comments, suggestions, and recommendations from the experts. The phase of the expert review resulted in a tentative version of the scale that was evaluated by a focus group of chief residents (Appendix F).

Phase 3. Following the expert review, the scale was evaluated by a focus group of chief residents representing potential subjects from the target population for which the scale was intended. The chief residents were recruited from residency programs in three primary care specialties (family medicine, internal medicine, and pediatrics) affiliated with a university medical center and from the chief resident group participating in the International Evidence-Based Clinical Practice Workshop at McMaster University (Hamilton, Canada) during the period of May 31 to June 5, 2009. The residents were approached by e-mail and invited to evaluate the scale online.

Those who agreed to participate in the evaluation were sent an e-mail message with a link to the tentative scale online with instructions on the evaluation process. They were asked to rate each item on a scale of 3 (very important) to 0 (not important) (Holt & Roff, 2004), rating the items according to how important they felt each item was in creating an environment conducive to residents' EBM learning and practice. In addition, the residents were also asked to provide any comment on item clarity and appropriateness and to offer any suggestion for each item. The same decision rule using CVI for the expert review was adopted for item exclusion and inclusion. At this stage, the residents were not expected to rate their EBM environment.

The instrument is just one element in a validation study. Other elements in the validation procedure need to be examined and specified as well, including the wording of the items, the rules for scoring, the instructions given to the person responding to the instrument, the time limits, and the like, should be specified (Cronbach, 1971). Thus, in phase 2, the scale was refined and further trimmed to a more manageable set based on feedback collected from the group of residents. The estimated time needed to complete the scale, rules of scoring, and instructions for the scale administration were determined prior to piloting the revised scale—the first version of the EBM Environment Scale (Appendix G).

Phase 4. A pilot study was conducted with the EBM Environment Survey to collect preliminary data to validate the scale. The results of data analysis provided initial evidence for reliability and validity of the scale. The results also informed decisions on revising certain items and eliminating poor-quality items from the scale.

Data Collection

Residents were recruited according to each institution's residency program guidelines for resident communications (Robert, 2006). Two survey modes (online and paper) were provided to tailor the self-administered survey procedure to the specific situation and resource constraints at each training site (Dillman, 2000). Three recruitment strategies were taken for data collection:

Programs A-C. The researcher distributed the paper survey to residents face to face during one of their educational events at their training sites. The researcher provided a brief introduction about the study and invited residents to participate in the study. Those who agreed to participate in the study were given a copy of the research information sheet (Appendix D) and the EBM Environment survey. The researcher collected the complete surveys on the spot.

Program D. A packet of paper surveys and research information sheets was mailed to the program director who designated a chief resident to distribute the surveys to residents in the program on behalf of the researcher during one of their educational events. The chief resident signed the form "Signature Sheet for Administration of the EBM Environment Survey" (Appendix E). A stamped and self-addressed envelope was provided for the chief resident to mail back to the researcher all complete surveys collected along with blank surveys. Given the fact that half of the residents in the program were on another shift during the first survey administration, a second packet of replacement surveys and research information sheets was mailed to the program director. The same procedure was followed in administering the survey to the residents who were on a different shift.

Programs E-F. The online survey mode was used. A generic e-mail message template was provided to the directors of the two programs who forwarded the message to their residents. The message included a link to the online survey along with the research information sheet as an attachment. Two e-mail reminders within a two-week interval were provided for the program directors to forward to the residents two weeks after the initial recruitment e-mail message. The directors were asked to distribute the e-mail message to residents in their respective residency program.

SPSS (Statistical Package for the Social Sciences Personal Computer Version, v.17) was used for data analysis. Data collected from the online survey were downloaded to the researcher's personal computer with built-in security protection (password protected). They were imported to a data file in SPSS. Data from the paper surveys were entered to the same data file in SPSS.

Data Analysis

A combination of qualitative and quantitative techniques was employed for data analysis to establish reliability and validity of the EBM Environment Scale. Descriptive statistics such as mean, median and standard deviation were used to analyze nominal and ordinal data collected from the EBM Environment Survey. Nonparametric tests were used to examine the relationships between participants' variables as independent variables and scores on the EBM Environment Scale as a dependent variable. Data were analyzed with nonparametric statistical analyses since perception scores were measured on an ordinal scale. Nonparametric statistics such as the Mann-Whitney U and Kruskal-Willis tests make no assumptions about the normal distributions of the variable being assessed and they are appropriate for nominal and ordinal data as from a questionnaire items with attitudinal scales (Guerra-López, 2007, 2008).

The Mann-Whiteney U test was used with research questions 2-3 as they dealt with differences between two independent groups (female vs. male, U.S. residents vs. international residents). For questions 4-7, dealing with differences among three or more independent groups, the Kruskal-Wallis test was used to compare and evaluate group differences on perception scores.

Although the two nonparametric tests were used to test the group differences in scores of the EBM Environment Scale, they did not assess strength and size of correlations--the degree to which the independent variables and dependent variable were related (Tabachnick & Fidell, 2001). Strength of association assesses the proportion of variance in scores on the scale that was associated with levels of the independent variables. For research questions 8-10, dealing with how well independent variables predicted the perception score, bivariate linear regression was used to collect data on independent or predictor variables (e.g., level of residency training, level of prior EBM training in medical school, level of prior EBM training during residency) and the perception scores on the scale as the dependent or criterion variable.

Regression analyses work with continuous or dichotomous variables. However, regression analyses can also be used with categorical variables if they are first converted into a set of dichotomous variables (Tabachnick & Fidell, 2001). In the study, the three learner variables of interest were categorical variables with several levels. To examine how they might predict the score on the scale, they were first reconfigured for regression analyses as dichotomous variables, coded as 0 or 1 only, with the 0 representing the absence of a characteristic and a 1 representing its presence. Each categorical variable with more than two levels were turned into a series of dummy coded variables for k-1 categories of the variable (Rea & Parker, 2005), i.e., "numbering one fewer than the number of discrete categories" (Tabachnick & Fidell, 2001).

A *p* value of <.05 was used to determine significance in all analyses for research questions 2-10.

Let us now turn to validation issues for the study**.** Validation of an instrument calls for an integration of many types of evidence through studies of content validity, construct validity, and criterion-related validation (DeVellis, 2003; Netemeyer, et al., 2003; Nunnally & Bernstein, 1994). Several methods of inquiry were used to establish evidence of validity for the scale as they tend to complement one another in practice (Anastasi, 1982).

Content validity is the representativeness or sampling adequacy of items in a measuring instrument. It answers the question as to whether the content of the measure is representative of the content or the universe of content of the property being measured (Kerlinger & Lee, 2000), or whether a sample of all possible items can measure the particular construct of interest (Suen, 1990). Content validity requires the establishment of both item validity (the scale items measure the intended content area) and sampling validity (how well the scale samples the total content area) (Guerra-López, 2008). Content validity for the EBM Environment Scale was achieved in the process of item generation resulted from the literature review in Chapter 2, expert review, focus-group evaluation, and a pilot study of the scale.

Face validity is concerned with the extent to which an instrument "looks like" it measures what it is intended to measure (Nunnally & Bernstein, 1994); whether its potential users (nonexperts or administrative personnel) like the types of items; or whether the content of the instrument simply looks relevant to test takers (Furr & Bacharach, 2008). It does not refer to what an instrument actually measures, but to what it appears to measure on the surface (Anastasi, 1982). The evaluation of the scale by a focus group of chief residents in Phase 2 served the purpose of achieving face validity for the scale. Since face validity is not validity in the technical sense, Anastasi cautioned against using it as a substitute for determining objective validity for an instrument (1982).

Construct validity determines the extent to which an instrument may be said to measure a trait or a construct (Anastasi, 1982). A construct is defined as the underlying phenomenon, or latent/unobservable variable, that an instrument is intended to measure (DeVellis, 2003). Construct validation of the EBM Environment Scale was achieved by means of factor analysis of item loadings on a factor or construct—a method for organizing instrument items into groups or factors (Munro, 2001) or assessing dimensionality of a set of items through factor loadings (correlations of each item with the factor) (Kline, 1994, 2000). Factor analysis is most often used as part of the instrument development process and “an important statistical tool for providing validity evidence concerning the structure of instruments” (Dixon, 2001, p. 307). DeVellis (2003) suggests that it be used as part of the scale development process at the stage of evaluating scale item performance. The results of factor analysis can also provide information for the scale developer to decide how scale items should be grouped into subscales and which items should be dropped from the scale entirely (Munro, 2001). In this study, principal component factor analysis was performed in SPSS to “verify that items empirically form the intended subscales” (Spector, 1992, p. 53) and to examine the internal structure of the EBM Environment Scale. The scale items were predicted to load on those factors that constituted the EBM environment.

The final source of evidence for validity was criterion-related validity. It usually involves comparing scores on the scale of interest with scores on other variables. It also involves comparing different identifiable groups of respondents on the scale of interest. In describing the use of criterion-related validity, Spector (1992) remarks:

> The typical scale-validation strategy involves testing the scale of interest in the context of a set of hypothesized interrelations of the intended construct with other constructs. That is, hypotheses are developed about the causes, effects, and correlates of the construct. The scale is used to test these hypotheses. Empirical support for the hypotheses implies validity of the scale (p. 46).

To further validate the scale, research questions 2-10 were posed to examine the relationships between scores on the EBM Environment Scale and several learner characteristic variables about medical residents (e.g., levels of residency training, residency programs, and previous EBM training experience). It was hypothesized that the scale had the ability to discriminate groups of participants with different learner characteristics.

Issues of validity go hand-in-hand with reliability. The most common procedures used to assess reliability can be grouped into three types: test-retest reliability, alternative-form reliability, and internal consistency reliability (Netemeyer, et al., 2003). Description and examination of each type of reliability was beyond the scope of the study. Due to constraints such as time, cost, and availability of subjects at multiple occasions, testing the internal consistency reliability was the main concern for establishing reliability of the EBM Environment Scale. Internal consistency as a concept to measure reliability requires only a single administration of an instrument to respondents (Netemeyer, et al., 2003). Internal consistency reliability refers to the degree of the intercorrelations of items with one another or with a total score on the scale as a whole (American Thoracic Society, 2007; Furr & Bacharach, 2008). Two forms of internal consistency reliability were used to measure reliability in the scale development process: split-half reliability and Cronbach’s coefficient alpha.

A split-half reliability coefficient assesses the consistency in scores between the two equivalent halves of an instrument. The set of items that makes up a single scale is divided into two subsets that are correlated to assess reliability (DeVellis, 2003). When computing the split-half reliability, it is important to choose which items to include in each half so that the two halves are as equivalent as possible and no two adjacent items are included in the same half. Therefore, the split-half reliability known as odd-even reliability was employed to avoid some potential problems associated with first-half versus second-half split halves (e.g., problems such as respondents’ fatigue when completing the second half of the scale) (Green & Salkind, 2008). The split was done to take into consideration of the ordering of items: no two adjacent items were included on the same half. The subset of odd-numbered items was compared to the even-numbered items (DeVellis, 2003).

Coefficient alpha, the most widely used method for establishing reliability, was performed to assess internal consistency coefficients. Cronbach's alpha is a way of looking at the extent to which scale items go together and at the same time, identifying weak items that may be omitted in subsequent analysis (Munro, 2001). It is used to test internal consistency of scale items that measure the same underlying construct (Kanashiro, McAleer, & Roff, 2006) or reveal the degree of interrelatedness among the set of items created to measure the underlying factors of the EBM environment. The greater the consistency in responses among items, the higher coefficient alpha will be.

The values of Coefficient alpha range from 0 to 1. Investigators and researchers expressed their different opinions about the acceptable levels of alpha in scale development. DeVellis (DeVellis, 2003) comments on different alpha levels in scale development:

> My personal comfort ranges for research scales are as follows: below .60, unacceptable; between .60 and .65, undesirable; between .65 and .70, minimally acceptable; between .70 and .80, respectable; between .80 and .90, very good; much above .90, one should consider shortening the scale….The suggested guidelines are suitable for *research instruments* that will be used with *group data.* A scale with an alpha of .85 is probably perfectly adequate for use in a study comparing groups with respect to the construct being measured " (pp. 95-96).

For the scale development in the study, internal consistency reliability analysis was performed to test reliability of the entire scale and subscales. In conducting reliability analysis of the scale as a whole and subscales, DeVellis's (2003) suggestions for an alpha level were considered as general criteria for reliability testing.

In addition, item analysis was also conducted to examine how any one scale item is correlated with all remaining items in a set of items under consideration, excluding the item itself (DeVellis, 2003). "The purpose of item analysis is to find those items that form an internally consistent scale and to eliminate those items that do not" (Spector, 1992, p. 29). The type of correlations is referred to as corrected item-to-total correlations. The reliability analysis procedure used for item analysis allows for a comprehensive exploration of how a scale's reliability might increase or decrease as specific scale items were deleted or added. Item analysis is an iterative process that facilitates the continuous exploration of the conceptual underpinnings of the construct and refinement of the scale under development (Green & Salkind, 2008).

The EBM Environment Scale items were grouped into subscales conceptually and relationally to assess different aspects of contextual factors of the EBM environment. Item analyses were performed on each subscale. Items with low corrected item-to-total correlations with the subscale score to which they were hypothesized to belong were considered as candidates for deletion. Examples of decisions rules for corrected item-to-total correlations were to retain items that showed initial item-to-total correlations in the range of .35 to .80 (Bearden, Hardesty, & Rose, 2001; Netemeyer, et al., 2003; Tien, Bearden, & Hunter, 2001).

Summary

Chapter 3 presents an overview of the methods used in the development of a reliable and valid scale to analyze the EBM environment. Scaling procedures conducted in four phases are described. The sampling, scale development process, data collection, and analysis techniques are also delineated. Chapter 4 reports the results of the scale development process and the findings from internal consistency reliability analysis and scale validation.

CHAPTER 4

RESULTS

The purpose of the study was to develop and validate the EBM Environment Scale to measure medical residents' perceptions of the environment in which they learn and practice EBM. The chapter presents the results of the scale development process and the findings related to the study's specific research questions.

Development of the EBM Environment Scale

Several procedures were performed to assure that a content valid scale was developed at the early stages of scale development. The content validity of the scale was established through the procedures of item generation and subsequent evaluation of items by expert judges and a focus group of chief residents.

Item generation. Between March and June 2009, a large pool of 158 items, was generated to form an inventory of items to reflect the identified content area for contextual analysis of the EBM environment. The items were refined, reworded, and arranged under an initial 17 categories of dimensions based on contextual factors derived from Tessmer and Richey's (1997) contextual analysis model (Table 3 below).

Table 3 *Summary of Initial Dimensions and Items*

	Scale Dimension	Number of Items
1	Goal Setting	7
2	Utility and Accountability	10
3	Learner Role and Involvement	8
4	Task Orientation	8
5	Applicability	8
6	Resource Availability	8
7	Social Support	15
8	Physical Setting	5
9	Faculty Role	9
10	Learning Schedules	9

Table 3 continued

Summary of Initial Dimensions and Items

	Scale Dimensions	Number of Items
11	Transfer Opportunities	6
12	Situational Cues	11
13	Learning Support	12
14	Faculty Support	11
15	Teaching Support	10
16	Learning Culture	14
17	Incentives	7

Expert Review. On June 2009, 11 experts who were trainers at the International Evidence-Based Clinical Practice Workshop were contacted and invited to serve on a panel of content experts reviewing the inventory. Seven of them agreed to participate in the expert review process: one was the expert in contextual analysis for instructional design, and the other six were physician faculty with expertise in EBM. Table 4 provides a profile of the EBM experts based on the selection criteria specified in Chapter 3. During July 2009, a packet of content validation information was sent to the 7 experts (Appendix C).

Table 4

Expert Panel Profile

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6
Title	Assistant Professor	Professor	Associate Professor	Associate Clinical Professor	Professor	Associate Professor
Medical Specialty	Internal Medicine	Internal Medicine, Diabetology	Family Medicine	Emergency	Internal Medicine	Urology
Years of teaching residents	3-6	11-14	7-10	5-18	≥19	7-10
Years of teaching EBM	7-10	11-14	7-10	15-18	15-18	3-6
Role in teaching EBM	Preceptor, Tutor	Preceptor	Academic Director for an EBM Curriculum	Preceptor	Attending Physician	Course director

The six EBM experts reviewed the items using the instructions provided in the packet. They raised questions on some ambiguous and redundant items and provided suggestions for item improvement, revision, and deletion. Based on the experts' feedback, some items were revised and poor items were deleted. The expert in context analysis suggested that a number of dimensions be removed since they were not specific to the purpose of the EBM Environment Scale under development. Based on her suggestions, some items were consolidated; a number of redundant items were dropped; and several dimensions were eliminated from the scale. Table 5 shows the results of the item and dimension selection and reduction process.

Table 5

Summary of Items and Dimensions Consolidated and Deleted

- The items under Applicability were combined with those under Utility and Accountability.
- Items in Learner Role and Task Orientation were consolidated.
- The dimension Physical Setting was deleted.
- The Faculty Role dimension was deleted and three items were merged with Social Support.
- The Learning Schedules dimension was deleted and two items were retained and merged with Learning Support.
- The Incentives dimension was deleted. Three items were combined with Learning Culture.

The content validity index (CVI) as a quantitative technique was employed to quantify the item review process. A decision rule was adopted to retain those items with CVI ≥ .80. The results of the CVI analysis resulted in the elimination of 42 items from the inventory. Items with low clarity and high CVI scores were retained after they were revised and consolidated with different categories of dimensions. Based on experts' feedback and suggestions, additional 53 items were eliminated from the inventory.

The expert review process resulted in a tentative version of the EBM Environment Scale that comprised 59 items (Appendix F). These items clustered under 7 dimensions that formed the initial seven subscales in the EBM Environment Scale (Table 6).

Table 6

Subscales and Items for the Tentative Version of the EBM Environment Scale

Subscale	Number of Items
1. Utility and Accountability	7
2. Learner Role and Task	8
3. Resource Availability	5
4. Learning Support	12
5. Social Support	8
6. Situational Cues	7
7. Teaching Support	3
8. Learning Culture	9

Focus Group Evaluation. In September 2009, 10 chief residents were assembled as a focus group to evaluate the scale online. They were asked to rate each item on a 3-point scale from "very important" to "not important". At this stage of scale development, the residents were not expected to rate their perceived EBM environment. Instead, they were asked to rate the items according to how important they felt each item was in creating an environment conducive to residents' EBM learning and practice. The residents were also asked to offer additional suggestions and comments regarding item clarity and the estimated time needed to complete the scale.

Content validity index (CVI) was also employed to evaluate scale items for retention and deletion. Items with CVI lower than .80 were considered as candidates for exclusion. The teaching support subscale was eliminated since the items of the subscale had low CVI (< .80). These items may not be appropriate for inclusion in the scale since residents would not have the information they need to voice their opinions regarding the support available for faculty in terms of teaching and practicing EBM. Items were further edited based on the residents' ratings and feedback. Items in a few subscales were consolidated. In addition, a few new items were added to the scale to represent the content area of several subscales. When making final decisions on inclusion and exclusion of scale items, the researcher's subjective judgment was applied in conjunction with the results of the CVI analysis and residents' feedback and comments

Following the focus group evaluation, scale items were further edited. The scale was trimmed down to 48 items that formed the first version of the EBM Environment Scale (Appendix H). A survey was created for the purpose of collecting empirical data to validate the scale. It contained two parts: Part I contained the 48 scale items; Part II included a list of 7 demographic questions on learner characteristic variables. These questions were intended to explore and test their possible relationship with the dependent or criterion variable—perception scores on the EBM Environment Scale. From October to the mid-December 2009, the scale was pilot tested to a convenience sample of medical residents recruited from six residency programs in primary care specialties.

Data Preparation

The responses submitted by 3 respondents (3 cases) exhibited the tendency of apparent acquiescence—the tendency to agree or disagree with items regardless of whether the items were positively or negatively worded. According to Graham (1990), the individual's scores that manifest response bias "should be considered invalid and should not be interpreted further" (p. 22). As the scores of the three respondents were extreme on the scale--either very high or very low, their responses were excluded in the final data analysis to avoid distortion of estimates of means and the results of statistical analysis conducted on the scale scores.

Missing values were randomly scattered throughout. They were assigned "9", "99", and "999" in SPSS to be handled by SPSS as missing. In the statistical analysis, cases were deleted when data were missing. The procedure provided a sample data set without missing data for statistical analysis.

Before data analysis, ten scale items that were negatively worded were reversed scored. Each individual's responses were recoded when a total scale score was summated. By doing that, a response of "5 (*strongly agree*) was recoded to a response of "1" (*strongly disagree*); a response of 4 "agree" to a "2" (*disagree*); an original response of "1" (*strongly disagree*) was recoded to a response of "5" (*strongly agree*); and a response of "2" (*disagree*) to "4" (*agree*).

Descriptive Overview

Residents in four programs completed the paper version of the survey, which was administered to them during one of their educational events. Residents in the other two programs completed the online survey through SurveyMonkey. The response rate for the paper version ranged from 60%-92%, while the response rate for the online version was from 19% to 43%.

Demographic Characteristics of Participants. Among 262 medical residents who were recruited from six residency programs, 127 residents participated in the survey, representing a 47% response rate. Table 7 provides a summary of selected demographic variables for resident respondents. Valid responses from 124 respondents (n=124) were used for data analysis. Out of the 124 respondents, 49 (39.5%) participants self-identified themselves as first-year residents (interns), 32 (25.85%) as second-year residents (juniors), and 38 (30.6%) as third-year residents (seniors). More male residents (67, 54%) responded to the survey than female residents (51, 41.1%). In comparison, 75 (60.5%) participants attended a medical school outside of the United States while 42 (33.9%) attended a medical school in the United States. A majority of participants reported to have some level of prior EBM training: 91 (72%) in medical school; 94

(75.8%) during residency, while 25 participants (20.2%) indicated no prior EBM training in medical school and 19 (15.3%) no EBM training during residency.

Table 7

Summary of Demographic Characteristics of Participants

Variable	Frequency	%
Level of Residency Training		
PGY-1	49	39.5
PGY-2	32	25.8
PGY-3	38	30.6
No Response	5	4.0
Gender		
Female	51	41.1
Male	67	54.0
No Response	6	4.8
Country of Medical School Attended		
U.S.	42	33.9
Other	75	60.5
No Response	7	5.6
Current Residency Training Program		
Program A	11	8.9
Program B	21	16.9
Program C	29	23.4
Program D	28	22.6
Program E	18	14.5
Program F	16	12.9
No Response	1	0.8
Prior EBM Training in Medical School		
None	25	20.2
1-3	41	33.1
4-6	18	14.5
7-10	10	8.1
≥11	21	16.9

Table 7 continued

Summary of Demographic Characteristics of Participants

Variable	Frequency	%
No Response	9	7.3
Prior EBM Training during Residency		
None	19	15.3
1-3	52	41.9
4-6	19	15.3
7-10	8	6.5
≥11	15	12.1
No Response	11	8.9

Note. n = 124

Characteristics of Sites for Residency Training Programs. Data were collected from six residency programs in three primary care specialties: one in family medicine, one in pediatrics, and four in internal medicine. The locations for the six residency programs represented unique settings and diverse health care environments. Three residency programs A-C were university-based and located at three different training sites that were affiliated with the same academic medical center. The other three programs were in the same specialty of internal medicine: Programs D-E were community-based; Program F was university-based (Table 8 below). The size of residency programs varied from one program to another. The largest program had a total of 95 residents while the smallest one had 12 residents. The response rate to the survey ranged from 19% to 92% among the six programs.

Table 8

Distribution of Responses by Residency Program

Site	Program	Academic Affiliation of Program	Respondents	Total Residents	Response Rate
Site 1	Program A	University-based	11	12	92%
Site 2	Program B	University-based	29	43	65%
Site 3	Program C	University-based	21	24	88%
Site 4	Program D	Community-based	28	46	60%
Site 5	Program E	Community-based	18	95	19%
Site 6	Program F	University-based	17	42	43%
Total			127	262	47%

Analysis of Research Questions

The following session presents the results of statistical analysis of data pertaining to research questions 1-9 that examined issues related to the reliability and validity of the scale.

Question 1: What are the psychometric properties of the newly developed EBM Environment Scale?

Measures of Variability. The results of data analysis show that the overall item mean score for the scale as a whole was 3.89 with a standard deviation of 0.56. The item mean, subscale mean, and standard deviation for each subscale of the scale are shown in Table 9. The item mean scores ranged from 3.48 (learner role) to 4.44 (utility and accountability); subscale mean scores ranged from 12.46 (resource availability) with a standard deviation of 1.85 to 36.58 (learning culture) with a standard deviation of 12.33. Four of the subscales (learner role, social support, learning support, and situational cues) had item mean scores below 4. The findings suggest that participants tended not to agree with the items in these subscales. The utility and accountability, resource availability, and learning culture subscales had items means, 4.44, 4.15, and 4.01, respectively. That is, participants were more likely to agree or strongly agree with the item statements in these subscales.

Table 9

Summary of Subscales Means, Standard Deviations, and Cronbach's Alpha for the EBM Environment Scale of Version 1

Subscale	# of Items	Item Mean	Subscale Mean	*SD*	Cronbach's Alpha	Valid Cases
Learner Role	8	3.48	27.80	5.95	.454	(N=117)
Utility and Accountability	6	4.44	25.98	3.10	.792	(N=117)
Resource Availability	3	4.15	12.46	1.85	.746	(N=121)
Social Support	6	3.81	22.89	5.18	.359	(N=114)
Learning Support	7	3.59	25.10	3.84	.630	(N=117)
Situational Cues	9	3.67	33.26	5.48	.862	(N=115)
Learning Culture	9	4.01	36.58	12.33	.753	(N=112)

Initial internal consistency estimates of reliability. Initial item and reliability analyses were conducted to determine if the scale as a whole exhibits evidence of internal consistency. Two types of internal consistency estimates, coefficient alpha and split-half reliability, were employed for analysis of internal consistency. The results showed that the scale of version 1 (Appendix H) demonstrated strong evidence of internal consistency with Cronbach's alpha of .943. The split-half reliability analysis shows that the scale had an initial correlation of .919 between forms (two halves) and the Spearman-Brown split-half reliability coefficient of .958.

Cronbach's alpha coefficients of the subscales ranged from .359 for learner role to .862 for situational cues. As shown in Table 9, the alpha coefficients for learner role and social support were low compared with other subscales. Following the initial reliability analysis, item analysis with corrected item-to-total corrections was calculated to determine which items could be excluded from the scale and subscales. Bearden et al. (2001) employed some decision rules for retaining items in their scale development: (a) an average corrected item-to-total correlation greater than or equal to .35, and (b) an average interitem correlation greater than .20. Items with a judged degree of high face validity were retained even if they did not meet criteria a and b. The decision rules were adopted for item selection at this stage of scale development.

After items with lower correlations were weeded out, the corrected item-total correlations were recalculated. The iterative process of item analysis continued until a satisfactory set of items in a subscale remained. To evaluate the appropriateness of items, the item analysis procedure was conducted three times for the learner role and learning support subscales and twice for the social support and situational cues subscales. Two items (#33 and #44) that had acceptable corrected item-to-total correlations were dropped from the subscale situational cues to reduce redundancy among the subscale items. No items were reduced from the subscales of utility and accountability and resource availability. Table 10 lists items that were reduced from 5 subscales.

Table 10

Items Omitted from Subscales

Subscale	Omitted Items
Learner Role	Item 3: I understand the competency requirements of the Accreditation Council of Graduate Medical. Item 20: I am not sure of what I am supposed to learn in EBM training. Item 27: Residents rarely have any input on what is taught in EBM training. Item 39: Residents are involved in planning for EBM training events.
Social Support	Item 16: Residents share EBM learning experiences with one another.
Learning Support	Item 15: There are NOT any EBM trained faculty available to teach EBM at my residency training site.

Table 10 continued

Items Omitted from Subscales

Subscale	Omitted Items
	Item 32: My patient care workload is overwhelming. Item 41: My on-call schedule prevents me from attending EBM educational events.
Situational Cues	Item 23: Faculty serve as facilitators in the residents' EBM learning process. Item 44: There are faculty role models who assist me in adopting EBM to solve patient problems.
Learning Culture	Item 8: Evidence from clinical research is often consulted in guiding clinical decision making about patient care in my practice environment. Item 46: There is resistance to integrating EBM into clinical practice among attending physicians. Item 47: Residents are encouraged to raise clinical questions on clinical cases.

Item 23 was deleted from the subscale situational cues. However, it was added to the learning support subscale since it seemed more associated with the subscale conceptually. Two items (#17 and #34) in the learning culture subscale were retained even if they had lower corrected item-total correlations because the Cronbach's alpha increase would have been less than .10 if they were deleted. Another reason for keeping them was that they were useful items to represent the contextual factor that the subscale was intended to measure. Table 11 on the next page shows the increased alpha for several subscales undergoing the iterative process of item analysis.

As a result of the iterative item analysis procedures, the 48 items in the first version of the EBM Environment Scale were reduced to 36 items (Appendix I). The subscales that originally had low estimates of reliability demonstrated increased alpha coefficients, suggesting good internal consistency of the subscales. The shorter version of the scale could potentially alleviate some burden for respondents when they complete the survey in any future validation studies.

Table 11

Summary of Subscales Means, Standard Deviations, and Cronbach's Alpha for the EBM Environment Scale of Version 2

Subscale	# of Items	Item Mean	Subscale Mean	*SD*	Cronbach's Alpha	Valid Cases
Learner Role	4	3.39	13.56	2.76	.728	(N=118)
Utility and Accountability	6	4.44	25.98	3.10	.792	(N=117)
Resource Availability	3	4.15	12.46	1.85	.746	(N=121)
Social Support	5	3.80	18.99	2.74	.652	(N=114)
Learning Support	5	3.68	18.40	3.16	.727	(N=120)
Situational Cues	7	3.67	33.26	5.48	.861	(N=115)
Learning Culture	6	3.67	25.72	4.56	.800	(N=116)

Reliability statistics shows that the internal consistency reliability coefficient of the shorter scale was .863. The split-half correlation coefficient was also computed to evaluate the consistency in responding between the first half and the second half of items in the shorter scale. The analysis yielded a correlation of .891 between forms with the Spearman-Brown split-half reliability coefficient of .942. Next, factor analysis was conducted to screen for efficient items and to test the pre-defined internal structure of the scale to determine how items should be better grouped together into the subscales.

Exploratory Factor Analysis

Factor Analysis was conducted to further establish the validity of the EBM Environment Scale and to verify the internal structure of the modified 36 item EBM Environment Scale resulted from the initial reliability and item analyses.

A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity were conducted. The KMO Measure of Sampling Adequacy is a statistic to determine whether the data collected were appropriated for such analysis. The measure of sampling adequacy varies between 0 and 1. High values (in the .90's to .80's) generally indicate that a factor analysis may be useful for interpreting data. Small values for the KMO measure (below .50) indicate that a factor analysis of the data may not be appropriate (Norušis, 2006). The overall Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .802 for the data, indicating that there was sampling adequacy and that it was appropriate to conduct a factor analysis. Additionally, Bartlett's Test of Sphericity (a multivariate measure of normality regarding the set of distributions) tests the null hypothesis that the correlation matrix is an identity matrix (a matrix that has a 1 for each element on the main diagonal and 0 for all other elements). The goal is to reject the null hypothesis. In this sample, the Bartlett Test of Sphericity also indicated that the data were appropriately multivariate normal and this matrix was not an identity matrix and was suitable for factor analysis ($\chi^2 = 2417$, $df = 630$, $p = .000$).

Exploratory factor analysis (EFA) is a common technique for studying the dimensionality of a scale in instrument development. Therefore, principal components analysis would seem a reasonable factor analytic model to use (Spector, 1992). To perform the analysis, the 36 items on the scale was submitted to principal component analysis in SPSS.

A number of criteria can be used to help determine the number of factors to extract. One of commonly used ones is the Kaiser-Guttman criterion in which factors with eigenvalues greater than one are retained. An eigenvalue represents the relative proportion of variance accounted for by each factor. The rationale for this method is that those factors with eigenvalues less than 1 account for less variance than any single item and are, therefore, meaningless (Netemeyer, et al., 2003).

Another criterion for determining the number of factors is to decide a priori the number of factors to be extracted. The pre-specified number of factors is based on the number of factors that the researcher believes underlie a set of items (Netemeyer, et al., 2003). In performing the factor-analysis procedure, subjective judgment is necessary to determine the number of factors and meaningfulness of their interpretation (Spector, 1992). Because the scale was developed with seven factors in mind, a seven factor extraction (seven factor solution) was forced using the varimax rotation method (a variance maximizing procedure) (Table 12). The seven factors extraction was determined to be the most conceptually meaningful, interpretable, and logical.

Table 12

Rotation Sums of Squared Loadings

Factor	Total	% of Variance	Cumulative %
1	10.795	29.985	29.985
2	3.270	9.082	39.067
3	2.603	7.230	46.297
4	1.820	5.056	51.353
5	1.601	4.447	55.800
6	1.503	4.174	59.974
7	1.293	3.593	63.566

As Table 12 shows, the solution accounted for 63.57% of the total variance. The first factor had an eigenvalue of 10.79 and accounted for 29.99% of the total variance with 10 items. Based on the content of the items, the subscale was named as situational cues. Factor 2 had an eigenvalue of 3.27 and accounted for 9.08% of the total variance with 6 items and was labeled as learner role. Factor 3 had eigenvalues of 2.60 and accounted for 7.23% of the total variance with 6 items and was labeled as utility and accountability. Factor 4 had eigenvalues of 1.82 and accounted for 5.06 % of the total variance with 3 items and was labeled as learning culture. Factor 5 had eigenvalues of 1.60 and accounted for 4.17% of the total variance with 3 items and was labeled as resource availability. Factor 6 had eigenvalues of 1.50 and accounted for 4.17% of the total variance with 5 items and was labeled as learning support. Factor 7 had eigenvalues of 1.29 and accounted for 3.59 % of the total variance with 5 items and was named as social support.

A minimum value of about .30 to .35 is required to consider that an item “loads” on any factor (Spector, 1992). Tabachnick and Fidell (2001) suggest that, to be interpretable, variables with loadings should be .32 and above. To indicate good factor structure, there should be several strong loaders on each factor (.50 or better). In other words, a subset of items should load highly on one factor while cross-loaded lowly on other factors. Factor extractions from the principal component analysis in this factor analysis yielded items with loadings ranging from .395 to .973. The cutoff for size of loading acceptable was .35 for this factor analysis. Therefore, all items were retained since their loadings were higher than .35. A few items (#13, #34, and # 37) cross-loaded (>.35) on more than one factor. They were retained and were reassigned to factors with which they were identified more conceptually. The factor loadings for the 36 items in the seven subscales, item means, standard deviations, and corrected item-to-total correlations are presented in Table 13.

Table 13

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of the EBM Environment Scale

Item	Factor Loading	*M*	*SD*	Corrected Item-Total Correlation
Factor 1: Situational Cues (*10 Items*)				
12. My attending physician prompts me to apply evidence to solve clinical problems.	.790	4.23	.787	.733
28. My attending physician models evidence-based practice during rounds and case discussions in the clinical setting.	.670	3.64	.821	.690

Table 13 continued

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of the EBM Environment Scale

Item	Factor Loading	*M*	*SD*	Corrected Item-Total Correlation
2. My attending physician is supportive of my participation in EBM training.	.662	3.74	.863	.446
33. Faculty promote the application of EBM in solving clinical problems for individual patients.	.661	4.27	.953	.670
31. My attending physician provides me with clear feedback on my practice of EBM.	.650	4.10	.841	.597
11. Residents are not encouraged to practice EBM in the clinical setting.	.624	3.15	.989	.583
38. I often observe my attending physician citing evidence to support clinical decisions about patient care.	.570	3.87	.672	.587
7. I often observe my peers applying EBM principles in caring for patients.	.504	3.82	.793	.511
36. My attending physician does not provide me with any guidance on my EBM learning and practice.	.492	3.81	.949	.619
17. Residents are encouraged to become problem solvers.	.490	3.72	.888	.537
Factor 2: Learner Role *(6 items)*				
30. There are clear expectations for residents regarding EBM training in my residency training program.	.779	3.45	.863	.730
45. Residents usually lead EBM small group discussions.	.689	3.12	1.055	.552
48. Residents work as a team to apply EBM to solve clinical problems.	.630	3.75	.935	.588

Table 13 continued

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of the EBM Environment Scale

Item	Factor Loading	*M*	*SD*	Corrected Item-Total Correlation
40. There is a well-structured EBM component in my residency training program.	.619	3.36	.949	.614
22. I have clear goals for learning EBM.	.615	3.63	.835	.350
26. There is sufficient time allocated to EBM training in my residency training program.	.566	3.26	1.008	.567
Factor 3: Utility and Accountability *(6 Items)*				
21. Developing a high level of skills in evidence-based practice would help me provide high quality care for my patients as a physician.	.748	4.53	.714	.621
9. EBM training will enhance my ability to integrate the best evidence into clinical practice.	.729	4.35	.844	.589
42. Implementing EBM will improve the care that physicians deliver to patients.	.682	4.37	.738	.538
6. Learning EBM is NOT very useful to me in providing quality care for my patients.	.669	4.39	.719	.519
1. I see the value of adopting EBM in my clinical practice as a clinician.	.668	4.03	.706	.593
37. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.	.417	4.31	.701	.415
Factor 4: Learning Culture *(3 Items)*				
29. There is a high level of acceptance of the EBM approach in my practice environment.	.973	3.89	3.913	.982

Table 13 continued

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of the EBM Environment Scale

Item	Factor Loading	*M*	*SD*	Corrected Item-Total Correlation
24. The integration of EBM into clinical practice is met with skepticism by clinicians in my practice environment.	.973	4.35	3.818	.961
35. The use of clinical evidence is part of the routine for clinical practice in my practice environment.	.972	4.23	3.828	.974
Factor 5: Resource Availability (*3 Items*)				
14. Evidence-based information resources are easily accessible at the point of patient care in my practice environment.	.772	4.02	.764	.590
5. Evidence-based information resources are readily available in my practice environment.	.738	4.33	.746	.665
10. I am aware of the existence of evidence-based information resources in my practice environment.	.568	4.12	.766	.472
Factor 6: Learning Support (*5 Items*)				
23. Faculty serve as facilitators in the residents' EBM learning process.	.708	3.57	.926	.556
19. There is a high level of faculty involvement in teaching EBM at my residency training site.	.543	3.55	.963	.660
4. I have protected educational time to participate in EBM training events.	.454	3.59	1.045	.345
13. Faculty collaborate with residents in developing and providing EBM training.	.418	3.80	.766	.595
25. Nurses and other house staff are supportive of evidence-based practice.	.406	3.20	.944	.337

Table 13 continued

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of the EBM Environment Scale

Item	Factor Loading	*M*	*SD*	Corrected Item-Total Correlation
Factor 7: Social Support (*3 Items*)				
43. I feel part of the clinical team working here.	.753	4.23	.765	.400
18. My attending physician promotes an atmosphere of mutual respect.	.536	4.17	.752	.432
34. There is a commitment to life-long learning in my practice environment.	.395	4.12	.766	.455

Additional Item Analysis

Following the factor analysis, additional reliability and item analyses were conducted for the entire scale and subscales. The results show an alpha coefficient of .860 for the entire scale. The correlation between forms was .892 and the Spearman-Brown split-half reliability coefficient was .943. Table 14 presents a comparison of the internal consistency reliability coefficients for the three versions of the EBM Environment Scale resulted from the iterative process of scale development.

Table 14

Internal Consistency Reliability of the Three Versions of the EBM Environment Scale

Version of the Scale	Cronbach's Coefficient Alpha	Split-half Reliability Correlation between Forms	Spearman-Brown Split-half Reliability Correlation	Total Items
Version 1	.943	.919	.958	48
Version 2	.863	.891	.942	36
Version 3	.860	.892	.943	36

The item size for the subscales in the third version of the scale ranged from 3 to 10. The item mean scores ranged from 3.42 for learner role to 4.33 for utility and accountability. The subscale mean scores ranged from 12.46 for both resource availability and learning culture. Situational cues had the highest subscale mean score of 38.33. Although the subscales resource availability and learning culture had the same subscale mean score, the standard deviations for both varied considerably: resource availability had a SD of 1.85, and learning culture had a SD of 11.42 (Table 15). The result suggests that there was a wide difference on opinions among respondents regarding the learning culture subscale.

Table 15

Summary of Subscales Means, Standard Deviations, and Cronbach's Alpha for the EBM Environment Scale of Version 3

Subscale	# of Items	Item Mean	Subscale Mean	*SD*	Cronbach's Alpha	Valid Cases
Learner Role	6	3.42	20.57	4.03	.805	(N=118)
Utility and Accountability	6	4.33	25.98	3.10	.792	(N=117)
Resource Availability	3	4.15	12.46	1.85	.746	(N=121)
Social Support	3	4.17	12.52	1.72	.620	(N=114)
Learning Support	5	3.54	17.71	3.23	.730	(N=119)
Situational Cues	10	3.83	38.33	5.99	.882	(N=114)
Learning Culture	3	4.15	12.46	11.42	.987	(N=115)

The item analysis for corrected item-to-total correlations for each subscale was also conducted. The results show that alpha coefficients were increased for several subscales as a result of factor analysis, suggesting that items in each subscale were contributing to the increased internal consistency reliability of each subscale. Thus, all 36 items in the scale of version 2 were retained in the scale of version 3 (Appendix J). Although social support had a low alpha of .620, it was considered as being acceptable since it had the minimum number of 3 items.

Pearson product-moment correlation coefficients were computed among the seven subscales to determine the intercorrelations among the subscales. As shown in Table 16, 16 out of 21 correlations were statistically significant at the significant level of .05 and .01. The learning culture subscale was not statistically significant correlated with all other subscales except with the situational cues subscale (r = .187, p<.05).

Table 16

Summary of Intercorrelations, Means, and Standard Deviations for Scores on Subscales of the EBM Environment Scale (N=124)

Subscales	1	2	3	4	5	6	7
1. Situational Cues	1.00						
2. Learner Role	.615**	1.00					
3. Utility and Accountability	.454**	.284**	1.00				
4. Learning Culture	.187*	.160	-.001	1.00			
5. Resource Availability	.484**	.423**	.433**	.063	1.00		
6. Learning Support	.630**	.627**	.303**	.126	.397**	1.00	
7. Social Support	.586**	.385**	.418**	.066	.372**	.406**	1.00
M	38.33	20.57	25.98	12.46	12.46	17.71	12.52
SD	5.991	4.033	3.102	11.415	1.853	3.234	1.720

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Validation of the EBM Environment Scale

Spector (Spector, 1992) suggests that the validation effort should occur after the item analysis has been conducted and the scale items are selected. Nine research questions were formulated to examine the hypothesized relations of the scale to several characteristic variables about residents: gender, country of a medical school attended, level of residency training, affiliated residency program, prior EBM training in medical school, and prior EBM training during residency. Participants grouped by these variables were compared for any differences in scores of the EBM Environment Scale. The following section presents results with respect to the 9 research questions. Data analyses were based on responses to the 36-item scale of version 3 (Appendix J).

Question 2: Are there any difference among residents grouped by gender in reference to scores on the EBM environment?

The results of data analysis show that there was a slight difference between female and male residents on the overall mean score on the scale: female, *M* =3.92, *Mdn* = 3.86, *SD* = 0.64; male, *M* = 3.88, *Mdn* = 3.94, *SD* = 3.94 (Table 17).

Table 17

Summary of Means, Medians, and Standard Deviations for Scores by Gender

Gender	*n*	*M*	*Mdn*	*SD*	*n* (%)
Female	51	3.92	3.86	.64	51 (43.2%)
Male	67	3.88	3.94	.51	67 (56.8%)
Total	118	3.90	3.94	.57	118 (100.0%)

The Nonparametric test, the Mann-Whitney U test, was conducted to identify any differences between groups by gender. No statistically significant differences were found between female and male residents on scores of the entire scale. The test was also conducted on scores of subscales and individual items. The results indicate that there was a statistically significant difference between the two groups for the resource availability subscale (p = .033). Male residents had a higher mean rank (65.23) than female residents (51.96). Significant differences were also found between the two groups on item 22 (p =.001), asking about their goals for learning EBM, and item 32 (p = .036), about residents' patient care workload. For item 22, male residents had a mean rank of 67.31, while female residents had a mean rank of 48.25. For item 32, female residents had a mean rank of 65.51, while male residents had a mean rank of 53.19.

Question 3: Are there any differences among residents grouped by country of medical school attended in reference to scores on the EBM Environment Scale?

The question examined how U.S residents differed from international residents on their perception of the EBM environment. It was assumed that the two groups of residents may have different scores on the EBM Environment Scale since they may have different exposure to EBM training and different levels of access to EBM clinical information resources. As shown in Table 18, more international residents (64.1%) responded to the survey than U.S. residents (42%). There was a slight difference between the U.S. residents and international residents on scores on the scale: U.S. residents, *M* =3.98, *Mdn* = 3.86, *SD* =0.43; international residents, *M* = 3.86, *Mdn* = 3.91, *SD* = 0.57.

Table 18

Summary of Means, Medians, and Standard Deviations for Scores by Country

Group	*n*	*M*	*Mdn*	*SD*	*n* (%)
US	42	3.98	4.06	.43	42 (35.9%)
Other	75	3.86	3.91	.63	75 (64.1%)
Total	117	3.90	3.94	.57	117 (100.0%)

Using the Mann-Whitney U test, no statistically significant differences were found between the two groups on scores of the EBM Environment Scale. The Mann-Whitney U test was also conducted to evaluate whether the U.S. residents differed significantly from international residents on the seven subscales (Table 19). Statistically significant differences were found on scores of the two subscales: learning culture (p = .018) and social support (p = .010). The U.S. residents scored higher, on average, than international residents on the two subscales. The U.S. residents had a mean rank of 68.71 on learning culture and a mean rank of 69.54 on social support, while international residents had a mean rank of 53.56 on learning culture and 53.10 for social support.

Table 19

Mann-Whitney U Test Results Summary for U.S. and International Residents in Subscales Mean Rank

Subscales	Group	*n*	Mean Rank	U	*p*
Situational Cues	US	42	65.19	1315.00	.139
	Other	75	55.53		
	Total	117			
Learner Role	US	42	62.06	1446.50	.464
	Other	75	57.29		
	Total	117			
Utility and Accountability	US	42	63.29	1395.00	.303
	Other	75	56.60		
	Total	117			
Learning Culture	US	42	68.71	1167.00	.018*
	Other	75	53.56		
	Total	117			
Resource Availability	US	42	63.82	1372.50	.240
	Other	75	56.30		
	Total	117			
Learning Support	US	42	62.48	1429.00	.404

Table 19 continued

Mann-Whitney U Results Summary for U.S. and International Residents in Subscales Mean Rank

Subscales	Group	*n*	Mean Rank	U	*p*
	Other	75	57.05		
	Total	117			
Social Support	US	42	69.54	1132.0	.010*
	Other	75	53.10		
	Total	117			

*p<.05.

<u>Question 4: Are there any differences among residents grouped by level of residency training in reference to scores on the EBM Environment Scale?</u>

As shown in Table 20, out of 119 valid cases analyzed for the research question: 49 (41.2%) residents of PGY-1, *M* = 3.84, *Mdn* = 3.94, *SD* =0.49; 32 (26.9%) residents of PGY-2, *M* = 3.83, *Mdn* = 3.80, *SD* = 0.39; and 38 (31.9%) residents of PGY-3, *M* = 4.01, *Mdn* = 3.97, and *SD* = 0.7. Resident of PGY-3 appeared to have a slightly higher score than residents of the other two training levels.

Table 20

Summary of Means, Medians, and Standard Deviations for Scores by Level of Residency Training

Level of Training	*M*	*Mdn*	*SD*	*n* (%)
PGY-1	3.84	3.94	.49	49 (41.2%)
PGY-2	3.83	3.80	.39	32 (26.9%
PGY-3	4.01	3.97	.75	38 (31.9%)
Total	3.89	3.94	.57	119 (100.0)

The independent variable, level of residency training (year in residency training), divided residents into three groups. The Kruskal-Wallis test was used to compare three or more independent groups when samples are not all the same size. The test was used to determine if there were statistically significant differences among three groups of residents on the scale scores. The results show no statistically significant differences among the three groups on scores of the entire scale, χ^2 (2, N = 119) = 1.56, *p* =.461 and no statistically significant differences among the three groups on scores of the seven subscales.

In all the 36 scale items, one statistically significant difference (*p* = .011) was found among three groups on the rank mean of one item, #31, “My attending physician provides me with clear feedback on my EBM practice.”

<u>Question 5: Are there any differences among residents across residency programs in reference to scores on the EBM Environment Scale?</u>

The focus of validity research was investigating the ability of the scale to discriminate residency programs. Residents from 6 different programs with unique characteristics were recruited to participate in the survey. As Table 21 shows, the mean scores for the 6 programs ranged from 3.51 (Program A) to 4.13 (Program F), and medians ranged from 3.54 (Program A) to 4.12 (Program F). Program F had the highest mean score of 4.13; the second highest was 3.97 for Program D. Program A had the lowest mean score. The standard deviations ranged from 0.33 for Program F to 0.84 for Program B.

Table 21

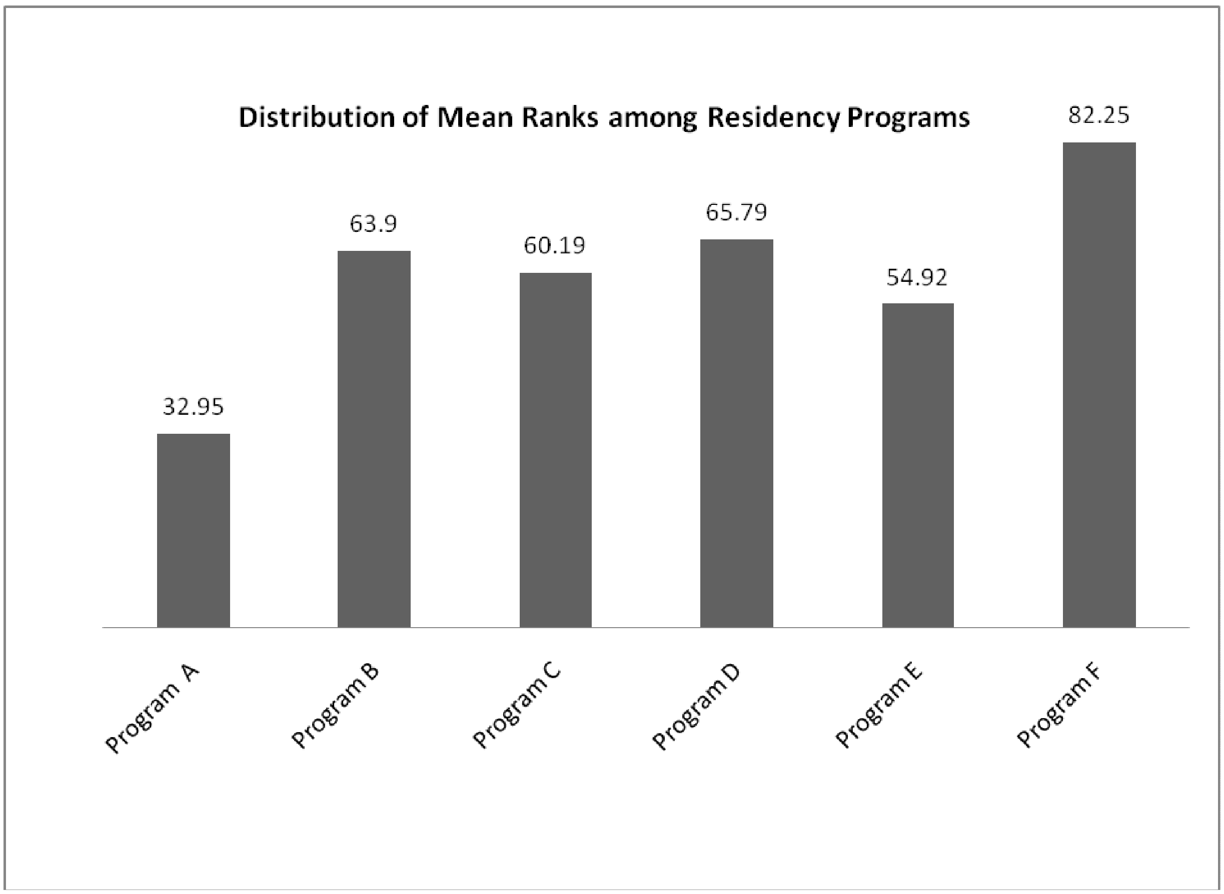
Summary of Means, Medians, and Standard Deviations for Scores by Residency Program

Residency Program	*n*	*M*	*Mdn*	*SD*	*n* (%)
Program A	11	3.51	3.54	.43	11 (8.9%)
Program B	29	3.97	3.94	.84	29 (23.6%)
Program C	21	3.85	3.86	.48	21 (17.1%)
Program D	28	3.94	3.99	.42	28 (22.8%)
Program E	18	3.79	3.93	.39	18 (14.6%)
Program F	16	4.13	4.12	.33	16 (13.0%)
Total	123	3.90	3.94	.56	123 (100.0%)

The Kruskal-Wallis test was used to evaluate the differences in scores on the EBM Environment Scale among residents grouped by residency program (independent variable). The results of the test indicate that there were statistically significant differences among 6 groups on scores of the scale, χ^2 (5, N = 123) = 13.63, *p* = .018. Participants from Program F perceived their EBM environment more favorably than participants in other five programs. Figure 2 illustrates the difference on mean ranks by program.

Figure 2

Mean Ranks on the EBM Environment Scale by Residency Program



The test was also performed to evaluate differences in scores of the seven subscales among the 6 groups. As shown in Table 22, statistically significant differences were found among the 6 groups on four subscales: learning culture (*p* = .002), resource availability (*p*=.017), learning support (p = .030), and social support (p = .024). Moderately significant differences were found on two subscales, learner role (p = .067) and utility and accountability (p = .081). Table 22 shows mean rank distribution by the six residency programs for the seven subscales.

Table 22

Differences in Subscale Scores among Residency Programs

Subscales	Residency Program	*n*	Mean Rank	χ^2	*p*
Situational Cues	Program A	11	46.86	7.278	.201
	Program B	29	59.86		
	Program C	21	64.67		
	Program D	28	57.66		
	Program E	18	61.31		
	Program F	16	81.16		
	Total	123			
Learner Role	Program A	11	45.41	10.304	.067
	Program B	29	57.22		
	Program C	21	51.38		
	Program D	28	71.25		
	Program E	18	62.89		
	Program F	16	78.81		
	Total	123			
Utility and Accountability	Program A	11	37.77	9.801	.081
	Program B	29	68.83		
	Program C	21	64.71		
	Program D	28	69.41		
	Program E	18	49.64		
	Program F	16	63.66		
	Total	123			
Learning Culture	Program A	11	32.18	19.283	.002*
	Program B	29	56.29		
	Program C	21	72.90		
	Program D	28	60.98		
	Program E	18	56.33		

Table 22 continued

Differences in Subscale Scores among Residency Programs

Subscales	Residency Program	*n*	Mean Rank	χ^2	*p*
	Program F	16	86.69		
	Total	123			
Resource Availability	Program A	11	36.64	13.790	.017*
	Program B	29	68.45		
	Program C	21	61.38		
	Program D	28	74.36		
	Program E	18	46.69		
	Program F	16	64.16		
	Total	123			
Learning Support	Program A	11	41.32	12.354	.030*
	Program B	29	67.29		
	Program C	21	51.62		
	Program D	28	63.54		
	Program E	18	56.94		
	Program F	16	83.25		
	Total	123			
Social Support	Program A	11	46.18	12.936	.024*
	Program B	29	59.47		
	Program C	21	66.24		
	Program D	28	62.20		
	Program E	18	49.00		
	Program F	16	86.19		
	Total	123			

*$p<.05$

<u>Questions 6: Are there any difference among residents grouped by level of prior EBM training in medical school in reference to scores on the EBM Environment Scale?</u>

One demographic question asked participants about their previous EBM training experience in medical school. Participants were divided into five groups based on their reported level of EBM training in medical school (Table 23). Among 115 valid responses, a majority of respondents (78%) reported that they had some level of previous EBM training in medical school, while 25 respondents (21.7%) indicated no prior EBM training (See Table 23). The two groups with prior EBM training in the levels of 4-6 and ≥11 had higher mean scores: level of 4-6, *M* = 4.14, *Mdn* = 4.13, *SD* =0.93; level of ≥11, *M* = 4.13, *Mdn* = 4.14, *SD* = 0.39.

Table 23

Summary of Means, Medians, and Standard Deviations for Scores by Level of Prior EBM Training in Medical School

Group	*M*	*Mdn*	*SD*	*n* (%)
None	3.62	3.69	.487	25 (21.7%)
1-3	3.87	3.91	.39	41 (35.7%)
4-6	4.14	4.13	.93	18 (15.7%)
7-10	3.79	4.0	.66	10 (8.7%)
≥11	4.13	4.14	.39	21 (18.3%)
Total	3.90	3.94	.57	115 (100.0%)

The Kruskal-Wallis test was used to evaluate differences among residents grouped by levels of previous EBM training in medical school, which was considered as the independent variable. It was found that there were statistically significant differences on perception scores on the entire scale among residents grouped by level of EBM training in medical school, χ^2 (4, N = 115) = 14.07, *p* = .007. Residents who reported no EBM training in medical school had the lowest mean rank of 40.70, while residents with the training level of 11 or more had the highest mean rank of 74.83 (Table 24 below).

Table 24

Mean Rank Distribution of Scores by Level of Prior EBM Training in Medical School

EBM Training in Med School	*n*	Mean Rank
None	25	40.70
1-3	41	55.62
4-6	18	68.42
7-10	10	56.90
≥11	21	74.83
Total	115	

Using the Kruskal-Wallis test to evaluate any significant differences in scores of the subscales among the 6 groups, statistically significant differences were found for the subscale learner role, χ^2 (4, N = 115) = 15.25, p = .004 and the subscale learning support, χ^2 (4, N = 115) = 12.11, p = .017. Table 25 shows the mean ranks for levels of EBM training in medical school under each subscale.

Table 25

Differences in Subscale Scores among Groups by Level of Prior EBM Training in Medical School

Subscale	Group	*n*	Mean Rank	χ^2	*p*
Situational Cues	None	25	48.00	6.118	.190
	1-3	41	54.72		
	4-6	18	67.86		
	7-10	10	57.80		
	≥11	21	67.95		
	Total	115			
Learner Role	None	25	41.52	15.249	.004*
	1-3	41	53.28		
	4-6	18	74.44		
	7-10	10	59.10		
	≥11	21	72.21		

Table 25 continued

Differences in Subscale Scores among Groups by Level of Prior EBM Training in Medical School

Subscale	Group	*n*	Mean Rank	χ^2	*p*
	Total	115			
Utility and Accountability	None	25	44.32	7.536	.110
	1-3	41	63.91		
	4-6	18	53.78		
	7-10	10	56.10		
	≥11	21	67.26		
	Total	115			
Learning Culture	None	25	45.82	8.531	.074
	1-3	41	59.80		
	4-6	18	53.89		
	7-10	10	56.05		
	≥11	21	73.43		
	Total	115			
Resource Availability	None	25	49.80	4.014	.404
	1-3	41	56.76		
	4-6	18	60.42		
	7-10	10	56.70		
	≥11	21	68.74		
	Total	115			
Learning Support	None	25	42.22	12.114	.017*
	1-3	41	56.62		
	4-6	18	66.53		
	7-10	10	53.70		
	≥11	21	74.21		
	Total	115			

Table 25 continued

Differences in Subscale Scores among Groups by Level of Prior EBM Training in Medical School

Subscale	Group	*n*	Mean Rank	χ^2	*p*
	Total	115			
Social Support	None	25	47.66	6.843	.144
	1-3	41	57.55		
	4-6	18	55.86		
	7-10	10	58.85		
	≥11	21	72.62		
	Total	115			

* p<.05.

<u>Question 7: Are there any differences among residents grouped by level of prior EBM training during residency in reference to scores on the EBM Environment Scale?</u>

Question 7 examines if there were any differences on perception scores and levels of prior EBM training during residency. Residents were grouped by their reported level of prior EBM training during residency. As Table 26 shows, out of 113 valid responses analyzed for this research question, 20 of them (17.7%) reported that they had no EBM training during residency, while 93 (84.3%) respondents reported prior training of some levels from 1-3 to ≥11. The two groups with prior EBM training in the levels of 7-10 and ≥11 had higher mean scores: level of 7-10, *M* = 4.25, *Mdn* = 4.21, *SD* =0.47; level of ≥11, *M* = 4.12, *Mdn* = 4.14, *SD* = 0.34. The results suggest that those who had more EBM training during residency ranked the EBM Environment higher than those who reported less or no prior EBM training.

Table 26

Summary of Means, Medians, and Standard Deviations for Scores by Level of Prior EBM Training during Residency

Group	*M*	*Mdn*	*SD*	*n*	% of Total n
None	3.69	3.67	.41	20	20 (17.7%)
1-3	3.82	3.92	.49	51	51 (45.1%)
4-6	3.84	3.91	.46	19	19 (16.8%)
7-10	4.25	4.21	.47	8	8 (7.1%)
≥11	4.12	4.14	.34	15	15 (13.3%)
Total	3.87	3.94	.47	113	100.0%

The Kruskal-Wallis test was also used to determine if there were any significant differences among the groups on the overall scale score. The results of the Kruskal-Wallis test in Table 27 show statistically significant differences in scores among groups by level of prior EBM training during residency, χ^2 (4, N = 113) = 13.220, p = .010. The mean ranks ranged from 43.10 for the group with no EBM training to 83.69 for the group with prior EBM training at the level of 7-10. Those who reported to have prior EBM training with the level of 11 or more had the second highest mean rank of 73.60.

Table 27

Mean Ranks Distribution of Scores by Level of Prior EBM Training during Residency

EBM Training during Residency	*n*	Mean Rank
None	20	43.10
1-3	51	54.21
4-6	19	54.79
7-10	8	83.69
≥11	15	73.60
Total	113	

With the Kruskal-Wallis test, statistically significant differences were found on two subscales (Table 28). These subscales were learner role, χ^2 (4, N = 113) = 20.081, p < .001 and learning support, χ^2 (4, N = 113) = 9.644, *p* = .047. Table 28 shows the mean ranks attributed by each group for the seven subscales. There was a moderate difference among groups on the utility and accountability subscale (*p* = .051).

Table 28

Differences in Scores among Groups by Level of Prior EBM Training during Residency

Subscales	Group	N	Mean Rank	χ^2	*p*
Situational Cues	None	20	50.23	7.752	.101
	1-3	51	53.57		
	4-6	19	54.05		
	7-10	8	80.81		
	≥11	15	68.73		
	Total	113			
Learning Role	None	20	37.80	20.081	.000*
	1-3	51	50.96		
	4-6	19	70.11		
	7-10	8	81.75		
	≥11	15	73.33		
	Total	113			
Utility and Accountability	None	20	45.70	9.439	.051
	1-3	51	59.54		
	4-6	19	47.79		
	7-10	8	82.50		
	≥11	15	61.50		
	Total	113			
Learning Culture	None	20	53.20	4.401	.354
	1-3	51	55.18		
	4-6	19	51.71		
	7-10	8	62.94		
	≥11	15	71.80		
	Total	113			

Table 28 continued

Differences in Scores among Groups by Level of Prior EBM Training during Residency

Subscales	Group	*n*	Mean Rank	χ^2	*p*
Resource Availability	None	20	55.33	4.046	.400
	1-3	51	56.20		
	4-6	19	49.45		
	7-10	8	75.19		
	≥11	15	61.83		
	Total	113			
Learning Support	None	20	41.65	9.644	.047*
	1-3	51	55.19		
	4-6	19	59.82		
	7-10	8	71.31		
	≥11	15	72.43		
	Total	113			
Social Support	None	20	55.55	4.294	.368
	1-3	51	53.47		
	4-6	19	53.21		
	7-10	8	70.50		
	≥11	15	68.53		
	Total	113			

* $p<.05$.

Research Question 8: How well does level of residency training predict scores on the EBM Environment Scale?

Bivariate linear regression was used to determine whether any of the three independent variables (predictors), year in residency training (level of residency training), prior EBM training in medical school, and prior EBM training during residency predicted scores of the EBM Environment Scale (criterion variables).

Level of residency training was a categorical variable (independent), called PGY, which had three values. They were converted to a set of dichotomous variables by dummy variable coding with 1s and 0s. The value 0 indicates that the respondent was in group 1 (PGY-1), 1 indicates they were in group 2; and 2 indicates they were in group 3. The two new dummy variables were named as PGY-2 and PGY-3. Table 29 shows the possible values of the three variables.

Table 29

Dummy Coded Variables for Levels of Residency Training

PGY_1	PGY_2	PGY_3
0	0	0
1	1	0
2	0	1

The correlational indices used to report strength of relationship is the Pearson product-moment correlation coefficient (*r*) that ranges from -1 to 1. Although the interpretation of strength of relationship should depend on the research context, correlation coefficients of .10, .30, and .50, regardless the correlation direction, are interpreted as small, medium, and large coefficients, respectively (Green & Salkind, 2008). The results of bivariate linear regression analysis are shown in Table 30. The variable, level of residency training, had a small correlation with scores of the EBM Environment Scale, $R = .148$, $R^2 = .022$, $F(2, 116) = 1.296$, $p = .278$.

Table 30

Predication by Level of Residency Training of the EBM Environment Scale Scores

Group	B	Std. Error	Beta	*t*	*P*
PGY_2	-.012	.128	-.010	-.097	.923
PGY_3	.173	.122	.144	1.422	.158

Note: $R = .148$, $R^2 = .022$, $F(2, 116) = 1.296$, $p = .278$.

<u>Research Question 9: How well does level of prior EBM training in medical School predict scores on the EBM Environment Scale?</u>

Using the same approach described in question 9, four dummy variables were created for the categorical variable prior EBM training in medical school: EBMMED.1_3, EBMMED.4_6, EBMMED.7_10, EBMMED.11_More. Table 30 shows that the regression equation with two strength predictors was moderately correlated with scores of the EBM Environment Scale, R = .337, R^2 = .114, F(4, 114) = 3.522, p = .010 (Table 31). The results suggested a moderate substantive association between level of EBM training in medical school and perception scores. That is, more prior EBM training experience in medical school (training levels of 4-6 or ≥11) was associated with higher perception scores.

Table 31

Predication by Level of Prior EBM Training in Medical School of the EBM Environment Scale Scores

Group	B	Std. Error	Beta	*t*	*p*
EBMMED.1_3	.248	.140	.208	1.775	.079
EBMMED.4_6	.517	.170	.329	3.043	.003
EBMMED.7_10	.161	.206	.079	.781	.436
EBMMED.11_More	.509	.163	.344	3.128	.002

Note. R = .337, R^2 = .114, F(4, 114) = 3.522, p = .010.

<u>Research Question 10: How well does level of prior EBM training during residency predict scores on the EBM Environment Scale?</u>

Using the same approach, four dummy variables were created respectively for the categorical variable of prior EBM training during residency, EBMRES.1_3, EBMRES.4_6, EBMRES.7_10, EBMRES.11_More. As shown in Table 32, level of prior EBM training during residency accounted for a significant amount of variability on scores of the EBM Environment Scale. The results indicate that the regression equation with two strength predictors was significantly correlated to scores of the EBM Environment: R = .336, R^2 = .113, F(4, 113) = 3.439, p = .011. The results indicate a moderate substantive association between level of prior EBM training during residency and perceptions scores. In other words, high perceptions scores were predicted by high levels of prior EBM training experience during residency.

Table 32

Predication by Level of Prior EBM Training during Residency of the EBM Environment Scale Scores

Group	B	Std. Error	Beta	t	p
EBMRES.1_3	.124	.121	.132	1.024	.308
EBMRES.4_6	.148	.147	.118	1.010	.315
EBMRES.7_10	.554	.190	.303	2.908	.004
EBMRES.11_More	.424	.156	.307	2.717	.008

Note. R = .336, R^2 = .113, F(4, 113) = 3.439, p = .011.

Summary

The EBM Environment Scale demonstrated content validity, as evidenced by the review of content experts and evaluation by a focus group of chief residents. Content validity was also quantified through the content validity index that derived from the rating of the content relevance and importance of the scale items during scale development.

The EBM Environment Survey was piloted to 262 medical residents: 127 participated in the survey; 124 valid cases were included for data analysis. The first version of the scale contained 48 items that demonstrated evidence of internal consistency with Cronbach's alpha of .943. Further item reduction and refinement of the scale resulted in a shorter version of a 36 item scale with Cronbach's alpha of .860. Cronhbach's alpha coefficients of the subscales in the scale ranged from .987 for the learning culture subscale to .620 for the social support subscale.

The EBM Environment Scale demonstrated construct validity through interitem correlations and corrected item-total correlations. Six of the subscales were significantly correlated with one another at the significant level of .05 and .01. Factor analysis verified the pre-identified structure of seven factors, which accounted for 63.57% of the variance. These factors reflected different aspects or attributes of the EBM environment: situational cues, learner role, utility and accountability, learning culture, resource availability, learning support, and social support.

The EBM Environment Scale was further validated by evaluating differences in scores among residents grouped by gender, country of medical school attended, level of residency training, residency program affiliation, level of prior EBM training in medical school, and prior EBM training during residency. The Kruskal-Wallis test indicated statistically significant differences ($p<.05$) on environment perception scores on the scale as a whole and subscales among groups identified by residency program affiliation, level of prior EBM training in medical school, and level of prior EBM training during residency. The following chapter provides a discussion of the findings and implications for instructional designers, performance improvement professional, EBM teachers, and health information professionals. Recommendations for further research and conclusions are presented as well.

CHAPTER 5

DISCUSSION

Chapter 5 discusses the research findings in reference to reliability and validity of the EBM Environment Scale, as well as results in relation to the research questions. Implications and recommendations for future research are also presented.

Overview

EBM training has become a component of training of many residency programs in this country as EBM skills and competency are part of practice-based learning and improvement requirements mandated by ACGME (Accreditation Council of Graduate Medical Education, 2007). However, most EBM training interventions or programs may not be able to achieve the optimal learning outcomes since various contextual factors are often overlooked when EBM training is being designed, developed, and provided to residents. Concerning the influence of context, Richey (1992) suggests that the context of instruction should be considered as an important variable cluster for those who design instruction. Suchman (as cited in Streibel, 1991) asserts that "human learning is phenomenologically and contextually bound" (p. 548). In a study to investigate barriers residents faced in practicing EBM, Green and Ruff (2005) concluded,

> While increased informatics training and reliable, rapid, and point-of-care access to electronic information resources remain necessary, they are not sufficient to help residents EBM. Educators must also attend to their attitudes toward learning and to the influence of programmatic and institutional cultures (p. 182).

Effective training involved the application of "a three-pronged approach: fostering attitudes, developing and practicing skills, and promoting understanding of the concepts and models behind the subject" (Silberman & Auerbach, 2006, p. 15). Residents' attitude towards evidence-based practice is one of multiple components or domains of EBM training, and it is one of the important criteria to evaluate learning outcomes in addition to skills and knowledge

(Green, 2000a; Shaneyfelt, et al., 2006). Assessing attitudes toward evidence-based practice (EBP) may unearth some “hidden but potentially remediable barriers to trainees’ EBP skill development and performance” (Shaneyfelt, et al., 2006, p. 1124). On the other hand, the “institutional cultures” are conceptually identical with contextual factors such as social support, learning support, and learning cultures at the workplace. Clearly, it is necessary to design an instrument which can be used to measure residents’ attitude and to identify and assesspossible contextual factors that may present barriers to residents’ learning and integration of evidence-based medicine into their clinical experiences.

The purpose of the study was to develop and provide initial validation for the new scale, the EBM Environment Scale, in response to the identified gap in instruments that can be used to assess residents’ attitude (Shaneyfelt, et al., 2006) and to analyze the environment to identify any facilitative and restraining factors affecting residents’ EBM learning and practice in a health care setting. It was the first study to specifically explore the contextual factors associated with EBM learning and practice.

Content Validity

In appraising 104 instruments used to evaluate EBM learning and evidence-based practice (EBP), Shaneyfeld and associates (2006) found that most instruments focused on measuring EBM knowledge and EBP skills. Among these instruments, at least 1 type of validity evidence was demonstrated for 53% of instruments and three or more types of validity evidence were established for 10% of the instruments. Although several instruments included a few attitude items, few instruments assess the attitude domain of EBM learning in depth. None of instruments evaluated met the quality criteria for establishment of validity.

The EBM Environment Scale development process followed the recommended scale development procedures that comprised several phases/steps (DeVellis, 2003; Netemeyer, et al., 2003; Spector, 1992). The process began with the identification of the content domain specifically related to the EBM environment based on the conceptual model of contextual analysis (Tessmer & Richey, 1997). Following the content domain identification was the generation of 158 potential scale items and multiple judging efforts by seven experts and a focus group of 10 chief residents. Judgments of content validity were qualified using scaling procedures and quantified with the content validity index (CVI) as an objective criterion to evaluate items in the content validity evaluation of scale items (Grant & Davis, 1997; Lynn, 1986; Rubio, et al., 2003). The content validation analysis led to the first version of the EBM Environment Scale with 48 items grouped under seven subscales. A survey that contained the 48 scale items and seven demographic questions was piloted to a convenience sample of residents recruited from six residency programs at multiple training sites. A total number of 127 surveys were returned and preliminary data on 124 valid cases were analyzed for internal consistency estimates of reliability and initial estimates of validity.

Reliability Estimates

Cronbach's alpha was used to measure the degree of interrelatedness among a set of items created to measure a single phenomenon—the environment. Initial reliability analysis resulted in Cronbach's alpha of .943, suggesting that the scale had high internal consistency and measured an underlying construct. Another form of internal consistency, split-half reliability, was also analyzed to examine the correlations between scores on two equal halves of the scale. The correlation between forms (.919) and Spearman-Brown split-half reliability coefficient (.958) equally provided evidence of the scale's internal consistency. However, it should be pointed out that the initial Cronbach's alpha was low for two subscales learner role (.454) and social support (.359). It became clear that further item analysis was needed to examine how items in these subscales contributed to the reliability of the subscales. Items with poor performance should be removed from the subscales. Furthermore, the 48 item scale could be trimmed further to present a short version for participants to complete in further validation studies. As DeVellis (2003) suggests, one should consider shortening an instrument when Cronbach's alpha is much above .90. Therefore, further factor analysis and an iterative process of item analysis with corrected item-to-total correlations were performed to trim and refine the scale and evaluate the appropriateness of items in each subscale.

The process resulted in the third version of the scale—a shorter version with 36 items. The revised scale demonstrated an adequate internal consistency with an alpha reliability coefficient of .86. As DeVellis (2003) points out, "A scale with an alpha of .85 is probably perfectly adequate for use in a study comparing groups with respect to the construct being measured" (p. 96). Item reduction and factor analysis also enhanced the reliability coefficients for the subscales, which ranged from .62 for social support to .99 for learning culture.

An analysis of Pearson product-moment correlations indicates that six of the seven subscales were statistically significantly correlated with one another at the significant level of .05 and .01. The small to large intercorrelations (r =.187 to r =.630) suggest that the constructs underlying the subscales were conceptualized as being related to one another but also distinct measures of different factors that contributed to the overall EBM environment. It should be noted that learning culture had a very high coefficient alpha (.98) as a subscale. However it was only slightly correlated with situational cues (r = .187, p<.05) and learner role (r = .160). Further research with a larger sample is needed to examine the appropriateness of the subscale items and how the subscale items could be developed or revised to tap the particular attribute of the EBM environment.

Evidently, the EMB Environment Scale as a whole and its seven subscales each by itself were shown to be statistically reliable with an adequate to high reliability coefficient in the pilot study. The principal component factor analysis confirmed the internal structure of the scale.

Subscales of the EBM Environment Scale

The scale measured the EBM Environment along seven dimensions that formed seven subscales including learner role, utility and accountability, resource availability, social support, learning support, situational cues, and learning culture. Each subscale comprised a number of items gauging contextual factors that conceptually represented different aspects of the overall EBM environment. The aspects represented by the subscales can mean what Genn and Harden (1986) refer to as "sub-environments" that constitute the environment for residents' EBM learning and practice.

The following section discusses results of internal consistency and item analysis in relation to the factors assessed by subscale items.

Situational Cues. The first factor *situational cues* refers to the extent to which trainees are cued on how to perform in their learning and workplace environment. The cues serve as a reminder for learners to apply new knowledge and utilize learned skills in their transfer behaviors. The situational cues can be translated as clear guides and relevant feedback within the framework of a human performance model (Van Tiem, et al., 2004). They are external to learners and are considered as part of contextual factors associated with transfer context (Tessmer & Richey, 1997). Research shows that timely performance feedback is one of important environment factors predicting the performance of health care providers (Crigler, Fort, Diez, Gearon, & Gyuzalyan, 2006). Regarding role-modeling, Taylor and Holten state, "Modeling an evidence-based approach to practicing medicine fosters the critical appraisal of personal assumptions as well as the framing and testing of good clinical questions that ultimately guide practice" (1999, para. 3).

The situational cues subscale consisted 10 items that reflected feedback, role-modeling, encouragement, prompts, peers and attending physicians' support. Item analysis showed evidence of very good internal consistency with Cronbach's alpha of .882. Corrected item-total correlations (correlation of an item and all subscale items, excluding itself) ranged from .672 to .989. The subscale accounted for 29.99% of the largest proportion of the variance in the total scale when the EBM Environment Scale was factor analyzed. Item mean scores ranged from 3.15 for item 11 to 4.27 for item 33. The overall mean score of 3.83 for the subscale showed that the perceptions of the sub-environment were not on the more favorable end, which could suggest that there was room for improving the situation cues to promote residents' learning and adoption of EBM. As Van Tiem et al. (2004) point out, to improve the environment with respect to situational cues, proper personal development interventions such as feedback and role-modeling should be made available. Such interventions can help residents overcome certain obstacles in applying EBM knowledge and skills in the process of evidence-base practice.

Learner Role. The factor *learner role* is defined as a dimension measuring perceptions of trainees' goal setting, role clarity, and expectations regarding EBM training. Based on the contextual analysis model, it is a learner factor viewed as part of contextual factors that contribute to successful instruction (Tessmer & Richey, 1997). For learners, active goal setting can be an important source of motivation for learning (Bandura, 1977). "When individuals set goals, they determine an external standard to which they will internally evaluate their present level of performance" (Driscoll, 2005, p. 314).

The learner role subscale contained 6 items that reflected trainees' perception of expectations, learning goals, learning role in the learning process, and task perception. As a dimension of the EBM Environment Scale, the subscale highlighted an aspect of the multifaceted environment for residents' EBM learning and practice. The subscale demonstrated evidence of very good internal consistency (Cronbach α = .805). Item-scale correlations for the subscale items ranged from .446 to .733. Item mean scores ranged from 3.12 for item 45 to 3.75 for item 48. Compared with other subscales, the subscale had the lowest mean score for a subscale (M = 3.42).

In his classic writing "Good-Bye, Teacher…", Fred S. Keller (1968) pictured what an individualized instruction would be like. Among other characteristics of such instruction, there was the "minimizing of the lecture as a teaching device and the maximizing of student participation" (p. 184). Frank Finger (1962) considered the teacher's principal job as "the facilitation of learning in others" (as cited in Keller, 1968). One of the strategies for stimulating motivation for learning in John M. Keller's (1983) model of motivational design is building confidence by providing learners with a reasonable degree of control over their own learning. Currently, faculty-led lectures on EBM topics tend to be the dominating method of delivering EBM-training. Residents as trainees play the minimum role in the process of design, development, and implementation of any EBM training. Little attention is paid to the learner role that should be regarded as an important variable for effective EBM training. The low score on the subscale indicates that respondents had less agreement about their role as clinical learners or it may imply that they were not clear about their learner role and expectations. Residents' perceived learner role as rated low by respondents in the survey could lead to the presupposition that any EBM training intervention would less likely result in the best return of investment.

In teaching adult learners, the learner role is linked with the motivation for learning and the ultimate learning outcome. According to Knowles' adult learning theory, adult learners have a need to know why they should learn something and they have the desire to be self-directed (Knowles, 1996). As Harris and Bell (1990) state, the roles that learners play determine what they learn, how they learn, and what role they expect the instructor to play (as cited in Tessmer & Richey, 1997). To maximize EBM training outcomes, the adult learner role for residents should be made explicit and clarified. They should have clear expectations, given the level and quantity of EBM training provided. They should also be encouraged to set realistic personal learning goals and to play an active role in the whole learning process. In designing EBM training, medical educators need to consider the active role that trainees can play in the learning process.

Utility and Accountability. The *utility and accountability* subscale as a dimension of the environment for EBM learning and practice refers to the learner' perceptions of usefulness, relevancy, and value of EBM training. It is the learner context that has been demonstrably associated with learning transfer (Noe, 1986). The learner needs to have the motivation to utilize the learned capabilities. The motivation is in part determined by the learners' belief that the learning can be applied in relevant transfer situations, and that its application is worthwhile (Noe, 1986; Tessmer & Richey, 1997). When learners have high levels of perceptions of utility of instruction, what they are to learn becomes more relevant to their personal goals. As Keller (1983) asserts, relevancy is one of the key components for stimulating motivation in learning. Along with perceived utility, perceived accountability "determines learners' impressions of whether it really matters if they attend to the anticipated education or training program" (Tessmer & Richey, 1997, p. 94). In instructional design of training programs, perceived utility and accountability can be cultivated to increase the likelihood of learning and transfer (Tessmer & Richey, 1997).

The subscale utility and accountability contained 6 items that emphasized trainees' perceptions of how the implementation and application of anticipated EBM training can enhance their ability to provide quality patient care. The reliability analysis yielded an acceptable reliability coefficient (Cronbach α = 0.792). Item-scale correlation for each item ranged from .415 to .621. Item mean scores ranged from 4.03 for item 1 to 4.53 for item 21. The mean score for the subscale was 4.33, the highest among all the subscales. The results suggest that respondents tended to agree or strongly agree with the value and utility of EBM training. High levels of perception scores on utility and accountability about EBM training could also indicate that the respondents had the motivation to learn and practice EBM and agreed that EBM skills were useful in providing quality patient care. However, as the low mean scores for learner role and learning support indicate, the participants may be less clear about their role as clinical learners in the learning process, and there may not be adequate learning support for their EBM learning and practice. Therefore, in designing and providing EBM training, it is important to ensure that residents' perceived utility and accountability about EBM training match their expected learner role and support available for their learning.

Learning Culture. The factor *Learning Culture* is defined as a shared belief that there is a strong support for the goal of learning and practicing EBM. As an organizational factor, it provides the "orienting context" (Tessmer & Richey, 1997) to support the transfer of the learning and work environment behaviors, and it sends a message that learning and practice of EBM is encouraged. The factor is a component or variable of the environment that can impact on EBM learning and implementation. The subscale included 3 items that emphasized trainees' belief that EBM adoption and integration into clinical practice are accepted as a routine practice of patient care at the organizational level. The subscale demonstrated very satisfactory internal item consistency (Cronbach's α = .987). The item-scale correlations were between .961 to .982. The item mean score was 3.89 for item 29, 4.23 for item 35, and 4.35 for item 24. The average score for the subscale was 4.15. The results suggest that respondents tended to agree or strongly agree with the item statements in the subscale.

Resource Availability. *Resource availability* is a contextual factor in the environment for EBM learning and practice. It is defined as beliefs, awareness, and perceptions that clinical information resources exist and are readily available and accessible whenever needed. One of the steps in evidence-based practice is to identify clinical information resources and locate the current best evidence relevant and specific to patient care (Sackett, et al., 2000). As Tessmer and Harris (1992) point out, learners who are not knowledgeable about the existence of available resources may not be motivated to apply their learned skills.

As a significant dimension of the environment, the resource availability subscale contained three items that focused on the availability and accessibility of evidence-based information resources. Item analysis showed an adequate level of internal consistency for the subscale (Cronbach's α = 746) and item-scale correlations ranged from .472 to .665. The item mean was 4.33 for item 5, 4.02 for item 14, and 4.12 for item 10. The mean score was 4.15 for the subscale. The results indicate that respondents were likely to agree or strongly agree that evidence-based information resources were accessible and available in their practice environment.

Residents' awareness and perceptions of the existing EBM clinical information resources can affect their subsequent steps of evidence-based practice: critically appraising the evidence and applying it to patient care. As Green and Huff's (2005) study on barriers facing residents in asking clinical questions indicates, lack of awareness and limited access to clinical information resources posted barriers for residents in taking the series of steps involving in learning and practicing EBM. Evidently, awareness and access to online information resources at the point of care are essential in integration of evidence-based practice into patient care. For that reason, it is important for EBM faculty and health information professionals to forge alliance in identifying information needs and making information resources readily available and easily accessible to residents and other health care professionals.

Learning Support. *Learning Support* is a characteristic of the immediate instructional context at the organizational level. Learning support for medical residents can include such elements as time allowance, learning assistance provided by faculty, support from the nursing staff, etc. The learning support factor can facilitate or hinder both instructor and learner behavior in the instructional context level (Tessmer & Richey, 1997). In the EBM Environment Scale, the factor consisted of 5 items that reflected protected educational time for residents to participate in EBM training, faculty assistance and support through their involvement in EBM training as facilitators and collaborators, and the support from nurses and hospital staff. The support from nurses and other hospital staff may help release a certain level of residents' workload pressure while they attend EBM training.

The learning support subscale demonstrated evidence of internal consistency (Cronbach's α = .730). Corrected item-total correlations ranged from .337 to .660. Item mean scores ranged from 3.20 for item 25 to 3.80 for item 13. The average item score for the subscale was 3.54. The low item score may be an indication that learning support was insufficient or unavailable for residents in the process of EBM learning and practice. The finding seems to be in agreement with the results of a number of studies indicating the limited time allowance for residents' individual learning (Green & Ruff, 2005; Hoff, et al., 2004) and lack of faculty who were trained to teach the EBM process (Bhandari, et al., 2003). As workload pressure (Yew & Reid, 2008) and time constraints (Green, 2000a) were attributable to major barriers to practicing EBM, changes in residents' work schedule and immediate training environment should be made to improve their learning outcomes.

Social Support. As a dimension in the EBM Environment Scale, *social support* is defined as a factor of how trainees felt accepted, recognized, and valued (Rotem, Godwin, & Du, 1995) or supported as members of the team by their peers, attending physicians, hospital staff, or any social contacts who form the immediate environment and who can also provide "cues" about training. Being social in nature, the environment serves as an orienting context for trainees. A favorable environment is where the social contacts support a given type of behavior. The social support factor can shape pre-instructional attitudes toward training and also influence the transfer of training (Tessmer & Richey, 1997).

The subscale for social support contained 3 items that reflected clinical team work, atmosphere of mutual respect, and commitment to life-long learning. The internal consistency estimates of reliability for the subscale was low compared with that of other subscales (Cronbach's $\alpha = .620$). Corrected item-total correlations for the subscale items ranged from .400 to .455. Netemeyer and colleagues (2003) suggest that items with low correlations (< .50) become candidates for deletion. However, component principal analysis demonstrated that the factor loadings for the three items were .753, .536, .395 respectively. Clearly, the loadings exceeded the criteria for the minimum loading size (.35), a decision rule set up for item retention in the study. The item mean was 4.23 for item 43, 4.17 for item 18, and 4.12 for item 34. The average score of 4.17 for the subscale suggests that the perceived social support for learning was adequate in the respondents' environment.

In a workplace or in the process of EBM learning and practice, the contextual factors discussed above could present as facilitative factors or barriers that exert a certain level of influence on residents' EBM learning process and transfer of acquired EBM knowledge and skills as well as their attitude formation and training motivation (Table 33). As the results of the study indicate, these factors could interact with one another and with some of learner characteristic or variables. To improve residents' outcome-based performance in practicing EBM, there need to be conditions present within the residency setting to maintain the learning-oriented culture (Hoff, et al., 2004). These conditions need to be in place to bring out the optimal learning outcomes.

Table 33

Steps of EBM Process and Influences of Contextual Factors

<table>
<tr><th>Contextual Factors →</th><th>EBM Process</th><th>Steps of EBM Process</th><th>Contextual Factors ←</th></tr>
<tr><td rowspan="5">Learner Role
Utility and Accountability
Social Support
Learning Culture</td><td>Ask</td><td>Define and formulate a focused clinical question</td><td>Learning Support
Situational Cues</td></tr>
<tr><td>Acquire</td><td>Select appropriate EBM resources and search for the best evidence</td><td>Learning Support
Resource Availability</td></tr>
<tr><td>Appraise</td><td>Appraise the evidence critically</td><td>Learning Support</td></tr>
<tr><td>Apply</td><td>Return to the patient and apply the evidence</td><td>Learning Support
Situational Cues</td></tr>
<tr><td>Assess</td><td>Evaluate outcomes</td><td>Learning Support
Situational Cues</td></tr>
</table>

Clearly, it is of importance to examine these factors and to identify ways to assess and analyze the factors as they interact to form the conditions for EBM learning and practice. Any deficient condition identified could become the target area for change and improvement before investment is made into designing and providing EBM training programs.

Criterion-Related Validity of the EBM Environment Scale

Validation research was conducted to further test the validity of the scale by examining the relationship between scores of the scale/subscales and learner characteristic variables. These variables identified participants as groups by gender, country of medical school attended, level of residency training, affiliated residency program, and previous EBM training in medical school and during residency. Stern (1970) pointed out that characteristics of the study body are demonstrably important correlates of climate in educational environments. According to Seels and Richey (1994), "learner characteristics are those facets of the learner's experiential background that impact the effectiveness of a learning process" (p. 32). As learner characteristics interact with the situation/context and content (Richey, 1992), the process of developing and validating the contextual analysis tool of the EBM Environment Scale cannot be separated from the assessment of these important variables about learners. The following section focuses on the discussion of the findings related to research questions to investigate the relationship between environment perception scores and learner variables.

Gender. The results of the study show that there were no significant differences between female and male residents on the scores of the EBM Environment Scale as a whole. The finding suggests that the scale was not sensitive in discriminating resident groups by gender. It is in agreement with what Cassar (2004) found in his validation study indicating there were no significant differences between male and female residents on scores of an instrument to measure the surgical operating theatre learning environment as perceived by basic surgical trainees.

However, there were significant differences on the average mean score of the perceptions of the resource availability subscale and two scale items, “I have clear goals for learning EBM,” and “My patient care workload is overwhelming.” The results indicate that male and female residents perceived resource availability differently. Male residents were likely to agree that they had clear goals for learning EBM, while more female residents tended to agree that their patient care workload was overwhelming. The gender difference could suggest that female and male residents had different perceptions of their workload. The different perceptions could potentially influence residents’ participation in EBM training and practice in patient care settings.

In a study on assessing the educational environment in the operating room, Kanashiro, McAleer, and Roff (2006) found that there was a significant difference in the perceived educational environment between female and male residents. Female residents perceived their environment less favorably and they perceived fewer learning opportunities in their educational experience in the operating room. In another study of evidence-based practice knowledge and skills, significant differences were found between male and female residents on the scores of a test of biostatistics and interpretation of research results (Windish, Huot, & Green, 2007). Roff et al. (1997) also found that statistically significant differences existed between male and female faculty and medical student respondents on mean scores of a number of scale items in an education environment study. Research shows that significant differences existed in the practice style behaviors between female and male doctors as indicated by female physicians providing more preventive services and psychosocial counseling (Bertakis, 2009) or quality of care to patients with type 2 diabetes (Berthold, Gouni-Berthold, Bestehorn, Bohm, & Krone, 2008).

Thus, gender can be a great variable to affect perceptions of the EBM environment. With respect to EBM learning and practice, further study is needed to investigate how different female and male residents perceive their environment for learning and practicing EBM so that training strategies could be designed and implemented for bringing out the most knowledge and skill gain in residents of both genders.

Country of Medical School Attended. More than 50% of international residents participated in the survey (64.1%). Although there was a difference on the scores of the entire scale between the two groups, the Mann-Whitney test did not reveal any statistically significant difference between the two groups. However, statistically significant differences emerged in their perceptions of social support and learning culture. The international residents scored significantly lower on the subscale of learning culture than the U.S. residents. Previous research also provides evidence that international residents had little training in EBM before residency (Al-Almaie & Al-Baghli, 2004; Allan, Manca, Szafran, & Korownyk, 2007). A study conducted in a non-western country found that undergraduate medical students had significant barriers to evidence-based medicine practice such as negative faculty attitudes toward EBM use at the point of care and lack of encouragement from faculty (Lam, Fielding, Johnston, Tin, & Leung, 2004). Lack of understanding of the EBM process and exposure to EBM training may account for international residents' unfavorable perceptions of support for EBM learning and learning culture in the EBM environment.

The results of several studies indicate that different medical training background was associated with evidence-based care that patients received from physicians who graduated from a U.S. medical school and those graduating from a medical school in another country (Pham, Schrag, Hargraves, & Bach, 2005). Further research is needed to determine if it should be a concern for residency programs to design and develop training tailored to the needs of international residents who comprise a large size of resident population in residency programs in this country.

Level of Residency Training. Level of training was analyzed by grouping residents into three groups based on three levels of residency training: PGY-1, PGY-2, and PGY-3. The mean scores for the three groups ranged from 3.84 to 4.01. Although there were differences in scores among the groups, i.e., the mean score for PGY-3 was higher than the other two groups, differences among the three groups were not statistically significant. The results also show no statistically significant difference on scores of the seven subscales among the groups. The finding indicates that there was not much disagreement among residents grouped by level of residency training regarding their perceptions of their EBM environment. Thus, the scale was not sensitive to detecting differences among groups by level of residency training. The finding is consistent with a study conducted by Kanashiro and associates (2006) who examined the perceptions of general surgery residents regarding the educational environment in the operating room. In their study, participants were grouped into junior residents and senior residents for comparing any difference in perceptions of the environment. The comparison of the scores on the scale as a whole or on subscales did not indicate any significant differences between the two groups in their perception of the operating educational environment.

However, an interesting finding through the EBM Environment Survey was revealed when differences on individual items were compared among the three groups. The three groups differed statistically significantly on one item, #31, "My attending physician provides me with clear feedback on my EBM practice." Senior residents had the highest mean rank (71.09) than intern residents (56.95) and junior residents (48.09). The finding may suggest that senior residents were likely to receive clear feedback as they may have more time allowance to practice EBM in patient care settings and that junior residents tended to receive less feedback since they were no longer interns who needed more feedback on evidence-based practice. More research with a larger sample across programs is needed to confirm the findings regarding differences among residents of different training levels in reference to the environment perception.

Residency Program. According to Stern (1956), two levels of analysis of the environment can be conducted: the idiosyncratic or private view that each person has of the environment, and the shared or consensual view that members of a group hold about the environment. In designing classroom environment study, researchers must decide whether analyses involves perception scores obtained from members as individuals or as a group (Fraser, 1991). The development and validation of the EBM Environment Scale emphasized the analysis of combined perception scores from medical residents as groups to obtain “the average of the environment scores” of all participants in groups.

In medical education research, climate has been studied mainly following three lines of research involving: 1) a measurement of climate to find what its nature is; 2) the detection and description of differences in climate between or among educational environments of interest; and 3) the examination of climate as a dependent (criterion) or independent (predictor) variable (Genn & Harden, 1986). Of particular interest in the study was the desire to identify any significant differences among residency programs on the environment perception scores. It was assumed that the EBM Environment Scale had the ability to discriminate residency programs at different training sites that were characterized by multifaceted contextual factors.

The results of the Kruskal-Wallis test show that there were statistically significant differences on perception scores among programs on the entire scale and subscales. Participants in Program F had the highest mean rank (82.25) on the scale as a whole and on five subscales including situational cues, learner role, learning culture, learning support, and social support. Their EBM environment seemed to be more conducive to residents' learning and practice of EBM. The results also show that participants in Program D had the highest rank mean on the two subscales, utility and accountability, and resource availability, suggesting that participants in Program D tended to view the two aspects of their environment more favorably.

In a study assessing the physician and staff perceptions of the learning environment in ambulatory residency clinics, Roth and colleagues (2006) found that the learning environment at two training sites differed significantly. The finding from the EBM Environment Scale validation study provides further evidence that the EBM Environment Scale could be used to compare and contrast programs of interest. The comparative information can be of much potential interest and value to EBM faculty who would like to understand and improve the quality of the environment for residents' learning and practice of EBM.

Prior EBM Training. The success of a training intervention is closely related to key demographic characteristics and previous educational experience (Tessmer & Richey, 1997). Two demographic questions were included in the EBM Environment Scale to tap the learner factor with respect to their previous EBM training experience in medical school and during residency. Driscoll (2005) states that learning what is new depends to a large extent on what has been learned before. The learner's prior experience is the resource for learning; therefore, the "core methodology of adult education is the analysis of experience" (Knowles, Holton, & Swanson, 2005, p. 45). As adult clinical learners, residents' previous training background in EBM may exist in different volume and quality. The information on residents' prior EBM training could contribute to understanding of "learner profile" and "experiential background" that are two learner factors in the orienting context. The type of context "shapes learner motivation and one's cognitive preparation to learn" (Tessmer & Richey, 1997, p. 92).

Part of the validation research in the study involved the exploration of relationships between residents' prior EBM training and how they perceived the environment for their EBM learning and practice. Statistically significant differences were found between groups identified by prior EBM training level in medical school and during residency. The findings indicate that there was a very clear trend of higher scores on the EBM Environment Scale for those residents who reported to have high levels of previous EBM training in medical school or during residency. In other words, residents with a higher level of previous EBM training tended to perceive their EBM environment more favorably.

An interesting finding was that higher levels of previous EBM training in medical school and during residency were both related with higher mean ranks on the same subscales learner role and learning support. The results could be an indication that residents with more EBM training may have better awareness and understanding of their learner role. They may become clear about their learning goal and expectations regarding their EBM learning and practice. As a result, they may have better awareness of their existing EBM training component and make better judgment of adequacy of time for the training. In terms of learning support, the results may be an indication that residents with more previous EBM training began to utilize more of the support they needed for learning as their knowledge and skills in EBM grew. They may develop a better relationship and interaction with their attending physicians, peers, nurses, and hospital staff.

Furthermore, bivariate linear regression analyses were conducted to evaluate how well the three predictor variables, level of residency training, level of prior EBM training in medical school, and level of prior EBM training during residency, could predict the criterion variable--scores on the EBM Environment Scale. The focus was to investigate the strength, size, or direction of the relationship between these variables. The results demonstrate that there was a low positive correlation between level of residency training and perception scores (r = .148), not significant at the level of .05. However, the results show a significant positive correlation between perception scores and level of prior EBM training, at the level of .05. The results suggest that level of prior EBM training in medical school (r = .337) and level of prior EBM training during residency (r = .336) were both moderately correlated with the environment perception scores. Evidently, prior EBM training in medical school and during residency was the best predictor of scores on the EBM Environment Scale.

In short, the findings regarding the relationship of prior EBM training experience with perception scores on the EBM Environment Scale provided evidence of validity of the EBM Environment Scale that may be used as a measure of associations between EBM learning outcomes and perceptions of the EBM learning environment.

Summary

The findings of the study indicate that certain learner characteristics were associated with how residents perceived their EBM learning environment. Further research with a large sample of representative population is needed to demonstrate how these characteristics as independent or predictor variables are related to the environment perception scores. Genn and Harden (1986) thoroughly reviewed studies of climates of medical education environment. They concluded that climate is a real phenomenon and that it is worth investigating for the two reasons: it is important as an end in itself; it is essential as a means associated with educational outcomes of fundamental importance, such as learner development and achievement. In their words, “climate should only be assessed of course, if such measures have utility as guides to the improvement of educational practice" (Genn & Harden, 1986, p. 122). The findings of the study indicate that the EBM Environment Scale may have potential to be used alongside other objective measures and judgment about the quality of EBM training programs to monitor any change in learning outcomes resulted from an EBM training intervention. Further research would provide more information on the outcomes of any change following the EBM training intervention in relation to the EBM environment being as an important end as well as a means by which the ultimate EBM training goals are achieved.

Limitations

The EBM Environment Scale development process resulted in an instrument that had been piloted for testing the psychometric quality of the scale. The findings of the study are subject to several limitations inherent in this study due to its research design and several other factors. First, the survey was confined to residents in several residency programs in primary care specialties. The scale was only validated on data collected from a convenience sample of medical residents at six training sites. The sample may not represent the population for which the scale was intended. The results may not be generalizable to residents at other training sites or in other specialties. Thus, the scale requires expanded testing to increase the generalizability of findings to a larger population.

Second, the sample for the study (n=124) did meet the sample size criterion of 100-200 for initial item analysis (Spector, 1992). However, a larger sample size of 300 would be ideal for scale development and validation (Nunnally, 1978). With a small sample size, the correlations among items are potentially subject to the influence of chance factors. If the scale whose items were selected based on occasions of small samples is re-administered, the degree of the influence of chance factors may change and items that initially looked good may look different due to the chance factors. In addition, the coefficient alpha obtained on occasions other than the initial scale development may be lower than expected. With a small sample size, a potentially good and relevant item may have been eliminated because its correlation with other items was weakened simply by chance (DeVellis, 2003). Future studies with larger and more representative samples are necessary to further validate the scale and address the generalizability of the scale across residency programs and relevant population.

Third, the assessment of the EBM environment was through respondents' self-report of how the EBM environment appeared to be from their own perspective. Their perceptions and notions may not reflect the actual environment in which they were located since their self-report was subject to personal or recall bias. Their impression and memory may not accurately reflect what they experienced in their EBM learning and practice environment.

Fourth, study participation was voluntary and participants were all self-selected, which may lead to biased responses. Therefore, data collected may not adequately represent those who chose not to participate in the study. Compared with those who responded to the survey, residents who did not respond may have scored differently, which could potentially cause non response bias. Guerra (2001) points out that "collecting appropriate and sufficient non-respondent data is essential for determining whether a systematic bias has had an impact on results" (p. 118). She suggests additional measures (e.g., phone calls) taken to track non-respondents. Further research involving the use of the EBM Environment Scale could be conducted to utilize alternative techniques such as phone calls and interviews to elicit responses from non-respondents regarding their perceptions of their EBM environment.

A final limitation is that study participation involves two different modes of the survey procedure. Participants from four residency programs completed the EBM Environment Survey in the paper format while participants from two other programs submitted their responses to the survey via the Internet. The two different survey modes may raise two issues. One is that participants may give different responses to the survey of one mode as they may have preferences for the mode. Another is the different response rate resulted from different survey modes. The results of data analysis show that the response rate for the online EBM Environment Survey was lower (ranging from 19% to 43%) compared to that of the paper survey (ranging from 60% to 92%). The low response rates for the online survey might result in potential bias in responses that may not represent the overall EBM environment perceptions of the majority of residents in a residency program. In addition, the low response rate may also have an impact on the variance in scores on the scale and subscales among residents grouped by residency programs.

As more online survey tools become available and online surveys become more popular, the features, strengths, and weaknesses of different survey modes should be considered in order to identify the proper survey mode that would fit the purpose of a particular study. To deal with challenges in different survey procedures, for future studies, mixed-mode surveys may be used to compensate for the weaknesses of each survey mode (Dillman, 2000).

Implications for Instructional Designers and Performance Improvement Professionals

The results from the study have provided additional evidence to validate Tessmer and Richey's (1997) contextual analysis model that can be applied for designing on-the-job training within the context of health care settings regarding EBM learning and practice. The findings of the research have added to the knowledge base of instructional technology and performance improvement with respect to four areas:

1. The EBM Environment Scale with solid evidence of reliability and validity has potential to be used as an instrument for contextual analysis in systematic instruction design of EBM training for the specific group of adult clinical learners—medical residents (physician-in-training). It could be used as a needs assessment tool in the first phase of the performance improvement systematic process to identify gaps in results (Kaufman, 2006). These phases constitute the A^2DDIE model that comprises assessment, analysis, design, development, implementation, and evaluation (Guerra, 2003).
2. It has shown that perception scores on the scale were associated with trainees' affiliated residency program and prior EBM training experience in medical school and residency. Further testing of the scale validity would support use of the EBM Environment Scale as a summative measure of EBM learning outcomes, specifically related to attitudinal change in trainees.
3. Two subscales, learner role, utility and accountability, were intended to tap on learner characteristics related to their perceptions of goal setting, utility and accountability for training. The subscales with adequate internal reliability could provide a means to study important learner characteristics when designing effective training interventions.
4. Not all performance problems are caused by lack of knowledge and skills. Several subscales that constituted the scale were created to tap the environmental support factors related to information, instrumentation, and motivation as being delineated in Gilbert's Behavior Engineering Model (Gilbert, 1996) and at the multiple levels such as the organizational and process levels (Rummler & Brache, 1995; Van Tiem, et al., 2004).

The EBM Environment Scale has contributed to environmental analysis tools to assess performance needs at the workplace--the patient care setting for medical residents.

Molenda and Russell remarked that “the corporate training literature tends to place learning, instead of performance, at the center of the universe, ignoring the impact of the many environmental factors surrounding performance in the workplace” (2006, p. 336). It is true with the medical education literature specifically related to teaching, learning, and practicing EBM. Good training programs may not deliver the lasting effects or change behavior at the workplace if learner factors and other contextual factors are overlooked in designing instructional interventions or learning experiences. The Dick and Carey instructional design and development model provides an overall planning process for instructional interventions in various environments. The model recommends beginning instructional design with needs assessment to analyze the instructional content, the learners, the instructional context, and the context in which the skills will be applied (Dick, Carey, & Carey, 2005). Clearly, the model fits the clinical training environment where residents are expected to develop competency in practicing EBM for the quality care of patients.

With the aid of the EBM Environment Scale to be used as an needs assessment tool, instructional designers and performance improvement professionals working in the health care setting can conduct a context analysis to gather useful information in designing and providing effective EBM instructional interventions. To foster and augment the learner role in learning and practice of EBM and to improve perceptions of EBM training utility and accountability, an array of instructional performance support systems or interventions can be borrowed from the field of performance improvement and applied to designing and providing effective teaching and learning strategies. Such teaching and learning strategies would incorporate adult learning principles (Knowles, et al., 2005), consider the effect of different contextual factors, and support different types of learning modes or experiences to equip clinical learners with EBM knowledge and skills and to develop appropriate attitude towards EBM learning and practice.

"A true instructional performance support system reinforces the integration of workplace learning and performance" (Van Tiem, et al., 2004, p. 27). Several teaching and learning strategies based on the instructional performance support systems described by Van Tiem, Moseley, and Dessinger (2001) are adaptable for use in designing what Green (2000a) advocated as integrated EBM training. Extensive and detailed description and discussion of these strategies are beyond the scope of the research project. Table 34 provides a few highlights and innovative ways of applying them in designing EBM training that would help residents link workplace learning (learning EBM) with performance (applying evidence in patient care).

Table 34

Instructional Interventions to Support Residents' Development of EBM Knowledge and Skills

Interventions	**What**	**Why**	**How**
Self-directed Learning	• Design training to allow trainees to master EBM principles and knowledge individually, at their own pace of understanding, based on their developmental stage in the EBM process	• Meet diverse training needs • There is a lack of EBM faculty or trainers • Meet great need for individual development • Promote continuous learning • Individuals take charge of their own learning	• Learning depends on trainee readiness • Individual trainees select their own materials • Individual trainees set their own pace • Faculty serve as coach or mentor
Action Learning	• Learn EBM around important, real, and complex patient problems or clinical cases	• Emphasize group or collaborative learning • Emphasize learning and development of group members	• Select appropriate patient problems • Apply EBM knowledge and skills to solve problems

Table 34 continued

Instructional Interventions to Support Residents' Development of EBM Knowledge and Skills

Interventions	**What**	**Why**	**How**
Action Learning	• Focus on process and problem • Focus on inquiry and problem solving • Small group learning • Team building	• Enable learning transfer Consider group member needs	• Encourage collaborative work among group members • Seek possible solutions and take action on pressing patient problems presented to the group
Formal Training	• Provide trainees with instructional experience focusing on what they need to know and /or what they need to do to provide quality care for patients • Addresses attitudes as well as behavior	• Trainees lack the necessary skills, knowledge, or appropriate attitudes to perform evidence-base care	• Host conferences • Offer workshops and lectures • Provide integrated courses
Knowledge Capture and Management	• Capture and manage scattered knowledge within or across residency programs and departments	• Retain, share, and disseminate knowledge across residency programs • Promote access to information	• Acquire, store, and manage access to EBM resources, clinical cases, clinical questions, and critical appraisals in an online knowledge database that would assist teaching and learning EBM
eLearning	• Learning conducted via electronic media, especially the Internet • Offer an alternative to classroom instruction	• Cost-effective • Fit trainees' busy patient care or on-call schedules • Save traveling time • Meet learning needs of geographically dispersed trainees	• Use online course development, lecture capture, or web conferencing tools such as Adobe Connect, Illuminate, or Echo 360 to create training experiences for e-learning

Table 34 continued

Instructional Interventions to Support Residents' Development of EBM Knowledge and Skills

Interventions	What	Why	How
Interactive Learning Technologies	• Use a blog for critical appraisal postings resulted from journal clubs; Wiki for posting clinical cases, questions, and search strategies • Skype for individual tutorials related to EBM searching or any EBM content	• Encourage collaborative efforts • Prompt active involvement in the learning process • Learner-centered • Create an opportunity for trainees to collect electronic portfolios through electronic postings	• Choose appropriate technologies to fit the setting and learner needs • Set guidelines for online postings of cases, clinical questions, and critical appraisals • Set up clear expectations

Similarly, these interventions are applicable to designing educational events for medical students in clerkships and faculty looking for faculty development focusing on the area of teaching and practicing EBM. It is critical to establish continuity of EBM instruction from medical school to residency. Faculty development for academic and clinical faculty is the key that would promise the quantity, quality, and continuity of EBM instruction in undergraduate and graduate medical education.

Implications for Academic and Clinical Faculty Teaching EBM

The findings through the scale development and validation have offered an additional perspective to the literature on graduate medical education in relation to medical residents' learning and practice of EBM in health care settings. To the researcher's knowledge, the EBM learning environment has never been empirically defined or studied. Therefore, this study empirically introduces the EBM learning environment as a phenomenon comprising various aspects or factors that could be investigated for the purpose of facilitating EBM learning and enhancing the integration of EBM into patient care.

It is hoped that researchers, medical educators, and residency program directors would use the scale in further research on medical education and utilize the scale as an assessment tool to identify and pinpoint areas that need to be changed and improved in the environment if residents are expected to learn and practice EBM in patient care settings. Information collected through the scale could help medical educators and program directors see beyond what training can do to bring about the optimal performance outcomes in trainees. As a result, performance solutions of non-instructional intervention types could be sought to deal with what hinders residents' effective learning and adoption of EBM.

To evaluate the effect of an EBM training intervention, a gamut of instruments has been designed to evaluate residents' knowledge, skills, and attitude. However, few existing instruments assess attitudes in depth and meet the reliability and validity testing criteria. A comprehensive review of literature on EBM teaching and practice conducted by the researcher confirmed the finding in an evaluative study on instruments that measure EBM training outcomes (Shaneyfelt, et al., 2006). According to the study, there is a paucity of evaluative tools to evaluate EBM attitudes and behavioral transfer in patient care settings (Shaneyfelt, et al., 2006). Wyer, Cook, Richardson, Elbarbary, and Wilson (2008) concur with Norman's (2004) position that a comprehensive approach to evaluating effectiveness of different EBM learning and teaching is called for and requires the development of psychometrically validated evaluation tools (2004).

The EBM Environment Scale validation study was an attempt to develop and validate a measurement tool to evaluate the EBM environment perceived by residents. The EBM

Environment Scale with evidence of adequate internal consistency could be used as a component of mixed-mode data collection systems for evaluation of residents' learning outcomes or be utilized to triangulate evaluative data about EBM learning outcomes with respect to attitudinal change. For example, it may be used in prospective studies to measure residents' changed perceptions of the EBM environment as they progress throughout their training. Furthermore, it would be of interest to know how contextual factors in their EBM learning environment interact to affect their learning and learning transfer. The scale may be used as a contextual analysis tool to assess how the EBM environment and sub-environments are conducive to residents' EBM learning and practice before resources are invested in developing and implementing EBM training.

A higher level of the variable (scores on the scale) is desirable for residency programs to aim for. When contexts at certain levels measured by subscales are perceived as less favorable, it could mean they are flagged for improvement. Therefore, non-instructional interventions (e.g., performance support systems) can be designed and implemented to modify and improve the areas in the environment to enhance EBM training outcomes. These areas could refer to factors such as learning support, social support, situational cues, and resource availability that are important to consider in the systematical design, development, and implementation of an EBM curriculum or program for residents.

Implications for Health Information Professionals

Health sciences librarians as health information professionals need to acquire unique expertise and experience different from those of colleagues in other library services since they are situated within "the intellectually and technologically sophisticated context" of the rapid changing health care environment (Medical Library Associaiton, 2007). The paradigm shift in practicing medicine and the attention to evidence-based care in the current health care climate have created unique opportunities for librarians to apply their knowledge and skills as health information professionals.

The educational policy statement of the Medical Library Association (MLA) includes clear definitions of competencies for health sciences librarians to pursue in order to achieve success in the health sciences environment. The competencies include, but are not limited to:

1. Understand the health sciences and health care environment and the policies, issues and trends that impact that environment;
2. Understand the principles and practices related to providing information services to meet users' needs;
3. Have the ability to manage health information resources in a broad range of formats;
4. Understand and use technology and systems to manage all forms of information;
5. Understand curricular design and instruction and have the ability to teach ways to access, organize, and use information;
6. Understand scientific research methods and have the ability to critically examine and filter research literature from many related disciplines (Medical Library Associaiton, 2007, pp. 4-7).

Since the current best clinical evidence from clinical research is one of the three important components in evidence-based practice (Guyatt, 2008; Sackett, et al., 2000), it is expected that, to a large extent, effective learning and practice of EBM depend on the availability and easy access to evidence-based resources. Logically, health sciences librarians with knowledge and skills in the MLA defined competency areas would become an indispensible driving force in the successful implementation of EBM training and integration given the role of librarians in health information retrieval, organization, management, and dissemination.

The findings of this study demonstrate that different contextual factors exerted certain influence on residents' EBM learning and practice. With a systems approach to contextual analysis, these factors need to be taken into consideration in designing and providing EBM training and facilitating the incorporation of the current best evidence into decision making about individual patient care. Besides the factor of resource availability, learning support, social support, and learning culture as environmental factors are potential areas in which librarians with the right competencies can augment their role and functions that would contribute a great deal to residents' successful learning and practice of EBM. Librarians cannot become experts in all competency areas, but they can broaden their expertise, expand their capacity, gain new knowledge and skills in certain areas. Developing competencies in relevant areas would enable them to position themselves as a key player in their institutional context and become a resource person in the designing, teaching, and integrating EBM into the undergraduate and graduate medical educational curricula. Clearly, it is necessary for librarians to proactively promote their expertise and ability as health information professionals. The understanding and awareness of librarians' qualifications, roles, and functions, on the part of medical educators and health care professionals, would set the stage for librarians when they seek partnership, forge alliances, and build collaborative relationships with medical educators and other health care professionals in providing EBM training and facilitating the adoption of EBM in clinical care settings.

Biomedical information expands exponentially each year. Change is a constant in health care organizations. It is vital for librarians to provide evidence of an ongoing assessment of the information needs of residents, health care professionals, and their parent organization, and to develop and implement a plan to provide appropriate resources and services to meet those identified needs (Bandy, Doyle, Fladger, Frumento, Girouard, Hayes, & Rourke, 2008). In Gilbert's (1996) view, six basic influences on human behavior impact performance improvement. The six basic influences fall under two categories: environmental support and individual repertory of behavior. Individual skills and knowledge belong to the category of individual repertory of behavior while resources and tools are part of the environmental support.

To facilitate effective learning and practice of EBM, there are three major functions that librarians can perform to enhance residents' EBM learning and practice: 1) design and provide effective integrated training to develop residents' knowledge of knowledge-based EBM information resources and build their skills in searching these resources for the best evidence; 2) provide environmental support through provision of knowledge-based EBM information resources to facilitate learning transfer for behavior change in patient care settings and create support tools for these resources to become readily available and easily accessible at the point of patient care; and 3) develop residents' awareness of the existence and availability of the resources by promoting them through a variety of venues.

To design and create ongoing support tools, librarians need to harness the power of information technologies and to seek information solutions to provide easy access to evidence-based information resources at the point of patient care and ensure optimal use of these resources. Support tools such as an online EBM resource center (Dunn, Wallace, & Leipzig, 2000), digital repositories of clinical cases, online collections of clinical questions and critical appraisals of evidence could become useful in supporting learning and teaching of EBM.

Recommendations for Future Research

The study provides several interesting research directions for those involved in teaching and practice of EBM. More research could be conducted to further establish the reliability and validity of the EBM Environment Scale. With its ability to discriminate groups by residency program and prior EBM training in references to perception scores, the scale may be used to compare and contrast programs of interest for comparative information that program directors and medical educators can use to understand and improve the quality of the EBM environment for residents. Different samples of residents from various residency programs could be recruited to participate in the EBM Environment Survey. Data collected can be used for additional item analysis and internal consistency estimates to further refine the scale. In addition, test-retest reliability can be conducted to examine the stability of the scale over a certain interval (respondents' scores on the scale are correlated on two different occasions).

Different validity types are used in scale development in order to generate and develop valid items and to provide evidence of measure quality. Under the broader label of criterion-related validity are a number of sources of validity--concurrent, predictive, convergent and discriminant validity (Netemeyer, et al., 2003). To collect evidence of concurrent validity for the EBM Environment Scale, future research could also be conducted to measure correlations between scores on the scale and other objective measures of EBM knowledge and skills. The Berlin Questionnaire (Fritsche, Greenhalgh, Falck-Ytter, Neumayer, & Kunz, 2002) and the Fresno test (Ramos, Schafer, & Tracz, 2003) are two objectives tests of EBM knowledge and skills. They are instruments widely used to evaluate knowledge and skills in EBM training. The EBM Environment Scale and one of the two tests can be administered to trainees before and after an EBM intervention. Any resulted finding indicating statistically significant relations of the environment perception score with the scores on one of the two skill tests could be taken as support for validity (Spector, 1992).

Another source of validity is the predictive validity that is often used interchangeably with criterion validity (Netemeyer, et al., 2003). It traditionally refers to the ability of a measure to effectively predict future variables. As the results of the study show, residents' previous training in EBM was associated with their scores on the EBM Environment Scale. Research could be conducted to investigate how the EBM Environment perception scores are associated with EBM training outcomes measured by the Berlin Questionnaire (Fritsche, et al., 2002), the

Fresno test (Ramos, et al., 2003), or other locally developed measures. As for the type of convergent validity, it would be interesting to find out possible correlations between scores on the EBM Environment Scale and those of other measures such as the learning environment (Copeland & Hewson, 2000; Roff, et al., 2005; Rotem, et al., 1995; Roth, et al., 2006) and the organizational environment (Probst, et al., 1998). For the evidence of discriminant validity, future investigation could be conducted to compute correlations between residents' board certification examination scores and scores on the EBM Environment Scale.

Another interesting area for future research is to modify the scale and administer it to a faculty group. The responses from faculty and residents in a residency program could be compared for any differences between the two groups. Comparative information collected from the survey may be useful in informing decisions about program offerings related to faculty development.

Conclusions

This dissertation was a first attempt at studying some contextual factors in the environment that can impact residents' EBM learning and practice. The exploratory study underscored the EBM environment and its multifaceted aspects as important variables to be examined for the purpose of systematic design, development, implementation, and evaluation of EBM curricula or programs in graduate medical education.

The EMB Environment Scale holds promise as a reliable and potentially valid measure of the environment of EBM learning and practice by medical residents. However, good scale development is an iterative process involving further studies across samples and settings. These studies would provide additional evidence to verify the reliability and validity of the EBM Environment Scale.

APPENDIX A

Human Investigation Committee Approvals
Wayne State University

WAYNE STATE UNIVERSITY

HUMAN INVESTIGATION COMMITTEE
101 East Alexandrine Building
Detroit, Michigan 48201
Phone: (313) 577-1628
FAX: (313) 993-7122
http://hic.wayne.edu

Association for the Accreditation of Human Research Protection Programs, Inc. Full AAHRPP Accreditation

NOTICE OF EXPEDITED APPROVAL

To: Fangqiong Mi
Administration & Organization Stud

From: Ellen Barton, Ph.D.________________________________
Chairperson, Behavioral Institutional Review Board (B3)

Date: May 29, 2009

RE: HIC #: 058709B3E

Protocol Title: Development and Validation of a Measurement Scale to Analyze the Environment for Evidence-Based Medicine Learning and Practice by Medical Residents

Sponsor:

Protocol #: 0906007176

Expiration Date: May 28, 2010

Risk Level/Category: Research not involving greater than minimal risk

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The above-referenced protocol and items listed below (if applicable) were **APPROVED** following *Expedited Review* (Category 7*) by the Chairperson/designee *for* the Wayne State University Behavioral Institutional Review Board (B3) for the period of 05/29/2009 through 05/28/2010. This approval does not replace any departmental or other approvals that may be required.

- Recruitment Letter for Panel of Experts
- Internet Information Sheet (dated 4/29/09)
- Note to PI: When surveys are ready for distribution, please provide a copy of the email that residency directors will send to students in their programs; this email must be sensitive to the possibility of students' perceiving coercion to participate.

- Federal regulations require that all research be reviewed at least annually. You may receive a *"Continuation Renewal Reminder"* approximately two months prior to the expiration date; however, it is the Principal Investigator's responsibility to obtain review and continued approval ***before*** the expiration date. Data collected during a period of lapsed approval is unapproved research and can ***never*** be reported or published as research data.
- All changes or amendments to the above-referenced protocol require review and apprval by the HIC **BEFORE** implementation.
- Adverse Reactions/Unexpected Events (AR/UE) must be submitted on the appropriate form within the timeframe specified in the HIC Policy (http://www.hic.wayne.edu/hicpol.html).

NOTE:

1. Upon notification of an impending regulatory site visit, hold notification, and/or external audit the HIC office must be contacted immediately.
2. Forms should be downloaded from the HIC website at ***each*** use.

*Based on the Expedited Review List, revised November 1998

APPENDIX B

Permission Letters or HIC Approval for the EBM Environment Survey Administration

Yale University

Human Investigation Committee
School of Medicine
47 College Street, Suite 208
P.O. Box 208010
New Haven CT, 06520

Telephone: 203-785-4688
Fax: 203-785-2847
http://info.med.yale.edu/hic

To: [redacted]
From:
Date: 11/17/2009
HIC Protocol #: 0911005981
Study Title: Development and Validation of a Measurement Scale to Analyze the Environment for Evidence-Based Medicine Learning and Practice by Medical Residents
Approval Date: 11/17/2009
Submission Type: Initial Application

The research that you describe in your application involving the above-named project is exempt from HIC review under the parts of the federal regulations as noted below. Please keep a copy of this letter for your records.

Based upon the description of your project, the HIC finds the criteria below to be met. Please note that any revisions to this project must be submitted to the HIC for further review. At that point, a determination will be made regarding the continued exempt status of the research. You may keep a copy of this letter for your records.

Investigators conducting research involving human participants are required to report within 48 hours of discovery any serious and unanticipated adverse events related to the research participation and unanticipated problems involving risks to subjects or others occurring in the course of the research.

You should keep a copy of this letter for your records.

Review Comments:

- EXEMPTION 45 CFR 46.101(b)(2). This research is exempt from IRB review under federal regulation 45 CFR 46.101(b)(2). This part of the regulations covers research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects# responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects# financial standing employability, or reputation.

EBM_environment_HIC_2009

[redacted]
Program Director, Department of Medicine
Phor[redacted]
Fax: [redacted]

Morristown Memorial Hospital
100 Madison Ave
Morristown, NJ 07962

Morristown Memorial Hospital
ATLANTIC HEALTH

9/17/2009

RE: Research on Evidence Based Learning and Practice by Medical Residents

To whom it may concern:

I have been contacted by Misa Mi regarding the feasibility of having the residents in my program participate in a research project with the above name.

This project has my support, and I am happy to give Ms. Mi the permission to administer the survey to my residents. I will ensure that they review the informed consent prior to taking the survey.

Sincerely,

[redacted]

Program Director, Internal Medicine
Associate Clinical Professor of Medicine
Mount Sinai School of Medicine

THE PASSION TO LEAD

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Family Medicine
Residency Program

6005 MONCLOVA ROAD | MAUMEE, OHIO 43537 | 419-383-5522
HTTP://RESIDENCY.STLUKESHOSPITAL.COM

October 7, 2009

Misa Mi, M.A., M.L.I.S., A.H.I.P.
Medical Librarian
Mulford Library
MLB 409
3000 Arlington Ave.
Mail Stop 1061
Toledo, OH 43615

Dear Misa:

We would be happy to have you administer your survey as part of your ongoing research. We will be expecting you next Wednesday at 11:45 a.m. to speak with the residents.

Sincerely,

[redacted]
Program Director

[redacted]

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2213 Cherry Street
Toledo, Ohio 43608
(419) 251-8000
Toll-free: (877) 322-2200

September 29, 2009

RE: Learning Environment Survey/Study of Ms. Misa Mi

To Whom it May Concern:

I am writing to indicate my full support for Ms. Misa Mi to distribute and score a resident learning environment survey and evaluation of their practice of evidence based medicine.

The information sheet that will be given to the residents documents sufficiently the risks, benefits and other important issues, such as confidentiality. No resident will be required to participate.

If you have any questions, please call [redacted]

Sincerely,

[redacted]

Director, Pediatric Residency Program

[redacted] MD
Associate Chair, Department of Medicine
Director, General Internal Medicine Division
Medical Director, Retroviral Disease Clinic
Lenox Hill Hospital
New York, NY
[redacted]

Misa F. Mi
Instructional Technology, College Of Education, Wayne State University

Dear Ms. Misa Mi,

This letter is to confirm that the medical residents at Lenox Hill hospital are able to participate, by responding to survey questionnaire, in your study titled "Development and Validation of a scale to analyze the Environment for Evidence-Based Medicine learning and practice by Medical Residents".

We hope our collaboration help advance our understanding in the topic.

Sincerely,

[redacted]

Mi, Misa

From: [redacted]
Sent: Monday, September 28, 2009 10:06 AM
To: Mi, Misa
Subject: Letter of support

Dear Mrs Mi

It was my pleasure to meet with you and discuss your fascinating work on your PHD thesis. I give you my permission to administer the questionnaire
Evidence Based Medicine (EBM) Environment Scale to our internal medicine residence following their scheduled didactics.

[redacted]
Professor of Medicine
Pulmonary/critical care /Sleep
Program Director Internal Medicine Residency
Director, medical Intensive Care

APPENDIX C

Content Validation Packet for Expert Panelists

Recruitment Letter for Panel of Experts

Dear Dr. (name of expert):

I am conducting a research project for my dissertation. The purpose of the project is to develop and validate an instrument, the EBM Environment Scale, to measure medical residents' perceptions of the environment in which EBM learning and practice occur. The development of residents' competency in EBM through the adoption of evidence-based clinical practice depends on many factors, among which are contextual factors that can interact to affect learning and transfer in a health care environment.

You are being invited to serve on a panel of experts because of your knowledge and your involvement in teaching EBM to residents. Your participation in the review process is valuable as a preliminary step to validating the scale and subsequent phases of the scale development.

The scale consists of items related to different contextual factors that may affect instructional design, development, and implementation of effective EBM training for optimal learning and learning transfer. When the scale is administered to medical residents who will be recruited for the study participation, they will be asked to rate each item on a 5-point response scale from "strongly agree" to "strongly disagree".

Thank you for your contribution to the research study. Should you have any questions concerning this study or would like a final version of the scale please feel free to contact me at xxx-xxx-xxxx or misami@wayne.edu.

Sincerely,

Fangqiong (Misa) Mi, PhD Candidate
Instructional Technology
Administrative & Organizational Studies Division
College of Education
Wayne State University
3 South Education Building
Detroit, MI 48202

Instruction for Expert Panelists

As part of the content validation process of the EBM Environment Scale, you are asked to evaluate to what extent you think each item is relevant to the dimensions that represent the content domain of the EBM environment. You are also asked to indicate how concise and clear you think each item is.

Items in the enclosed scale inventory have been generated as candidates for eventual inclusion in the scale. The expert review process is intended to improve the scale through the trimming, selection, substitution, or revision of these scale items. Your input is vital and will be used as constructive feedback for the scale development, so please be as completely candid and detailed as possible.

- As you read through each item, please rate it as follows:

  1. Rate the level of relevance on a scale of 1-4 (1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant). Space is provided for you to comment on individual items as you see fit.

  2. Indicate the level of clarity for each item, also on a four-point scale (1=not clear, 2=needs major revisions to be clear, 3=needs minor revisions to be clear, 4= clear). Space is provided for you to comment on individual items as you see fit.

- Feel free to recommend any items that should be included or deleted under the “Comment” column.

- After completing the scale inventory, please answer the final questions at the end of the inventory.

- Please return this completed packet to Misa Mi using the enclosed self-addressed stamped envelope by Friday, July 31st, 2009.

Thank you very much for your time! Should you have any questions concerning this study please contact Misa Mi at xxx-xxx-xxxx or misami@wayne.edu, or the Chair of the Wayne State University Human Investigation Committee at 313-577-1628.

Once again, thank you very much for your contribution to this study!

EBM Environment Scale Item Inventory

Goal Setting (Personal learning goals prior to any EBM training)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (For each item, provide any comments. Also, please indicate whether the item should be deleted from the final version of the scale.)
1. I understand why I need to participate in EBM training.	1 2 3 4	1 2 3 4	
2. I want to develop knowledge of EBM content.	1 2 3 4	1 2 3 4	
3. I want to become familiar with EBM resources available for residents to use.	1 2 3 4	1 2 3 4	
4. I need to develop my skill in searching for the evidence.	1 2 3 4	1 2 3 4	
5. I need to develop my ability to critically appraise the evidence.	1 2 3 4	1 2 3 4	
6. I need to learn how to apply the current best evidence to patient care.	1 2 3 4	1 2 3 4	
7. I have clear personal goals for learning EBM.	1 2 3 4	1 2 3 4	
Utility and Accountability (Perceptions of usefulness, relevancy, and value of EBM training)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. EBM is relevant to what I do as a resident.	1 2 3 4	1 2 3 4	
2. EBM training will benefit me in caring for my patients.	1 2 3 4	1 2 3 4	
3. I see the value in learning EBM content.	1 2 3 4	1 2 3 4	
4. I see the value of adopting EBM in my clinical practice.	1 2 3 4	1 2 3 4	

5. Training in EBM will help me provide better care for my patients.	1 2 3 4	1 2 3 4	
6. Learning EBM will help me develop my competency as a physician.	1 2 3 4	1 2 3 4	
7. The EBM training will enhance my ability to integrate the evidence into clinical practice.	1 2 3 4	1 2 3 4	
8. Learning EBM is very useful to me in providing quality care for my patients.	1 2 3 4	1 2 3 4	
9. The knowledge and skills I gain from EBM training will affect my practice in patient care.	1 2 3 4	1 2 3 4	
10. A post-training evaluation will motivate me to participate more in EBM training.	1 2 3 4	1 2 3 4	
Learner Role and Involvement (Perception of role clarity and expectations for residents in EBM training)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. I understand the competency requirements by the Accreditation Council of Graduate Medical Education.	1 2 3 4	1 2 3 4	
2. I have an understanding of what EBM training entails.	1 2 3 4	1 2 3 4	
3. Residents are encouraged to become active participants in the learning process.	1 2 3 4	1 2 3 4	
4. Faculty determine what is to be learned in EBM training events.	1 2 3 4	1 2 3 4	
5. Residents are given the opportunity to contribute to EBM learning content.	1 2 3 4	1 2 3 4	
6. Residents are involved in planning for EBM training events.	1 2 3 4	1 2 3 4	
7. Residents have input on what should be taught in EBM.	1 2 3 4	1 2 3 4	
8. Mandated training in EBM would	1 2 3 4	1 2 3 4	

increase the level of residents' attendance to EBM training.			
Task Orientation (Perceptions of the purpose and instructional objectives of EBM training)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Residents are aware of what they are supposed to learn in EBM training.	1 2 3 4	1 2 3 4	
2. There are clearly stated objectives of EBM training.	1 2 3 4	1 2 3 4	
3. There are objective measures of residents' EBM knowledge and skills.	1 2 3 4	1 2 3 4	
4. Residents are aware of expectations on them with respect to EBM training.	1 2 3 4	1 2 3 4	
5. There are training goals for EBM in my residency-training program.	1 2 3 4	1 2 3 4	
6. There is a well-structured EBM component in my residency training program.	1 2 3 4	1 2 3 4	
7. There are desired EBM outcomes for EBM training in the residency training program.	1 2 3 4	1 2 3 4	
8. There is congruence between EBM training goals, EBM learning content, and measures of learning outcomes.	1 2 3 4	1 2 3 4	
Applicability (Belief that EBM learning can be applied in the patient care settings and its application is worthwhile)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. I will be able to apply EBM knowledge and skills in patient care.	1 2 3 4	1 2 3 4	
2. There will be opportunities for me to apply my EBM knowledge and skills	1 2 3 4	1 2 3 4	

in the clinical setting.			
3. Evidence can be translated into better clinical practice.	1 2 3 4	1 2 3 4	
4. EBM results in better clinical care for patients.	1 2 3 4	1 2 3 4	
5. I am sure that I can practice EBM.	1 2 3 4	1 2 3 4	
6. I am sure that I can implement EBM in a time efficient way.	1 2 3 4	1 2 3 4	
7. Implementing EBM will improve the care that physicians deliver to patients.	1 2 3 4	1 2 3 4	
8. Using evidence will change my clinical practice.	1 2 3 4	1 2 3 4	
Resource Availability (Awareness and belief that EBM resources are available and that they are accessible whenever needed)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. There are trained EBM faculty who can teach EBM in my residency program.	1 2 3 4	1 2 3 4	
2. I am aware of existing EBM resources available for me to use.	1 2 3 4	1 2 3 4	
3. The EBM resources are conveniently accessible at the point of care.	1 2 3 4	1 2 3 4	
4. There are enough computer workstations for residents to use to search for the clinical research evidence.	1 2 3 4	1 2 3 4	
5. EBM resources needed for EBM practice are readily available to me.	1 2 3 4	1 2 3 4	
6. There is an adequate level of EBM resources provided by the library at my training site.	1 2 3 4	1 2 3 4	
7. Access to EBM resources and tools is easy in my environment.	1 2 3 4	1 2 3 4	
8. I am not sure that I can access the best	1 2 3 4	1 2 3 4	

resources in order to practice EBM.			
Social Support (The extent to which residents are supported, accepted, and recognized by those around them)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Residents are regarded as an important contributing group in patient care.	1 2 3 4	1 2 3 4	
2. There is a high degree of physician-nurse collaboration in the clinical setting.	1 2 3 4	1 2 3 4	
3. I feel part of the clinical team working here.	1 2 3 4	1 2 3 4	
4. I work collaboratively with my attending physician.	1 2 3 4	1 2 3 4	
5. I work collaboratively with other residents in small group discussions.	1 2 3 4	1 2 3 4	
6. My attending physician promotes an atmosphere of mutual respect.	1 2 3 4	1 2 3 4	
7. There is a mutual respect among faculty and residents.	1 2 3 4	1 2 3 4	
8. There is sufficient nursing and ancillary staff support at my training site.	1 2 3 4	1 2 3 4	
9. There are frequent and close interactions between attending physicians and residents throughout a working day.	1 2 3 4	1 2 3 4	
10. Nurses and other hospital staff are supportive of EBM practice.	1 2 3 4	1 2 3 4	
11. Residents work as a team to apply EBM to solve a clinical problem.	1 2 3 4	1 2 3 4	
12. Residents share EBM learning experiences with one another.	1 2 3 4	1 2 3 4	
13. I often observe my peers applying EBM in caring for their patients.	1 2 3 4	1 2 3 4	
14. I often discuss EBM with other	1 2 3 4	1 2 3 4	

residents in the patient care setting.			
15. Residents interact with each other in learning and practicing EBM.	1 2 3 4	1 2 3 4	
Physical Setting (The extent to which the spatial environment facilitates EBM learning)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Classrooms are available for EBM small group discussions.	1 2 3 4	1 2 3 4	
2. The classroom used for EBM training is conducive to active learning.	1 2 3 4	1 2 3 4	
3. The room for EBM training is comfortable.	1 2 3 4	1 2 3 4	
4. I feel comfortable interacting with faculty and other residents in the learning environment.	1 2 3 4	1 2 3 4	
5. The seating arrangement encourages residents' participation in group discussions.	1 2 3 4	1 2 3 4	
Faculty Role (The degree to which faculty are involved in EBM training)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Faculty lead all small group discussions.	1 2 3 4	1 2 3 4	
2. Faculty collaborate with residents in providing EBM training.	1 2 3 4	1 2 3 4	
3. Faculty teach all EBM content.	1 2 3 4	1 2 3 4	
4. Faculty determine all content in EBM training.	1 2 3 4	1 2 3 4	
5. Faculty ask residents' input on what	1 2 3 4	1 2 3 4	

they want to learn about EBM.			
6. Faculty are the ones who provide all EBM training content in my residency program.	1 2 3 4	1 2 3 4	
7. Faculty serve as the coach in the residents' learning process.	1 2 3 4	1 2 3 4	
8. Faculty serve as the facilitator in the residents' learning process.	1 2 3 4	1 2 3 4	
9. Faculty's role is to deliver didactic lectures on EBM.	1 2 3 4	1 2 3 4	
Learning Schedules (The extent to which EBM training is provided to residents)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. There is adequate time allocated for formal EBM lectures.	1 2 3 4	1 2 3 4	
2. There is adequate time allocated for EBM small group discussions.	1 2 3 4	1 2 3 4	
3. The length of the EBM training is appropriate.	1 2 3 4	1 2 3 4	
4. There is adequate time provided for residents to learn EBM content.	1 2 3 4	1 2 3 4	
5. There is sufficient time devoted to EBM training in my residency program.	1 2 3 4	1 2 3 4	
6. There are regular EBM training offerings in my residency program.	1 2 3 4	1 2 3 4	
7. The residency program provides adequate EBM training that I need to become adept at the EBM approach.	1 2 3 4	1 2 3 4	
8. The time for the EBM training fits my schedule.	1 2 3 4	1 2 3 4	
9. Training in online searching for the evidence is always available for me.	1 2 3 4	1 2 3 4	

Transfer Opportunities (Perception of available opportunities to transfer acquired EBM knowledge and skills to the care of patients)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. There are opportunities for me to apply EBM knowledge and skills in the clinical setting.	1 2 3 4	1 2 3 4	
2. I have plenty of opportunities to apply EBM in caring for my patients.	1 2 3 4	1 2 3 4	
3. I have the opportunity to observe and interact with other residents in learning and practicing EBM.	1 2 3 4	1 2 3 4	
4. It is difficult to incorporate EBM into my residency training program.	1 2 3 4	1 2 3 4	
5. I have opportunities to use my EBM skills in a patient care setting.	1 2 3 4	1 2 3 4	
6. There are enough opportunities for me to reinforce my EBM skills in the clinical setting.	1 2 3 4	1 2 3 4	

Situational Cues (The extent to which attending physicians role model EBM practice and provide feedback/guidance for residents on EBM learning and practice)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. My attending physician practices EBM in the clinical setting.	1 2 3 4	1 2 3 4	
2. Faculty role model evidence-based practice during rounds and case discussions in the clinical setting.	1 2 3 4	1 2 3 4	
3. I often observe my attending physician applying the evidence in decision making about patient care.	1 2 3 4	1 2 3 4	
4. My attending physician provides me with clear feedback on my practice of	1 2 3 4	1 2 3 4	

EBM.			
5. There are faculty role models who can assist me in adopting EBM in real time to solve patient problems.	1 2 3 4	1 2 3 4	
6. My attending physician involves me in decision making about clinical cases.	1 2 3 4	1 2 3 4	
7. Faculty are good at mentoring residents.	1 2 3 4	1 2 3 4	
8. I can get guidance I need on my EBM learning and practice.	1 2 3 4	1 2 3 4	
9. Residents receive constructive feedback for applying EBM to patient care.	1 2 3 4	1 2 3 4	
10. My attending physician provides me with clear feedback on my practice of EBM.	1 2 3 4	1 2 3 4	
11. My attending physician models the EBM process in the patient care setting.	1 2 3 4	1 2 3 4	
Learning Support **(**The extent to which time is allowed for residents to participate in EBM training and assistance is available to residents in learning EBM)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. I have protected time to participate in EBM training events.	1 2 3 4	1 2 3 4	
2. My workload allows me to devote time to learning EBM content.	1 2 3 4	1 2 3 4	
3. There is a balance between service and education at the training site.	1 2 3 4	1 2 3 4	
4. My workload is overwhelming.	1 2 3 4	1 2 3 4	
5. My on-call schedule provides me with the opportunity to attend EBM educational events.	1 2 3 4	1 2 3 4	
6. My on-call schedule prevents me from attending EBM educational events.	1 2 3 4	1 2 3 4	

7. My clinical responsibilities are overwhelming.	1 2 3 4	1 2 3 4	
8. My clinical schedule allows me to search for the evidence.	1 2 3 4	1 2 3 4	
9. I have protected time for searching for the evidence during my clinical rotation.	1 2 3 4	1 2 3 4	
10. I have protected time for critically appraising the evidence during my clinical rotation.	1 2 3 4	1 2 3 4	
11. There are shortages in resident coverage at my training site.	1 2 3 4	1 2 3 4	
12. There are staff shortages at my training site.	1 2 3 4	1 2 3 4	
Faculty Support (The extent to which residents receive help, guidance and direction from attending physicians/preceptors in learning and practicing EBM)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. My attending physician is easily accessible.	1 2 3 4	1 2 3 4	
2. My attending physician is supportive of my EBM learning.	1 2 3 4	1 2 3 4	
3. My attending physician is supportive of my EBM practice.	1 2 3 4	1 2 3 4	
4. Trained faculty are available to teach EBM at my training site.	1 2 3 4	1 2 3 4	
5. Faculty encourage residents to express their ideas about learning and practicing EBM.	1 2 3 4	1 2 3 4	
6. Faculty explain to residents why we need to learn and practice EBM.	1 2 3 4	1 2 3 4	
7. Faculty and residents share EBM learning and practice experiences.	1 2 3 4	1 2 3 4	
8. There is a high level of involvement of faculty in teaching EBM.	1 2 3 4	1 2 3 4	
9. Faculties accept EBM as a practical	1 2 3 4	1 2 3 4	

and valuable approach to patient care.			
10. Faculty promotes the use of EBM in solving clinical problems for individual patients.	1 2 3 4	1 2 3 4	
11. My attending physician prompts me to apply the evidence to solve clinical problems.	1 2 3 4	1 2 3 4	
Teaching Support (The degree to which faculty are supported in terms of time allowance for faculty professional development, involvement, and teaching assistance in EBM)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Faculty are provided opportunities for professional development related to EBM teaching and practice.	1 2 3 4	1 2 3 4	
2. Faculty are given opportunities to gain necessary knowledge and skills to become effective EBM teachers.	1 2 3 4	1 2 3 4	
3. Faculty are encouraged to become EBM teachers.	1 2 3 4	1 2 3 4	
4. Faculty are given opportunities to gain necessary knowledge and skills to become effective EBM practitioners.	1 2 3 4	1 2 3 4	
5. Faculty are encouraged to learn EBM content.	1 2 3 4	1 2 3 4	
6. Faculty are recognized for their involvement in teaching EBM.	1 2 3 4	1 2 3 4	
7. Faculty have time to teach EBM in a formal classroom setting.	1 2 3 4	1 2 3 4	
8. Faculty have time to teach EBM in a patient care setting.	1 2 3 4	1 2 3 4	
9. Faculty have resources that can assist them in their effort to teach and practice EBM.	1 2 3 4	1 2 3 4	
10. Faculty physicians express interest in EBM.	1 2 3 4	1 2 3 4	

Learning Culture (Shared belief that there is a strong support for the goals of learning, teaching, practicing EBM)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Attending physicians' own knowledge and expertise are more valued in my environment.	1 2 3 4	1 2 3 4	
2. There is resistance with integrating EBM content into the residency-training program.	1 2 3 4	1 2 3 4	
3. There is resistance with integrating EBM into clinical practice.	1 2 3 4	1 2 3 4	
4. There is apathy to EBM among attending physicians.	1 2 3 4	1 2 3 4	
5. My preceptor/attending physician accommodates my attendance at the EBM training by rearranging my schedule.	1 2 3 4	1 2 3 4	
6. There is a high level of acceptability of the EBM approach in my environment.	1 2 3 4	1 2 3 4	
7. The environment is conducive to residents' EBM learning and practice.	1 2 3 4	1 2 3 4	
8. There is a climate supportive of the EBM implementation.	1 2 3 4	1 2 3 4	
9. There is a climate for continuous learning among attending physicians.	1 2 3 4	1 2 3 4	
10. Medical staff will frown on my application of EBM.	1 2 3 4	1 2 3 4	
11. EBM training offerings align with the requirements specified for residents in the residency training program.	1 2 3 4	1 2 3 4	
12. Residents share evidence from a clinical research study with the patient care team.	1 2 3 4	1 2 3 4	
13. The evidence from clinical research is consulted in making decisions about patient care.	1 2 3 4	1 2 3 4	

14. EBM is integrated into the clinical medicine curriculum.	1 2 3 4	1 2 3 4	
Incentives (Organizational attitude towards evidence-based practice in forms of approval and encouragement)	**Relevancy** 1=not relevant 2=somewhat relevant, 3=quite relevant 4=highly relevant	**Clarity** 1=not clear 2=needs major revisions 3=needs minor revisions 4=clear	**Comments** (Provide any comments on the items and recommendations for item addition or deletion)
1. Residents are encouraged to adopt the EBM principles.	1 2 3 4	1 2 3 4	
2. I feel rewarded when my EBM practice is acknowledged.	1 2 3 4	1 2 3 4	
3. I am encouraged to engage in the life-long learning process through the EBM training and practice.	1 2 3 4	1 2 3 4	
4. I am encouraged to raise clinical questions on clinical cases.	1 2 3 4	1 2 3 4	
5. Residents are encouraged to become problem solvers.	1 2 3 4	1 2 3 4	
6. Residents are encouraged to ask clinical questions.	1 2 3 4	1 2 3 4	
7. Residents are encouraged to apply EBM knowledge and skills.	1 2 3 4	1 2 3 4	

Additional Questions

1. Do you have any additional general suggestions or comments?

Expert Profile

In an effort to establish a profile of expert panelists, please provide the following information:

Note: Your name will not be attached to any comments you make.

1. Your title: ________________________

2. Please indicate your medical specialty:

    - ❑ Emergency Medicine
    - ❑ Internal Medicine
    - ❑ Pediatrics
    - ❑ Surgery
    - ❑ Others

3. How long have you been teaching residents?

    - ❑ 3-6
    - ❑ 7-10
    - ❑ 11-14
    - ❑ 15-18
    - ❑ ≥19

4. How long have you been teaching residents EBM?

    - ❑ 3-6
    - ❑ 7-10
    - ❑ 11-14
    - ❑ 15-18
    - ❑ ≥19

5. What is your role in residents' learning and practice of EBM?

6. Please indicate any additional advanced degree obtained beyond MD:

    - ❑ Master
    - ❑ PhD
    - ❑ Others

7. What is your academic rank?

    - ❑ Assistant professor

- Associate profession
- Professor
- Others

8. Please indicate the number of your journal publications related to EBM teaching and practice:

   - 1-3
   - 4-6
   - 7-10
   - 11-14
   - ≥15

9. In your opinion, what questions have I missed?

APPENDIX D

Research Information Sheet

Title of Study: Development and Validation of a Measurement Scale to Analyze the Environment for Evidence-Based Medicine Learning and Practice by Medical Residents

Principal Investigator (PI):	Misa Mi Instructional Technology, College of Education, Wayne State University xxx-xxx-xxxx, misami@wayne.edu

1. **Purpose:** You are invited to participate in this research study that focuses on development and validation of a scale to analyze some of the issues related to the environment for evidence-based medicine learning and practice perceived by medical residents. A survey has been created to collect data from residents which will be used to validate the scale.

2. **Study Procedures**: If you participate in the study, you will be asked to take 15 minutes to fill out the survey with a total of 48 scale items and several demographic questions. Each scale item is a statement followed by a 5-point scale ranging from strongly agrees to strongly disagree.

3. **Benefits**: As a participant in this research study, there will be no direct benefit for you; however, information from this study may benefit other people now or in the future.

4. **Risks**: There are no known risks to participation in this study.

5. **Costs**: There will be no costs to you for participation in this research study.

6. **Compensation:** You will not be compensated for taking part in this study. You may submit your name and email address to be part of a drawing for a $100 cash gift card. You may enter the drawing even if you decide not to complete the survey.

7. **Confidentiality:** The scale does not ask for any information that would identify you personally (i.e., it is anonymous). Your identity will not be revealed if any research report is published.

8. **Voluntary Participation /Withdrawal**: Taking part in this study is voluntary. You can stop your participation at any time.

9. **Questions**: If you have any question about the study now or in the future, you may contact Misa Mi at at xxx-xxx-xxxx or misaim@wayne.edu. If you have questions or concerns about your rights as a research participant, you may contact the Wayne State University Human Investigation Committee office at 313-577-1628.

Participation: By completing the scale you are agreeing to participate in this study.

APPENDIX E

Chief Resident Signature Sheet for Administration of the EBM Environment Survey

Please use the stamped, self-addressed envelope enclosed to return all collected surveys to Misa Mi, principle investigator, by **October 16, 2009**.

Should you have any questions concerning this survey or the study please contact Misa Mi at xxx-xxx-xxxx (Cell) or misami@wayne.edu.

Please read, acknowledge and sign the following before administering the survey.

I acknowledge that I have been asked to administer the survey on behalf of the principle investigator and I will not be copying, keeping, and sharing any completed survey. I will keep all collected information strictly confidential.

AFTER placing the completed surveys and signature sheet in the enclosed envelope, I will seal and mail the envelope right back to the principle investigator of the research project.

Signed:

____

Name of the Person to Administer the Survey

APPENDIX F

Tentative Version of the EBM Environment Scale for Focus-Group Evaluation

Items	How important is		
	Very Important	Important	Not Important
1. I have clear personal goals for learning EBM.			
2. I know what I need to learn about EBM.			
3. EBM is relevant to what I do as a clinician.			
4. I see the value of adopting EBM in my clinical practice as a physician.			
5. Developing a high level of skills in evidence-based practice will help me provide better care for my patients as a physician.			
6. Learning EBM will help me develop my competency as a physician.			
7. EBM training will enhance my ability to integrate evidence into clinical practice.			
8. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.			
9. I understand the competency requirements of the Accreditation Council of Graduate Medical Education (ACGME).			
10. Residents are encouraged to set up individual goals in learning EBM.			
11. There is a well-structured EBM component in my residency training program.			
12. There are clear expectations for residents regarding EBM training.			
13. Residents have input on what should be taught in EBM training.			
14. There are clear objectives for EBM training in my residency training program			
15. There are objective measures of residents' EBM knowledge and skills.			
16. Mandated training in EBM would increase residents' attendance level to EBM training.			

17. There is a lack of EBM trained faculty who can teach EBM in my residency training program.			
18. I am aware of the existence of EBM resources.			
19. EBM resources are available to me in my practice environment.			
20. EBM resources are readily accessible at the point of patient care.			
21. It is easy to access EBM resources and tools in my practice environment.			
22. I have protected educational time to participate in EBM training events.			
23. My workload allows me to devote time to learning EBM.			
24. My on-call schedule provides me with the opportunity to attend EBM training events.			
25. My attending physician is supportive of my learning of EBM.			
26. There is sufficient time devoted to EBM training in my residency training program.			
27. I have opportunities to search for the evidence during clinical rounds.			
28. I have opportunities to appraise the evidence during clinical rounds.			
29. My attending physician is supportive of my EBM practice.			
30. There is a high level of faculty involvement in teaching EBM.			
31. Faculty accept EBM as a practical and valuable approach to patient care.			
32. Faculty promote the use of EBM in solving clinical problems for individual patients.			
33. My attending physician prompts me to apply the evidence to solve clinical problems.			
34. Nurses and other hospital staff are supportive of EBM practice.			
35. Residents work as a team to apply EBM to solve a clinical problem.			

36. Residents share EBM learning experiences with the clinical team.			
37. Faculty collaborate with residents in providing EBM training.			
38. Faculty serve as facilitator in residents' EBM learning process.			
39. My attending physician often applies EBM principles in the clinical setting.			
40. Residents interact with one another in practicing EBM.			
41. My attending physician promotes an atmosphere of mutual respect among the clinical team			
42. My attending models EBM practice during rounds and case discussions in the clinical setting.			
43. I often observe my attending physician citing evidence to support clinical decisions about patient care.			
44. There are faculty role models who can assist me in adopting EBM in real time to solve patient problems.			
45. I can get guidance I need on my EBM practice.			
46. My attending physician provides me with clear feedback on my practice of evidence-based care.			
47. My attending physician provides me with timely feedback on my practice of evidence-based care.			
48. Faculty are given opportunities to gain necessary knowledge and skills to become effective EBM teachers.			
49. Faculty are recognized for their involvement in teaching EBM.			
50. Faculty have resources that can assist them in their effort to teach and practice EBM.			
51. The integration of EBM into clinical practice is met with skepticism by faculty in my practice environment.			

52. The use of clinical evidence is part of the routine for clinical practice in my practice environment.			
53. It is difficult to incorporate EBM into my residency training program.			
54. There is a high level of acceptability of evidence-based care in my practice environment.			
55. The evidence from clinical research is consulted in guiding clinical decision making about patient care.			
56. Residents are encouraged to adopt the EBM principles.			
57. My EBM practice is acknowledged in my practice environment.			
58. Residents are encouraged to become problem solvers.			
59. There is a commitment to life-long learning at my site.			

APPENDIX G

The EBM Environment Survey

PART I: EVIDENCE-BASED MEDICINE* (EBM) ENVIRONMENT SCALE

The following survey is designed to collect information on some of the issues related to the EBM learning and practice environment. The survey is anonymous and will take approximately 15 minutes to complete. Please be candid and circle the response option that best describes your agreement or disagreement with each statement as it applies to you as a medical resident or your EBM learning and practice environment. Thank you for your time and cooperation!

1=Strongly Disagree, 2=Disagree, 3=Unsure, 4=Agree, 5=Strongly Agree

(*Evidence-based medicine (EBM) requires the integration of the best evidence with clinical expertise within the context of patients' personal circumstances and values. EBM is a process of precisely defining a clinical problem/question, using appropriate clinical resources to find the best evidence, critically appraising the evidence, and judiciously applying the evidence.)

Items	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)
1. I see the value of adopting EBM in my clinical practice as a physician.	1	2	3	4	5
2. My attending physician is supportive of my participation in EBM training.	1	2	3	4	5
3. I understand the competency requirements of the Accreditation Council of Graduate Medical Education (ACGME).	1	2	3	4	5
4. I have protected educational time to participate in EBM training events.	1	2	3	4	5
5. Evidence-based information resources are readily available in my practice environment.	1	2	3	4	5
6. Learning EBM is NOT very useful to me in providing quality care for my patients.	1	2	3	4	5
7. I often observe my peers applying EBM principles in caring for patients.	1	2	3	4	5

8. Evidence from clinical research is often consulted in guiding clinical decision making about patient care in my practice environment.	1	2	3	4	5
9. EBM training will enhance my ability to integrate the best evidence into clinical practice.	1	2	3	4	5
10. I am aware of the existence of evidence-based information resources in my practice environment.	1	2	3	4	5
11. Residents are NOT encouraged to practice EBM in the clinical setting.	1	2	3	4	5
12. My attending physician prompts me to apply evidence to solve clinical problems.	1	2	3	4	5
13. Faculty collaborate with residents in developing and providing EBM training.	1	2	3	4	5
14. Evidence-based information resources are easily accessible at the point of patient care in my practice environment.	1	2	3	4	5
15. There are NOT any EBM trained faculty available to teach EBM at my residency training site.	1	2	3	4	5
16. Residents share EBM learning experiences with one another.	1	2	3	4	5
17. Residents are encouraged to become problem solvers.	1	2	3	4	5
18. My attending physician promotes an atmosphere of mutual respect.	1	2	3	4	5
19. There is a high level of faculty involvement in teaching EBM at my residency training site.	1	2	3	4	5
20. I am NOT sure about what I am supposed to learn in EBM training.	1	2	3	4	5
21. Developing a high level of skills in evidence-based practice would help me provide high quality care for my patients as a physician.	1	2	3	4	5
22. I have clear goals for learning EBM.	1	2	3	4	5

23. Faculty serve as facilitators in the residents' EBM learning process.	1	2	3	4	5
24. The integration of EBM into clinical practice is met with skepticism by clinicians in my practice environment.	1	2	3	4	5
25. Nurses and other house staff are supportive of evidence-based practice.	1	2	3	4	5
26. There is sufficient time allocated to EBM training in my residency training program.	1	2	3	4	5
27. Residents rarely have any input on what is taught in EBM training.	1	2	3	4	5
28. My attending physician models evidence-based practice during rounds and case discussions in the clinical setting.	1	2	3	4	5
29. There is a high level of acceptance of EBM in my practice environment.	1	2	3	4	5
30. There are clear expectations for residents regarding EBM training in my residency training program.	1	2	3	4	5
31. My attending physician provides me with clear feedback on my EBM practice.	1	2	3	4	5
32. My patient care workload is overwhelming.	1	2	3	4	5
33. Faculty promote the application of EBM in solving clinical problems for individual patients.	1	2	3	4	5
34. There is a commitment to life-long learning in my practice environment.	1	2	3	4	5
35. The use of clinical evidence is part of the routine for clinical practice in my practice environment.	1	2	3	4	5
36. My attending physician does NOT provide me with any guidance on my EBM learning and practice.	1	2	3	4	5
37. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.	1	2	3	4	5

38. I often observe my attending physician citing evidence to support clinical decisions about patient care.	1	2	3	4	5
39. Residents are involved in planning for EBM training events.	1	2	3	4	5
40. There is a well-structured EBM component in my residency training program.	1	2	3	4	5
41. My on-call schedule prevents me from attending EBM educational events.	1	2	3	4	5
42. Implementing EBM will improve the care that physicians deliver to patients.	1	2	3	4	5
43. I feel part of the clinical team working here.	1	2	3	4	5
44. There are faculty role models who assist me in adopting EBM to solve patient problems.	1	2	3	4	5
45. Residents usually lead EBM small group discussions.	1	2	3	4	5
46. There is resistance to integrating EBM into clinical practice among attending physicians.	1	2	3	4	5
47. Residents are encouraged to raise clinical questions on clinical cases.	1	2	3	4	5
48. Residents work as a team to apply EBM to solve clinical problems.	1	2	3	4	5

PART II: DEMOGRAPHIC INFORMATION

1. Year in Residency Training Program (PGY, post graduate year):

- ❑ PGY-1
- ❑ PGY-2
- ❑ PGY-3
- ❑ PGY-4
- ❑ Other

2. Gender:

- ❑ Female
- ❑ Male

3. Country of Medical School attended:

    - ❑ The United States
    - ❑ Other

4. Current Residency Training Program:

    - ❑ Family Medicine
    - ❑ Emergency Medicine
    - ❑ Internal Medicine
    - ❑ Pediatrics
    - ❑ Pediatrics/Internal Medicine
    - ❑ Other

5. Name of Institution/Health Care Organization where your residency training program is based:

6. Since entering MEDICAL SCHOOL, about how many total courses, seminars, workshops or training sessions related to EBM concepts and principles, searching for evidence or critical appraisal of the evidence have you received?

    - ❑ None
    - ❑ 1-3
    - ❑ 4-6
    - ❑ 7-10
    - ❑ ≥11

7. Since entering RESIDENCY TRAINING PROGRAM, about how many total courses, seminars, workshops or training sessions related to EBM concepts and principles, searching for evidence or critical appraisal of the evidence have you received?

    - ❑ None
    - ❑ 1-3
    - ❑ 4-6
    - ❑ 7-10
    - ❑ ≥11

8. Do you have any comments or questions about this scale or study?

9. Would you like to enter a drawing for a $100 cash gift card? If YES, provide your name and an e-mail address to notify you if you win the certificate (your name and email will not be attached to any data used to validate the scale):

    NAME: __________________________ EMAIL: ___________________________

APPENDIX H

Subscales and Items of the EBM Environment Scale of Version 1

Subscales and Items
Learner Role
3. I understand the competency requirements of the Accreditation Council of Graduate Medical Education (ACGME).
22. I have clear goals for learning EBM.
20. I am not sure of what I am supposed to learn in EBM training.
27. Residents rarely have input on what is taught in EBM training.events.
30. There are clear expectations for residents regarding EBM training in my residency training program.
39. Residents are involved in planning for EBM training
40. There is a well-structured EBM component in my residency training program.
45. Residents usually lead EBM small group discussions.
Utility and Accountability
1. I see the value of adopting EBM in my clinical practice as a clinician.
6. Learning EBM is NOT very useful to me in providing quality care for my patients.
9. EBM training will enhance my ability to integrate the best evidence into clinical practice.
21. Developing a high level of skills in evidence-based practice would help me provide high quality care for my patients as a physician.
37. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.
42. Implementing EBM will improve the care that physicians deliver to patients.
Resource Availability
5. Evidence-based information resources are readily available in my practice environment.
10. I am aware of the existence of evidence-based information resources in my practice environment.
14. Evidence-based information resources are easily accessible at the point of patient care in my

practice environment.
Social Support
7. I often observe my peers applying EBM principles in caring for patients.
16. Residents share EBM learning experiences with one another.
18. My attending physician promotes an atmosphere of mutual respect.
25. Nurses and other house staff are supportive of evidence-based practice.
43. I feel part of the clinical team working here.
48. Residents work as a team to apply EBM to solve clinical problems.
Learning Support
2. My attending physician is supportive of my participation in EBM training.
4. I have protected educational time to participate in EBM training events.
15. There are NOT any EBM trained faculty available to teach EBM at my residency training site.
19. There is a high level of faculty involvement in teaching EBM at my residency training site.
26. There is sufficient time allocated to EBM training in my residency training program.
32. My patient care workload is overwhelming.
41. My on-call schedule prevents me from attending EBM educational events.
Faculty Role/ Situational Cues
12. My attending physician prompts me to apply evidence to solve clinical problems.
13. Faculty collaborate with residents in developing and providing EBM training.
23. Faculty serve as facilitators in the residents' EBM learning process.
28. My attending physician models evidence-based practice during rounds and case discussions in the clinical setting.
31. My attending physician provides me with clear feedback on my practice of EBM.
33. Faculty promote the application of EBM in solving clinical problems for individual patients.
36. My attending physician does not provide me with any guidance on my EBM learning and practice.

38. I often observe my attending physician citing evidence to support clinical decision about patient care.
44. There are faculty role models who assist me in adopting EBM to solve patient problems.
Learning Culture
8. Evidence from clinical research is often consulted in guiding clinical decision making about patient care in my practice environment.
11. Residents are not encouraged to practice EBM in the clinical setting.
17. Residents are encouraged to become problem solvers.
24. The integration of EBM into clinical practice is met with skepticism by clinicians in my practice environment.
29. There is a high level of acceptance of the EBM approach in my practice environment.
34. There is a commitment to life-long learning in my practice environment.
35. The use of clinical evidence is part of the routine for clinical practice in my practice environment.
46. There is resistance to integrating EBM into clinical practice among attending physicians.
47. Residents are encouraged to raise clinical questions on clinical cases.

APPENDIX I

Subscales and Items of the EBM Environment Scale of Version 2

Subscales and Items
Learner Role
22. I have clear goals for learning EBM.
30. There are clear expectations for residents regarding EBM training in my residency training program.
40. There is a well-structured EBM component in my residency training program.
45. Residents usually lead EBM small group discussions.
Utility and Accountability
1. I see the value of adopting EBM in my clinical practice as a clinician.
6. Learning EBM is NOT very useful to me in providing quality care for my patients.
9. EBM training will enhance my ability to integrate the best evidence into clinical practice.
21. Developing a high level of skills in evidence-based practice would help me provide high quality care for my patients as a physician.
37. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.
42. Implementing EBM will improve the care that physicians deliver to patients.
Resource Availability
5. Evidence-based information resources are readily available in my practice environment.
10. I am aware of the existence of evidence-based information resources in my practice environment.
14. Evidence-based information resources are easily accessible at the point of patient care in my practice environment.
Social Support
7. I often observe my peers applying EBM principles in caring for patients.
18. My attending physician promotes an atmosphere of mutual respect.
25. Nurses and other house staff are supportive of evidence-based practice.

43. I feel part of the clinical team working here.
48. Residents work as a team to apply EBM to solve clinical problems.
Learning Support
2. My attending physician is supportive of my participation in EBM training.
4. I have protected educational time to participate in EBM training events.
19. There is a high level of faculty involvement in teaching EBM at my residency training site.
26. There is sufficient time allocated to EBM training in my residency training program.
23. Faculty serve as facilitators in the residents' EBM learning process.
Situational Cues
12. My attending physician prompts me to apply evidence to solve clinical problems.
13. Faculty collaborate with residents in developing and providing EBM training.
28. My attending physician models evidence-based practice during rounds and case discussions in the clinical setting.
31. My attending physician provides me with clear feedback on my practice of EBM.
33. Faculty promote the application of EBM in solving clinical problems for individual patients.
36. My attending physician does not provide me with any guidance on my EBM learning and practice.
38. I often observe my attending physician citing evidence to support clinical decision about patient care.
Learning Culture
11. Residents are not encouraged to practice EBM in the clinical setting.
17. Residents are encouraged to become problem solvers.
24. The integration of EBM into clinical practice is met with skepticism by clinicians in my practice environment.
29. There is a high level of acceptance of the EBM approach in my practice environment.
34. There is a commitment to life-long learning in my practice environment.
35. The use of clinical evidence is part of the routine for clinical practice in my practice environment.

APPENDIX J

Subscales and Items of the EBM Environment Scale of Version 3

Subscales and Items
Learner Role
30. There are clear expectations for residents regarding EBM training in my residency training program.
45. Residents usually lead EBM small group discussions.
48. Residents work as a team to apply EBM to solve clinical problems.
40. There is a well-structured EBM component in my residency training program.
22. I have clear goals for learning EBM.
26. There is sufficient time allocated to EBM training in my residency training program.
Utility and Accountability
21. Developing a high level of skills in evidence-based practice would help me provide high quality care for my patients as a physician.
9. EBM training will enhance my ability to integrate the best evidence into clinical practice.
42. Implementing EBM will improve the care that physicians deliver to patients.
6. Learning EBM is NOT very useful to me in providing quality care for my patients.
1. I see the value of adopting EBM in my clinical practice as a clinician.
37. I will be able to apply EBM knowledge and skills to the care of patients in my practice environment.
Resource Availability
5. Evidence-based information resources are readily available in my practice environment.
10. I am aware of the existence of evidence-based information resources in my practice environment.
14. Evidence-based information resources are easily accessible at the point of patient care in my practice environment.
Social Support
43. I feel part of the clinical team working here.

18. My attending physician promotes an atmosphere of mutual respect.
34. There is a commitment to life-long learning in my practice environment.
Learning Support
23. Faculty serve as facilitators in the residents' EBM learning process.
19. There is a high level of faculty involvement in teaching EBM at my residency training site.
4. I have protected educational time to participate in EBM training events.
13. Faculty collaborate with residents in developing and providing EBM training.
25. Nurses and other house staff are supportive of evidence-based practice.
Situational Cues
12. My attending physician prompts me to apply evidence to solve clinical problems.
28. My attending physician models evidence-based practice during rounds and case discussions in the clinical setting.
2. My attending physician is supportive of my participation in EBM training.
33. Faculty promote the application of EBM in solving clinical problems for individual patients.
31. My attending physician provides me with clear feedback on my practice of EBM.
11. Residents are not encouraged to practice EBM in the clinical setting.
38. I often observe my attending physician citing evidence to support clinical decisions about patient care.
7. I often observe my peers applying EBM principles in caring for patients.
36. My attending physician does not provide me with any guidance on my EBM learning and practice.
17. Residents are encouraged to become problem solvers.
Learning Culture
29. There is a high level of acceptance of the EBM approach in my practice environment.
24. The integration of EBM into clinical practice is met with skepticism by clinicians in my practice environment.
35. The use of clinical evidence is part of the routine for clinical practice in my practice environment.

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ABSTRACT

DEVELOPMENT AND VALIDATION OF A MEASUREMENT SCALE TO ANALYZE THE ENVIRONMENT FOR EVIDENCE-BASED MEDICINE LEARNING AND PRACTICE BY MEDICAL RESIDENTS

by

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A growing number of residency programs are instituting curricula to include the component of evidence-based medicine (EBM) principles and process. However, these curricula may not be able to achieve the optimal learning outcomes, perhaps because various contextual factors are often overlooked when EBM training is being designed, developed, and implemented. A successful EBM training intervention must hinge on contextual analysis of these factors that may interact to form the conditions that can facilitate or hinder medical residents' learning process and learning transfer. An extensive review of literature reveals little attention to any instrument used to analyze contextual factors in designing and implementing EBM training for medical residents. The purpose of the study was to develop and validate an instrument, the EBM Environment Scale, to analyze the environment for EBM learning and practice as perceived by medical residents.

The development of the EBM Environment Scale underwent the process of content domain identification, item generation, review by content experts and a focus

group of chief residents. All items on the scale measured responses on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Low scores on the scale represented unfavorable perceptions and high scores represented favorable perceptions of the EBM environment for residents. An EBM Environment Survey that contained the EBM Environment Scale and several demographic questions was administered to residents recruited from six programs at six training sites (four programs in internal medicine, one in family medicine, and one in pediatrics). The psychometric properties of the scale were tested with Cronbach's coefficient alpha and split-half reliability. Validity was assessed by comparing predetermined subscales with the scale's internal structure assessed via factor analysis. The scale was further validated with the Mann-Whitney U and Kruskal-Wallis tests to evaluate any differences on perception scores among groups of participants identified by gender, country of the medical school attended, level of residency training, affiliated residency program, level of prior EBM training in medical school, and level of prior EBM training during residency.

One hundred twenty four out of 262 eligible residents completed the survey (a response rate of 47%). The overall mean score from the sample was 3.89 with a SD of .56. The initial reliability analysis of the 48 item scale had a high reliability coefficient (Cronbach α = .94). Factor analysis and further item analysis resulted in a shorter 36-item scale with a satisfactory reliability coefficient (Cronbach α =.86). The reliability coefficients for the subscales range from .62 to .98. Factor analysis verified the pre-identified structure of six factors, which accounted for 63.57% of the variance. These factors reflected different attributes or aspects that contributed to the EBM environment, including situational cues, learner role, utility and accountability, learning culture, resource availability, learning support, and social support. Perception scores differed significantly ($p<.05$) by residency program affiliation with mean scores ranging from 3.51 to 4.13 and by prior EBM training level in medical school with means scores ranging from 3.62 to 4.14 and during residency with mean scores ranging from 3.69 to 4.25.

In initial psychometric testing, the EBM Environment Scale exhibited evidence of adequate internal consistency and construct validity. If further testing confirms its properties, it has potential to be used to understand the influence of the learning environment on the effectiveness of EBM training for residents and to evaluate the quality of the training along with other objective measures to monitor any change in learning outcomes resulted from an EBM training intervention. Additionally, it may be used as a diagnostic tool to detect changes in the EBM learning environment in response to any performance support system interventions. The results of the study suggest strong implications for instructional designers, performance improvement professionals, medical educators, and health information professionals. Recommendations for future research are provided.

AUTOBIOGRAPHIC STATEMENT

Misa Mi is currently the medical librarian at the Mulford Health Science Library, serving as liaison to the University of Toledo College of Medicine and Medical Center. She coordinates the library educational activities, serves as a course director for a credit-based elective course as well as a clinical decision making group discussion facilitator for medical students at the College of Medicine, University of Toledo. Misa also holds a faculty appointment at the Department of Family Medicine at the university. She received her Master of Arts in Teaching from Oakland University and Master of Library & Information Science from Wayne State University, Michigan. Prior to joining the University of Toledo faculty, she was a medical librarian and senior information resource specialist at the Children's Hospital of Michigan, Detroit Medical Center. Working as a medical librarian both in the health care organization and academic institution over the past 10 years, she has been actively involved in designing and providing EBM training for faculty, residents, medical students, and allied health care professionals. Misa is certified as a senior member of the Academy of Health Information Professionals of the Medical Library Association. She is an active member of a number of local, state, regional, and national health information professional organizations, has served on committees in different capacities, and is a recipient of publication awards and several other awards and honors from these organizations. Her research and teaching interests include medical informatics, medical education, evidence-based medicine, performance improvement, needs assessment, program evaluation, instructional design, and adult learning.