

A MIXED METHODS EVALUATION OF A TOOL ASSESSING ADULT  
LEARNING THEORY CONTENT IN EHR TRAINING

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by

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The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

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LEARNING THEORY CONTENT IN EHR TRAINING

Presented by William Beach

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And hereby certify that in their opinion it is worthy of acceptance.

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Professor Wade Davis Ph.D.

To my wife, without whose support this journey could not  
have been attempted much less completed,  
and my friends,  
for understanding my quest.

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## TABLE OF CONTENTS

ACKNOWLEDGMENTS .....	ii
LIST OF FIGURES .....	iv
LIST OF TABLES .....	vi
LIST OF ABBREVIATIONS .....	vii
CHAPTER	
1. INTRODUCTION .....	1
2. REVIEW OF THE LITERATURE .....	16
3. RESEARCH METHODS .....	34
4. RESULTS .....	72
5. DISCUSSION .....	97
6. CONCLUSIONS AND RECOMMENDATIONS .....	114
REFERENCES .....	126
APPENDICES .....	134
PERMISSIONS .....	142
VITA .....	143

## LIST OF FIGURES

Figure	Page
1. Literature Review Flow Diagram .....	19
2. Example RALP Scoring .....	26
3. Summary of Adult Learning Assessment Instruments ...	28
4. Association of TAM Constructs with Adult Learning Principles .....	31
5. Effect of Multiple Adult Learning Principles on Learning Outcomes .....	33
6. Mixed Methods Exploratory Design Study .....	36
7. Hospital Adoption of EHR Technology 2008-2012 .....	39
8. Creating a Training Program Using the ADDIE Model ..	45
9. Example Data Collection Protocol Used In All Study Sites .....	49
10. EHR - RALP Rater Portal.....	54
11. Rater Document Review Instructions .....	56
12. Question by Question Comparison of Raters and Standard Scores .....	80
13. Total Time Worksheet Words .....	83
14. Total Time Evidence Based Rating .....	83
15. Percent Agreement and Evidence Based Rating .....	86

16.	Evidence Based Rating and Training Content Richness .....	87
17.	Relationship of Content Richness Score and Average RALP Rating .....	109
18.	Hospital One Training .....	110
19.	Hospital Two Training .....	112

## LIST OF TABLES

Table	Page
1. Core Objective/Professional Category Matrix .....	38
2. RALP Study Hospitals .....	43
3. ADDIE Model Versus Alternative .....	46
4. Range of Training Documentation .....	74
5. Consolidated RALP and RALPS Data .....	77
6. IRR for Raters Only .....	79
7. IRR of Raters and PI .....	79
8. RALP Time Characteristics .....	82
9. RALP Rater Effort .....	82
10. Comment Scoring Rubric .....	84
11. Comment Scoring Results .....	85
12. Interview Question One .....	88
13. Interview Question Two "A" .....	89
14. Interview Questions Two "B" .....	90
15. Interview Question Three .....	91
16. Interview Question Four "A" .....	92
17. Interview Question Four "B" .....	92
18. Agreement / Disagreement Matrix .....	94



## **List of Abbreviations (in alphabetical order)**

1. **ACH** Acute care hospital
2. **ALT** Adult learning theory
3. **CME** Continuing medical education
4. **CMS** Centers for Medicare and Medicaid Services
5. **CPOE** Computerized physician order entry
6. **EMR** Electronic medical record (note: EMR and EHR, electronic health record are often used interchangeably)
7. **EPs** Eligible professionals
8. **GTM** Grounded theory method
9. **HITECH** Healthcare IT for economic and clinical health
10. **HRD** Human resource development
11. **IRA** Inter-rater agreement
12. **IRB** Institutional review board
13. **IRR** Inter-rater reliability
14. **ISD** Industrial systems design
15. **IT** Information technology
16. **QI** Quality improvement
17. **RALP** Reporting of adult learning principles
18. **RRT** Registered respiratory therapist
19. **TAM** Technology acceptance model

## **Chapter One: Introduction**

### **Electronic Health Record Training Programs**

Sophisticated Electronic Medical Record (EHR) applications, such as Computerized Physician Order Entry, (CPOE) are being rapidly implemented in a variety of clinical settings, according to the Center for Medicare and Medicaid Services (CMS). (CMS, 2012) The timing of this research stems from the unprecedented numbers of physicians, nurses, and other clinicians engaged in training for EHRs. This explosion in EHR training is due in large part to Medicare and Medicaid EHR Incentive Programs established through the Recovery Act/HITECH Act of 2009 (CMS, 2012). With incentive payments tied to the "Meaningful Use" of EHRs rather than simply to their implementation, a focus on effective and efficient training has come to the forefront (Hesse, Ahern, & Woods, 2011; Yan, Gardner, & Baier, 2012)

While there is a lack of published research to guide the design, execution and evaluation of strategies for the teaching and learning of EHRs, researchers have identified training gaps as a potential cause of EHR implementation problems (Boonstra & Broekhuis, 2010; Gagnon et al., 2012; Keshavjee et al., 2006).

Boonstra and Broekhuis cited perceptions of poor or inadequate training as one of the most frequently identified barriers to EHR implementation (Boonstra & Broekhuis, 2010). Their work insightfully included innovative categories, such as change process barriers, with subcategories related to adult learning principles, such as adult learners need for control, belief in EHRs, and lack of participation in the learning process.

### **Adult Learning Theory and EMR Training**

Adult Learning Theory (ALT) is identified by learning theorists as an important framework in the education and training of adult populations (Mezirow, 1990). The importance of ALT in the field of Human Resource Development (HRD) can be traced back to at least 2004, recognizing the motivational aspects of self-direction in developing competence (Kessels & Poell, 2004).

ALT appropriately grounds the design and delivery of EHR training programs in the context of clinicians as adult learners, because by virtue of their age and professional achievement, working clinicians are adult learners.

### **The Reporting of Adult Learning Principles Tool (RALP)**

The study uses a mixed methods, exploratory design in a formative evaluation of a scoring tool previously developed and validated to assess documents for evidence of ALT

principles in the design and delivery of Continuing Medical Education (CME) programs, *Reporting of Adult Learning Principles* (RALP) (Marinopoulos et al., 2007).

### **Need for Tools to Identify ALT Principles**

Despite the identification of training barriers to successful EHR implementation identified by the previously cited authors, the degree to which EHR teaching of clinicians is grounded in established ALT is not yet found in the published literature, as will be seen in the forthcoming literature review. Much of the problem with understanding the degree to which EHR training is grounded in ALT principles can be traced to the lack of effective tools to make this measurement (Holton, Wilson, & Bates, 2009).

The most common method for evaluating training for the inclusion of ALT principles has been to survey the perceptions of trainers and trainees. Although useful, this method suffers from several limitations. From a practical standpoint, it requires multiple surveys, each requiring the achievement of a satisfactory response rate. It requires complex timing of the surveys, relative to the completion of the training. There are a myriad of methodological challenges in this approach which have resulted in a determination that such tools have been not

proven entirely successful in measuring the inclusion of ALT principles in learning programs (Holton et al., 2009).

### **Study Aim**

A significant aspect of the approach of this research is the evaluation of the RALP tool to assess source documents, rather than trainee or trainer perceptions, as an indicator of the inclusion of ALT principles in EHR training programs. The establishment of such a tool will provide a foundation for future research on EHR training.

The addition of a tool that evaluates EHR training programs based on their content, rather than perception surveys, will expand future researchers' abilities to evaluate EHR training programs, and explore the relationship between the inclusion of ALT principles and training outcomes.

### **Research Questions**

What is the degree of inter-rater reliability among raters, for the RALP, as used to evaluate the inclusion of ALT principles in an EHR training program context?

1. What is the level of effectiveness of the RALP's self-contained user training, for the anticipated user of the RALP in the EHR training program context?
2. What are the time demands of the RALP, as used to evaluate the inclusion of ALT principles in an EHR training program context?

3. What is the level of effectiveness of the EHR-RALP Rater Portal, designed by the Principle Investigator (PI), in providing the anticipated user of the RALP, in the EHR training program context, an online platform for using the RALP.

### **Significance**

The significance of this research stems from the unprecedented numbers of physicians, nurses, and other clinicians engaged in training for EHRs. According to the Centers for Medicare and Medicaid Services (CMS) more than 176,049 eligible professionals, eligible hospitals, and critical access hospitals are actively registered in the Medicare and Medicaid EHR Incentive Programs. The actual scope of effective and efficient EHR training needed is actually far greater than the numbers reflected in the earliest applicants for Meaningful Use incentive payments. According to figures published by the US Bureau of Labor Statistics, in 2010 there were 691,000 active physicians and 2,737,400 nurses in the United States. Most will need some level of EHR training. Training that is focused solely on the successful operation of a computer program may be challenging to many clinicians in itself, but will leave unaddressed the skills required for workflow integration that are important to adult learner clinicians (Hübner-

Bloder & Ammenwerth, 2009; Welter, Deserno, Fischer, Gunther, & Spreckelsen, 2011).

Advancing the meaningful use of EHRs has been touted as a critical step in improving health care in the US (Hoffman & Podgurski, 2011; Viitanen et al., 2011). This study, by addressing the training gaps these EHR implementations have faced, seeks to contribute to improving health care.

### **Specific Contribution**

Unanswered is the extent to which ALT principles are used in EHR education and training programs. To address this issue there needs to be a valid and reliable method for assessing the extent to which ALT is present in EHR training. This method should consider the entire process, from needs analysis, to design, through delivery, and efforts to evaluate the training (Peterson, 2003). This study will develop and assess a new approach for measuring ALT in acute care hospitals' EHR training programs. Until the training of the "clinician / adult learner" users of EHRs is better understood, and optimized, the anticipated benefits of EHR implementation may not be fully realized. Recognition of the role of clinician EHR training in the adoption and meaningful use of EHRs leads to the conclusion that advances in the science of EHR training of the clinician / adult learner will be critical to the goal of

improving the quality and safety of patient care in a more cost-effective and efficient manner.

### **Approach**

Because the US health care system is really a patchwork of independent practitioners, working in a wide range of public, private, for profit and not-for-profit health care delivery settings, there has been no single model used for the EHR training of clinicians. There are a large number of EHR vendors, sometimes within a single facility, each playing a varying role in the training process. This wide range of health care delivery models and EHR applications make understanding the training process more challenging. This research will evaluate ALT principles in EHR training in a range of settings relative to bed size and EHR vendor. It was anticipated that there would be a range of training models relative to "in-house" versus contracted or vendor supplied, however, all four study hospitals used employed, in-house trainers.

Missing from previous efforts has been any means of quantifying the inclusion of ALT principles in EHR training materials directly. We will define training materials, or source documents, to include everything printed, stored, or recorded a part of EHR training programs. Lesson plans, course syllabi, web pages, DVDs, and FAQs are all examples



of training source documents. Source documents may offer advantages as research focus compared to surveys and outcomes measures.

### **Limitations of Perception Surveys and Observations**

The limitations and difficulties of using perception surveys and outcomes measurements, particularly in the field of technology related education, were recently reviewed by Bebbel and colleagues. (Bebbel, O'Dwyer, Russell, & Hoffmann, 2010) Among these were issues of design, related to broad subject matter, and difficulties in achieving adequate response. Conducting surveys across multiple study sites may greatly increase the risk of conducting research based on survey results, due to the need for adequate response rates at each of the participating sites.

Observational methods have been employed in which the training programs are directly observed in real time. This method has been employed by the AIDS Education & Training Centers National Resource Center. The link below is for the unpublished, web-based Adult Learning Resource. Included are multiple checklists and expert observer guides.

([http://www.aidsetc.org/pdf/workgroups/adultlearn/AdultLearningTool\\_2010-11.pdf](http://www.aidsetc.org/pdf/workgroups/adultlearn/AdultLearningTool_2010-11.pdf))

These alternate methods are not well suited to EHR training that spans multiple times, locations and workgroups, due simply to logistical issues of multiple surveys and direct observations. For the same reason, they are also less suited to assessment of non-classroom, individual and online training, all of which are common to EHR training. EHR training program assessment is particularly suited to a methodology centered on evaluating the documents, sometimes referred to as artifacts or archival materials, used in the design and delivery of the training programs. This method has advantages.

The evaluation of training materials most important advantage is that it is not dependent on survey response rate. This advantage is most pronounced when training occurs in multiple segments and/or multiple forms. Perceptions of training subjects or trainers may be subject to biases related to privacy concerns. Finally, training material evaluations are adaptable to a full range of asynchronous training methods, including online.

### **Limitations of Training Content Assessment**

Training content assessment has some potential disadvantages. It may be time intensive, and inter-rater agreement must be established. Study hospitals may not have their EHR training materials organized in an easy to access manner. EHR training may often have been unstructured or undocumented. Trainers may have left and documents may not have been properly archived.

### **Benefits of the Research**

The benefits of completing this foundational, formative evaluation are twofold.

First, there are potential benefits for the research community. The addition of a new tool for the assessment of ALT principles in EHR training, or progress toward the development of one, will aid future researchers in efforts to study the evaluation, design, and delivery EHR training at a time when such training is critical to the meaningful use of EHRs. The RALP, if determined to be a good candidate for further investigation, will finally provide researchers a complimentary alternative to perception surveys and direct expert observation assessment. Once more rigorously studied and validated in large scale studies, the RALP, or an EHR Training Adaption of it, has the potential to serve as the gold standard for the evaluation of ALT principles

in EHR training content. When this goal is reached, evaluative toolsets, including the RALP and existing survey tools, could be used to study the outcomes of ALT principled EHR training in a meaningful way.

Secondly, there are potential benefits to the community of EHR training designers, trainers and ultimately trainees. EHR training designers and trainers work in a multidisciplinary field, spanning workforce training, IT, Informatics, clinical care, and human resource development. The advancement of the science of EHR training for clinicians would be of great value to them, given the large numbers of trainees, and the financial, patient safety, and other unintended consequences of suboptimal EHR training. From the clinicians' standpoint, EHR training is time consuming and distracting to those struggling to remain focused on the care of their patients.

### **Definition of Terms**

The following are definitions of terms used in this study:

#### EHR and related terms (CMS.gov)

**CPOE:** Computerized Provider Order Entry (CPOE)

CPOE entails the provider's use of computer assistance to directly enter medication orders from a computer or mobile device. The order is also documented or

captured in a digital, structured, and computable format for use in improving safety and organization.

**EHR:** Electronic Health Record; sometimes stated as EMR or Electronic Medical Record.

**Certified EHR:** To get an incentive payment, you must use an EHR that is certified specifically for the EHR Incentive Programs. Certified EHR technology gives assurance to purchasers and other users that an EHR system or module offers the necessary technological capability, functionality, and security to help them meet the meaningful use criteria. Certification also helps providers and patients be confident that the electronic health IT products and systems they use are secure, can maintain data confidentially, and can work with other systems to share information.

**Meaningful Use:** Under the Health Information Technology for Economic and Clinical Health (HITECH Act), which was enacted under the American Recovery and Reinvestment Act of 2009 (Recovery Act), incentive payments are available to eligible professionals (EPs), critical access hospitals, and eligible hospitals that successfully demonstrate are meaningful use of certified EHR technology.

The Recovery Act specifies three main components of meaningful use. They are the use of a certified EHR in a meaningful manner (e.g.: e-Prescribing); the use of certified EHR technology for electronic exchange of health information to improve quality of health care; and the use of certified EHR technology to submit clinical quality and other measures.

ALT related terms (International Encyclopedia of Adult Learning) (English, 2005)

**Adult Learning:** Adults learners can be defined either based on age, cognitive maturity or as a nontraditional learner. The adult learner is a social being who in relation to learning, has to contend with his individual person and the social and societal environment. The adult learner has her individual priorities and value systems which is a product of life experiences.

**Andragogy:** Andragogy is a scholarly approach to the learning of adults attributed to Malcolm Knowles. It is an adult learning theory that recognizes adults are self-directed and autonomous, seeing the teacher as a facilitator rather than simply as presenter of content.

**Critical Reflection:** Critical reflection assumes that adults can engage in an increasingly accurate analysis of the world, coming to greater political clarity and self-awareness. By learning how to surface assumptions and then subject these to critical scrutiny, people can sort out which assumptions are valid and which are distorted, unjust and self-injurious

**Self-Directed Learning:** A process where an individual takes initiative with diagnosing their learning needs, developing learning goals, planning and implementing strategies and evaluating their learning. The assessment can be done with others.

### **Organization of the Study**

The remainder of this study is organized in the following manner. The second chapter contains the review of the literature. There has been little published in the highly specific area of evaluation instruments used to assess adult learning theory principles in the training of clinicians for the use of EMRs. Therefore, the review considers work in adult learning theory, adult learning and training in healthcare, and adult learning principles in the workplace, outside of healthcare.

The third chapter describes the research methods employed in the study. The fourth chapter reports on the quantitative and qualitative data gathered and analyzed by the research. Finally, the fifth chapter is devoted to the findings and conclusions from the data, discussion of the implications, and considerations for future research.



## **Chapter Two: Review of the Related Literature**

### **Organization of the Review**

The initial review of the literature focuses on the use and assessment of adult learning theory (ALT) principles in the training of clinicians in the use of electronic medical record systems.

A secondary review was conducted, focused on ALT, the tools designed to assess the inclusion of ALT principles in training programs, including the RALP, and the training of any worker in an informatics application for use on the job.

This secondary review became necessary due to the lack of published literature specifically linking adult learning theory and the training of clinicians on the use of electronic medical record systems.

### **Initial (Primary) Literature Review**

The overall search strategy used MeSH Terms, supplemented by non-MeSH keywords, where commonly used terms did not have MeSH counterparts. An iterative process of search, full text review, and additions to search parameters was employed until a maximum number of potential articles were retrieved. All searches were restricted to peer reviewed

journals, in English, and published between 1960 and the present.

#### **MeSH Terms**

MeSH terms were used whenever possible. Those used were, medical records systems, computerized, including electronic health record and electronic medical record; teaching, including computer user training; models, educational, including patient simulation, problem-based learning and programmed instruction; health personnel, including allied health personnel and caregivers; and medical staff, including nurses, pharmacists and physicians.

#### **Non-MeSH Terms**

Non-MeSH terms were used where common search that are not actual MeSH terms existed. These were EHR and EMR, adult learning theory, andragogy, learning theory, training, education, instruction, competency, proficiency and clinicians.

The databases searched were ERIC, PsycINFO and Academic Search Complete for education, MEDLINE (Ovid), ABI/Inform and PubMed for medical.

**The Boolean search string**, with results in Medline in bold and in parenthesis following string, was:

("Medical Records Systems, Computerized" or "Electronic Health Records" or "Electronic Medical Record" or "EMR" or "EHR") (24717)

**AND**

("Teaching" or "Computer User Training" or "Models, or "Educational" or "Patient Simulation" or "Problem-Based Learning" or "Programmed Instruction" or "Adult Learning" or "Andragogy" or "Learning Theory" or "Training" or "Education" or "Instruction" or "Competency" or "Proficiency") (126837)

**AND**

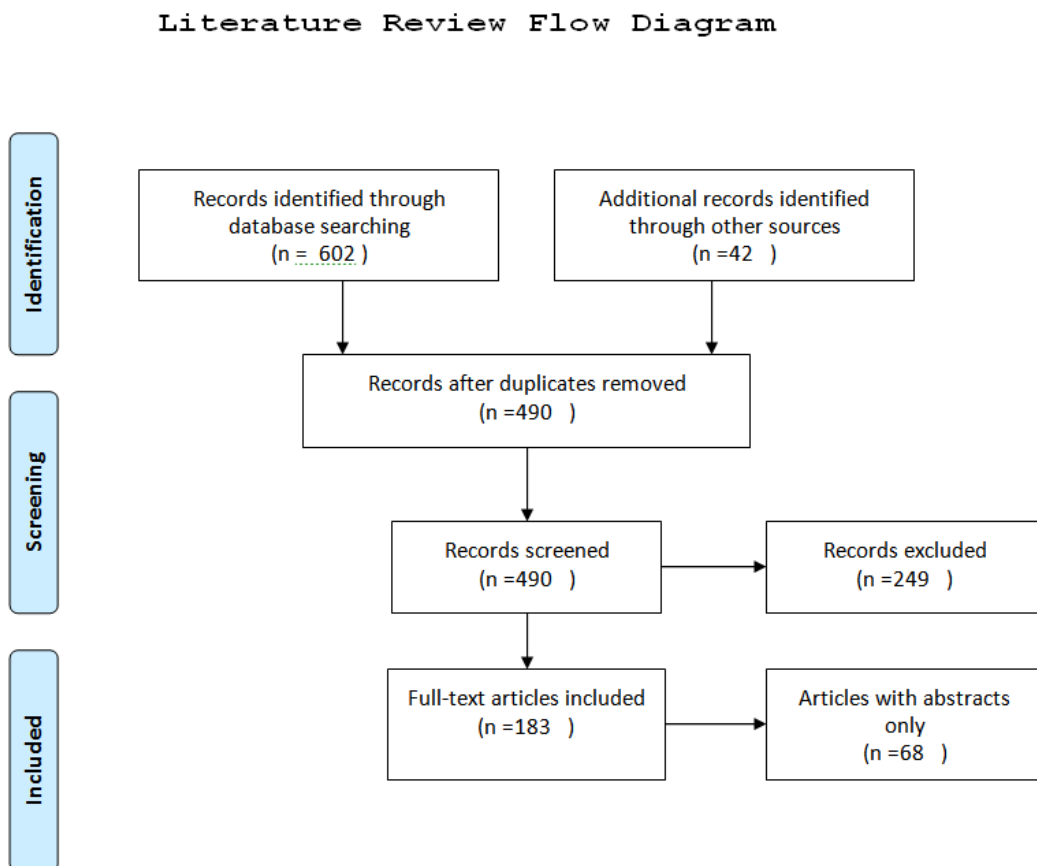
("Health Personnel" or "Allied Health" or "Caregivers" or "Medical Staff" or "Nurses" or "Pharmacists" or "Physicians" or "Clinicians") (609078)

**1 AND 2 AND 3 (321)**

Limit 4 to (English language and yr="1960 -Current") (300)

This strategy was repeated for each database. The total articles for review, after removal of duplicates were **448**. Abstracts of all **448** articles were reviewed, and **239** were eliminated as not pertinent to the study. Another **42** articles were added manually, mainly by searching references of remaining articles. The remaining **251** articles were retained in Endnote.

Of the **251**, full text was not available for **68**, leaving **183** articles with some relevance, for which full text was available. These **183** became the primary background sources for this study. They ranged in publication year from 1973 to 2013, and by source they were fairly divided between Informatics, Health Care Management or Quality, Human Resource Development, Education, and Psychology literature. The flow diagram for the primary literature review is shown below, in Figure 1.



**Figure 1:** Literature Review Flow Diagram

## **Secondary Review of the Literature**

This section on adult learning theory has two main purposes. The first is to provide the necessary background on the development and application of adult learning theory for workplace training. The second is to describe and differentiate the tools used to assess training programs for the inclusion of adult learning theory principles.

### Adult learning theory

Although concepts related to adult learning theory, or andragogy, have roots in 19<sup>th</sup> Century Europe (Thorpe, 1993), modern discussion of adult learning theory begin with Malcolm Knowles' work, *The Adult Learner: A Neglected Species* (M. S. Knowles, 1973).

Knowles' theories of adult learning are based on the unique characteristics of adults as learners (Merriam, 2008).

Knowles' andragogical theory at this time, was based on four assumptions; changes in self-concept, the role of experience, readiness to learn, and orientation to learning (M. S. Knowles, 1973). Human resource development (HRD), according to Knowles, is based on adult learning theories, which can serve as a guideline for developing training programs and training teachers.

Later, Knowles expanded his list of principles to six. Knowles' list, with descriptions derived by a later meta-analysis by Taylor (Taylor & Kroth, 2009), are quoted here from pages 1-11:

**Self-concept:** As a person matures, his/her self-concept moves from one of being a dependent personality towards one of being self-directed. Adults tend to resist situations in which they feel that others are imposing their wills on them.

**Experience:** As a person matures, he/she accumulates a growing reservoir of experience that becomes a resource for learning. Adults tend to come into adult education with a vast amount of prior experiences compared to that of children. If those prior experiences can be used, they become the richest resource available.

**Readiness to learn:** As a person matures, his/her readiness to learn becomes oriented to the development task of his/her social roles. Readiness to learn is dependent on an appreciation of the relevancy of the topic to the student.

**Orientation to learn:** As a person matures, his/her time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his/her orientation towards learning shifts from one of subject-centeredness to one of problem-centeredness. Adults are motivated to learn to the extent in which they perceive that the knowledge which they are acquiring will help them perform a task or solve a problem that they may be facing in real life.

**Motivation to learn:** Internal motivation is key as a person matures. Although adults feel the pressure of external events, they are mostly driven by internal motivation and the desire for self-esteem and goal attainment.

**The need to know:** Adults need to know the reason for learning something. In adult learning, the first task of the teacher is to help the learner become

aware of the need to know. When adults undertake learning something they deem valuable, they will invest a considerable amount of resources (e.g., time and energy).

Inevitably, debate ensued on the validity of andragogy in the 1980's (Merriam, Caffarella, & Baumgartner, 2007).

Merriam finds that Knowles agrees with his critics about the limitations of andragogy as a "Theory of Adult Learning," but concurs with Knowles that the principles remain an invaluable perspective on the adult learner.

There exist extensive peer reviewed publications on ALT. A simple keyword search in University of Missouri's "Summon" database of 6,200+ journals and books for "Adult Learning Theory," limited to peer-reviewed journals, yielded 1,942 results. In the following pages, this review adopts a progressively narrow focus, by beginning to apply limits based on specific relevancy to this study.

Variations of the core ALT principles continue to be identified by ALT theorists and researchers (Bryan, Kreuter, & Brownson, 2009; Dunst, Trivette, & Hamby, 2010; Goldman, 2009; Kessels & Poell, 2004; Merriam, 2008; Merriam et al., 2007) and include the following core principles, usually stated in very similar words, such as the need to establish a safe, effective learning climate. Also included are efforts to involve learners in mutual

planning of methods and content, and in determining their own needs to encourage internal motivation. Next are efforts to encourage learners to develop their own learning objectives, devise strategies to achieve their objectives and develop their skills of critical reflection. Lastly, is the principle to provide support for learners to carry out their learning plans.

In the years since this issue has been identified in the Human Resource Development (HRD) literature, progress has been made in the use of survey instruments measuring trainer and trainee perception of the inclusion of ALT principles in the clinical setting (Kaufman, 2003). Adult Learning Theory has been recently recognized as providing important advantages in the related area of clinical simulation training (Zigmont, Kappus, & Sudikoff, 2011). Others have looked at the learning outcomes of training methods considered to be grounded in ALT, such as "guided design and just-in-time learning (Kessels & Poell, 2004)."

### **Significance of ALT for EHR Training of Clinicians**

EHR trainees are adult learners by definition; as such, they require a unique approach to the design and delivery of EMR training. A core premise of ALT is that adult learner's willingness to incorporate new learning is related to the degree to which they are recognized and



negotiated with as adult learners (Goldman, 2009). Although the population being trained represents a unique segment of adult learners--clinicians engaged in non-medical workplace learning--targeted research into the application of established Adult Learning Theory (ALT) to EHR training has yet to be undertaken (Freeman, Wright, & Lindqvist, 2010; Mantzana, Themistocleous, & Morabito, 2010; Rouse, 2011). On the other hand, research in ALT is otherwise well established in the workplace (Dunst et al., 2010; Huerta-Wong & Schoech, 2010; Karen & Natasha, 2004). This prior work provides a strong foundation for examining the specific case of the adult learner, practicing clinician, in the acute and ambulatory health care setting. Work has been done in terms of how adult-learner clinicians continue to advance their clinical knowledge in the field, in the closely related field of information literacy transfer from IT professionals to clinicians (Spring, 2010). This paper specifically cited the need to "become more evidence based in our approaches to teaching."

### **The Reporting of Adult Learning Principles (RALP) Tool**

The reporting of Adult Learning Principles (RALP) was developed as part of an Evidence Report / Technology Assessment for the Agency for Healthcare Research and Quality (AHRQ) in 2007 (Marinopoulos et al., 2007). It was

initially known as the Quality of CME Activity Form. It played a relatively minor role as part of a comprehensive review of the Effectiveness of Continuing Medical Education (CME), conducted by the team of researchers.

The purpose of the authors' work was to synthesize evidence regarding the effectiveness of CME. The authors considered differing instructional designs in terms of "knowledge, attitudes, skills, practice behavior, and clinical practice outcomes" (Marinopoulos et al., 2007).

As part of this work, they used the RALP to evaluate one hundred and forty-five (145) published descriptions of CME Program content. The primary reference for the development of the RALP was a review published in the British Journal of Medicine, *Applying educational theory in practice* (Kaufman, 2003).

The primary article, *Effectiveness of Continuing Medical Education* is frequently cited; over two-hundred times as of May 12, 2013 on Google Scholar, but only one other published use of the RALP exists as of the date of this research. The RALP was also used in an article published in Journal of the American Medical Association also in 2007, submitted prior to the BMJ publication, but published after (Boonyasai et al., 2007). In this article, in which the tool is not identified as RALP or the Quality of CME

Activity Form, the identical tool is used to evaluate ALT principles in Quality Improvement (QI) training programs for clinicians.

The authors state in the appendix that "The reliability of all categorical questions was assessed for the first 27 articles abstracted. Overall agreement was 91.5% and inter-rater reliability for assessing adult learning principles was moderate ( $k=0.51$ ).\" Figure 2 below reproduces an example question from the original RALP.

To what extent does the curriculum enable learners to be active contributors to their learning?

**Good:** (Two or more of the following: learners identify/choose a question OR actively contribute to finding the answer OR teach the results of their learning to others)

**Fair:** (Only one of the above OR none of the above but the curriculum employed partially active learning methods such as interactive lectures or group discussions)

**Poor:** (None of the above are described)

**Figure 2:** Example RALP Scoring

As in this example, shown as depicted in the original tool, each of the nine RALP scoring categories measures the inclusion of a specific ALT principle. Each scoring category includes a descriptive guide to aid in the consistent scoring of the category. In this example, the documents of the training program are assessed for inclusion of the ALT principle of "Self-Concept" (Knowles, 1984). This principle, often described as "self-directed" posits that when adult learning is construed as meaning making, then encouraging reflection and dialogue enhances adult learning (Merriam, 2008).

### **Testing for Adult Learning Principles**

Important to this study are the published works concerning tools for testing or evaluating the incorporation of ALT principles into training. In one of the best reviews of such instruments, the authors assert that andragogy is one of the dominant frameworks for adult learning, but contend that an important gap in andragogy research is the lack of a measurement instrument. They review the history of such instruments up to the publication date of 2009. (Holton et al., 2009) Figure 3 below compiles the results of their review. Note that all of these instruments utilized perception surveys.

<b>Instrument</b>	<b>Measure</b>	<b>Date</b>
Educational Orientation Questionnaire (EQQ) by Hadley	Measures differences in beliefs among adult educators	1975
Educational Description Questionnaire (EDQ)	Converted Hadley's instrument about education or effective learning situations to statements describing educator behavior	1979
Christian's 50-item SOQ	Identified student preferences, attitudes, and beliefs about education. Examined conceptual agreement with the principles of androgogy held by members of the Commission of the Professors of Adult Education, by instructors	1979
The Androgogy in Practice Inventory, Suanmali	Examined conceptual agreement with the principles of androgogy held by members of the Commission of the Professors of Adult Education, by instructors	1981
Personal HRD Style Inventory by Knowles	Self-assessment tool on instructors general orientation to adult learning, program development, learning methods and program administration	1987
Principles of Adult Learning Scale by Conti	Measured the degree to which adult education practitioners accept and adhere to adult learning principles	1991
Adapted Principles of Adult Learning Scale, McCollen	Measured student perceptions of their teachers' learning styles	1998
Andragogical Practices Inventory	Survey item pool based on specific andragogical principles and design elements	2008
	Compiled from Holten E.F., Wilson L.S., and Bates R.A (2009) Towards development of a generalized instrument to measure Androgogy	

**Figure 3:** Summary of Adult Learning Assessment Instruments

\* Reprinted by permission from Holton, 2009

With one notable exception, the Reporting of Adult Learning Principles (RALP), the tool used for this study, up to this time no tool that measures training content directly, without the use of perception surveys, has been developed. Since 2000, articles and studies incorporating andragogy measurement into different disciplines are seen, but missing in the literature is whether andragogy is present in instructional design (Taylor & Kroth, 2009). In the previously cited 2009 article, Taylor and Kroth emphasize that such a tool needs to be created. In summary, the literature on the measurement of ALT in workforce training programs provides an excellent foundation for future work, but is extremely limited to the use of perception survey instruments.

### **ALT in Health Care**

Only one article was an exact match for adult learning theory and the training of clinicians on the use of electronic medical record systems. Published in 2012, and using strictly qualitative methods, *The Role of Cognitive and Learning Theories in Supporting Successful EHR System Implementation Training* specifically addresses the potential value of adult learning theory principles in training of clinicians on the use of electronic medical

record systems (McAlearney, Robbins, Kowalczyk, Chisolm, & Song, 2012).

Referring to EHR implementation and use, the authors found evidence that training practices in organizations with successful implementations were applied ALT principles to their training programs. The authors' suggest that by doing so, these organizations may increase the likelihood of successful EHR implementation and the meeting meaningful use requirements.

Other authors studied single aspects of ALT in the context of the informatics training of clinicians. One study retrospectively examined the difference in staff satisfaction between traditional instructor-led and blended learning (Edwards, Kitzmiller, & Breckenridge-Sproat, 2012). The findings suggest that healthcare staff, as adult learners prefer hands-on activities.

Zigmont et al. studied the use of simulation in training clinicians (Zigmont et al., 2011). Although this study considered training that was more directly clinical, it was focused solely on clinicians in the acute care setting, and evaluated simulation training specifically in the context of adult learning principles. The authors conclude that simulation demonstrates the most important tenets of experiential adult learning.

An important survey tool, related to ALT is the Technology Acceptance Model (TAM) (Morton & Wiedenbeck, 2009). TAM focuses on factors that determine users' intentions to use a new computer technology. The value of this study is that it assesses clinicians' adoption of EHR using a well vetted tool (TAM). Its importance here is that the TAM, clearly uses ALT principles, in my judgment. The logic for this is summarized in Figure 4.

<b>TAM Constructs</b>	<b>Adult Learning Principles</b>
1. Management support (F)	A. Adults are internally motivated and self-directed
2. Physician involvement (A,B,F)	B. Adults bring life experiences and knowledge to learning
3. Adequate training (C,E)	C. Adults are goal oriented
4. Physician autonomy (A,B,F)	D. Adults are relevancy oriented
5. Doctor-patient relationship (C,D)	E. Adults are practical
6. Perceived ease of care (C,E)	F. Adult learners like to be respected
7. Perceived usefulness (D,E)	
8. Attitude about EHR usage (A,D,F)	

**Figure 4:** Association of TAM with ALT Principles

This study's findings, highlight items that may often not be considered in EHR training, but have close association



with adult learning principles. Those with statistically significant correlations at  $< .05$  were perceived usefulness with  $r = 0.55$ , management support, with  $r = 0.43$  and physician involvement, with  $r = 0.20$ .

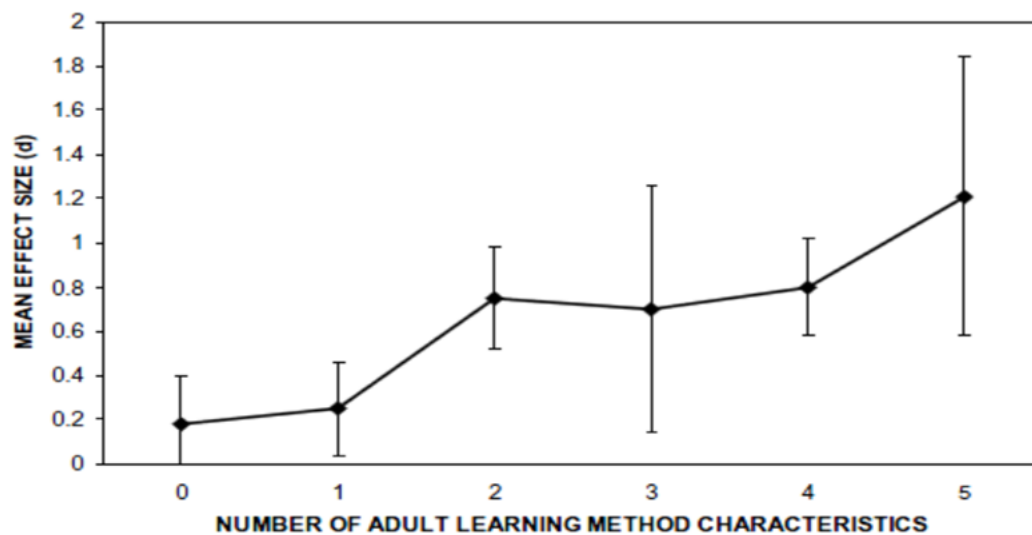
In summary, the literature specific to ALT in the context of the training of clinicians in the effective use of EHRs is limited. Those studies that exist do provide a foundation for future work, and often state the need for such in their discussions.

#### **Non-Healthcare Workplace Application of ALT**

One of the most extensive and rigorous studies of workplace application of ALT was published in *Practical Evaluation Reports* in March of 2009. "Characteristics and Consequences of Adult Learning Methods and Strategies" conducted a meta-analysis of 79 studies using either randomized controlled trials or comparison group designs (Dunst et al., 2010), with 3,152 experimental group participants and 2,988 comparison group participants. Results showed all six adult learning methods were associated with positive outcomes. The study included settings in college classrooms, hospitals and private physician practices; and "various business and work settings" but were limited to years 18

and older. The authors' search of databases was extensive, and was supplemented by hand search of relevant journals.

Among the study's findings was that increasing the number of adult learning principles included increased the overall effect. This is illustrated in Figure 5 below, from the publication.



**Figure 5:** Effect of Multiple Adult Learning Principles  
Used by permission (Dunst et al., 2010)

### Chapter Three: Research Methods

The study will evaluate a scoring tool previously developed and validated to assess documents for evidence of ALT principles in the design and delivery of CME programs, now known as the *Reporting of Adult Learning Principles* (RALP) (Marinopoulos et al., 2007). The methods used in this evaluation are designed to test the feasibility of using the RALP to assess EHR training documents for evidence of ALT principles in the design and delivery of EHR training programs. It is an important distinction that the RALP is designed to assess an entire training program unit at a given point in time, as opposed to the individual documents that make up a training program. Thus the RALP is designed to detect whether or not ALT principles are being used, but not to the extent to which they are used throughout all phases of a training program, nor in all subcomponents of specific educational curricula or lessons. In the original use of the RALP, a training program consisted of a specific CME program. In this proposed application of the RALP, the training program is a specific EHR training program, training Acute Care Hospital (ACH) clinicians in the use of a Computerized Physician Order Entry (CPOE) application.

## **Research Questions**

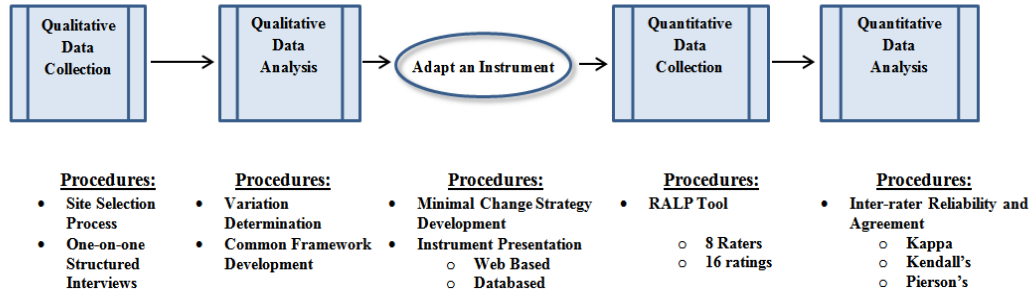
1. What is the degree of inter-rater reliability among raters, for the RALP, as used to evaluate the inclusion of ALT principles in an EHR training program context?
2. What is the level of effectiveness of the RALP's self-contained user training, for the anticipated user of the RALP in the EHR training program context?
3. What are the time demands of the RALP, as used to evaluate the inclusion of ALT principles in an EHR training program context?
4. What is the level of effectiveness of the EHR-RALP Rater Portal in providing the anticipated user of the RALP, in the EHR training program context, an online platform for using the RALP.

## **Study Design**

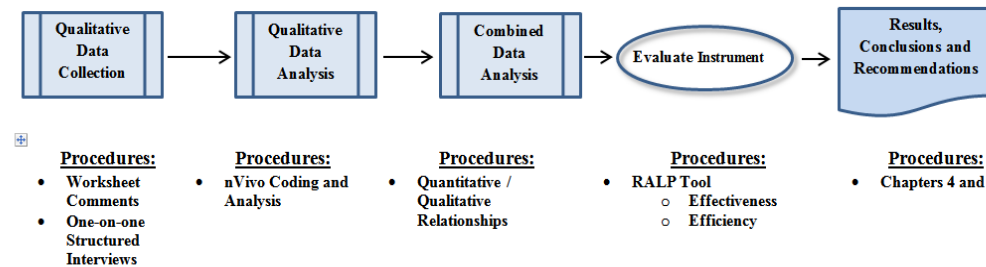
This research is a formative, mixed methods exploratory design study to assess the feasibility of the RALP tool to assess the presence of ALT principles in hospitals' CPOE training programs. The model for this work is shown below in Figure 6.

### Diagram for Mixed Methods Exploratory Design Study

#### PHASE I. Data collection and analysis



#### PHASE II. Data synthesis and interpretation



NOTE: Diagram based on Creswell and Clark (2011) from Meyers and Oetzel (2003)

**Figure 6:** Mixed Methods Exploratory Design Study Diagram  
 Note: Study design applied to Cresswell and Clark model

To accomplish this design goal, the study focuses on a specific EHR training program, CPOE. The study then organizes all the CPOE training documents / materials from four Missouri ACHs on a website for review by the raters. It uses a panel of raters and the PI as a standard expert rater to provide ratings for quantitative and qualitative evaluation. After the rating is completed, a structured debriefing of the eight raters, for a qualitative analysis

of the effectiveness and efficiency of the RALP was conducted, and a quantitative analysis of inter-rater reliability (IRR) between raters, including and excluding the PI as an expert rater was performed.

### **Design Focus on CPOE as an Example of EHR Training**

"Meaningful Use", discussed at length in Chapter 1, has standardized requirements for CPOE. Of the fourteen Core Objectives, five relate specifically to EHR use by clinicians. (<http://www.cms.gov/EHRIncentivePrograms/>)

#### Rationale one

Meaningful Use Core Objectives 1, 3, 4, 5 and 12 represent a subset of the 14 Core Objectives that are uniquely dependent on EHR use by "licensed healthcare professional who can enter orders into the medical record per State, local, and professional guidelines."

(<http://www.cms.gov/EHRIncentivePrograms/>)

Meaningful Use Core Objective	Clinical Staff Category			
	Physician	Nurse	Pharm D	Physician Assistant
CPOE	X	X	X	X
Problem List	X			X
Medication List	X	X	X	X
Allergy List	X	X	X	X
Discharge Instructions	X	X	X	X

**Table 1:** Core Objective / Professional Category Matrix

Table 1 depicts which core objective each profession is involved with for CPOE.

#### Rationale two

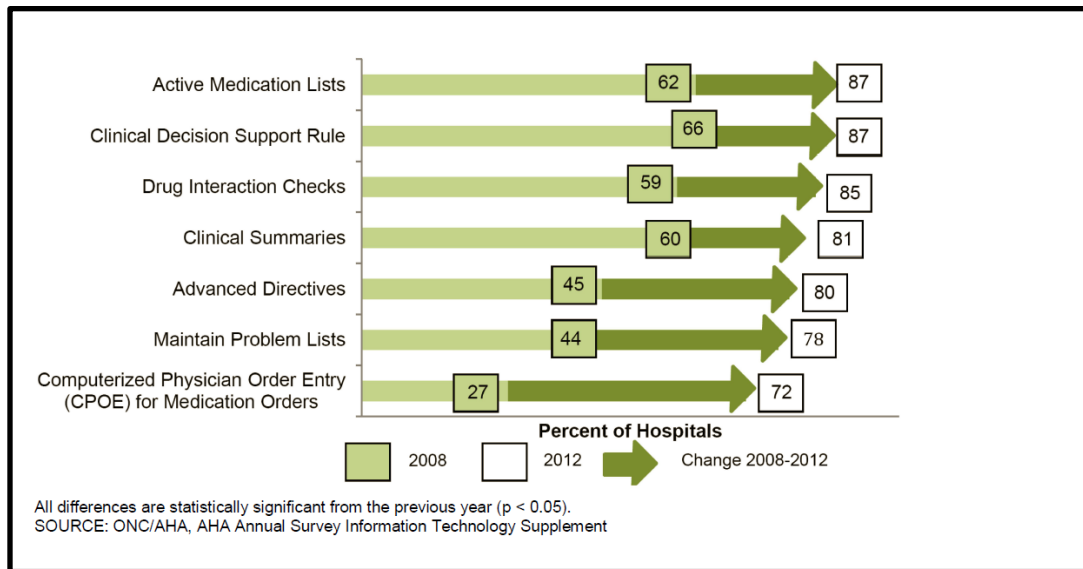
CPOE is normally a self-contained system or module of EHR implementation. Due to its complexity, CPOE is often implemented separately from other EHR applications.

Therefore, CPOE is likely to have specifically designated training materials separate from a range of other EHR training materials / curricula.

#### Rationale three

There has been a rapid increase in CPOE implementations between 2008 and 2012, resulting in a corresponding increase in the need for training programs during this period. According to the Office of the National

Coordinator for Information Technology Data Brief Number 10, dated March of 2013, since 2008, hospital adoption of EHR technology to meet Meaningful Use objectives has increased substantially (King, 2013).



**Figure 7:** Hospital Adoption of EHR Technology 2008-2012

## Data Collection

### Institutional review board (IRB) approval

The study did not seek to evaluate the training designers and trainers themselves, but rather the training design and content. Therefore, the collection and organization the source documents portion of the study received permission from the University of Missouri Health Sciences IRB to proceed without IRB oversight. IRB approval has been granted for the evaluation of raters' use of and



perspectives about the RALP tool's use to evaluate ALT principles in COPE training programs, and is documented in the data collection section.

### Study sites

As this study is intended to conduct a formative evaluation of the feasibility of using the RALP to evaluate adult learning principles in EHR training of CPOE in acute care hospitals, the selection of study sites was guided accordingly. For this study, a purposive sample of four acute care hospitals was drawn from among the 52 ACHs in Missouri receiving Medicaid or Medicare EHR Incentive Program Stage I Meaningful Use Payments as of April 15, 2012.

The decision to choose four study sites was pragmatic, based on the minimum number of hospitals required achieve some diversity of EHR vendor and hospital size. The sample size is justified by the nature and intent of the study; the study is a formative evaluation of the feasibility of using the RALP in the context of EHR training. The study is intended to provide foundational learning about pros and cons of using the RALP in this context.

The rationales for drawing from among these 52 hospitals were three. All hospitals would be known to have EHR's at a maturity level adequate for study, meaning simply that they

did in fact have a CPOE implementation and a CPOE training program in place. As previously noted, Meaningful Use attestation requires efforts by the hospital to achieve not only implementation, but widespread use of the technology by clinicians. Evidence of widespread use, defined as simple majority, was considered in the selection process. The hospitals had to agree to participate, understanding the time and access requirements of the PI.

The purposeful sample was made by starting with a list of Missouri ACHs that had attested for stage one meaningful use by April, 2012. The initial list was reduced to 14 based on existing contacts of the faculty and staff of The Center for Healthcare Quality at the University of Missouri.

The use of a purposeful sample allowed for the application of diversity of study site parameters. The parameters selected were bed size and EHR vendor. The rationale for these parameters came from recent research, as described and cited below.

#### Bed size and vendor

In a 2012 study of the relationship of financial position to EHR adoption by Shen and Ginn, the control variable of number of beds was significantly related to EHR adoption (Shen & Ginn, 2012). The authors could not determine all the

factors involved, but training differences were included. Therefore, to minimize the possible effect of size on EHR training programs, diversity of this factor was desirable. A 2011 Survey of over 2,000 family physicians by the American Academy of Family Physicians found significant variance of physician satisfaction with Hospital provided EHR training, by EHR vendor (Edsall, 2011). Most ACH EHR training programs are dependent somewhat on materials provided by the vendor, although to varying degrees. In this study, some diversity of vendor was considered desirable, to minimize the possible effects of a single vendor's influence.

In summary, as part of this formative evaluation a range of vendors and hospital sizes, that had implemented CPOE, were selected from the original list of Missouri ACHs that had implemented CPOE.

In Table 2 below, the bed size and EHR vendor of the four hospitals selected are displayed. Size and vendor diversity was achieved overall, although not in each category for each hospital. For example, hospitals 2 and 3 are similar in size, but not vendor, while hospitals 1 and 3 share a vendor, but are of different sizes.

RALP STUDY HOSPITALS		
Hospital Name	Beds	Vender
Hospital # 1	60-70	A
Hospital # 2	110-120	B
Hospital # 3	120-130	A
Hospital # 4	300-400	C

**Table 2:** RALP Study Hospitals

#### Document identification and storage

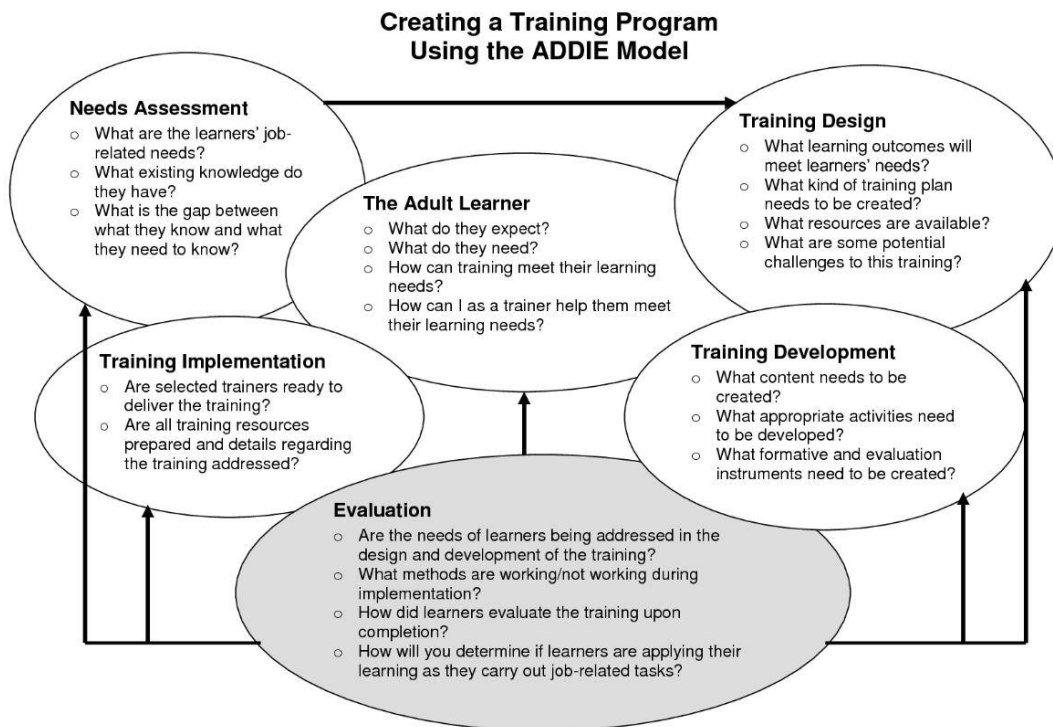
In order to assure that training documents are selected for assessment in a systematic and consistent manner, the framework adopted for uniform selection of training documents across multiple sites is the well-established "ADDIE" model developed in the Industrial Systems Design (ISD) literature (Allen, 2006). This framework consists of five phases, analysis, design, development, implementation, and evaluation. ADDIE takes into account the five elements of that should be present in a well- designed and executed training program of any kind in the workplace (Peterson, 2003). For example, pre-training analysis of unique training needs at each implementation site constitutes the first of five ADDIE components, and will therefore result in specific training documents to be scored. (Allen, 2006) ISD is rooted in cognitive and behavioral psychology, but more recently has influenced thinking in the field of

workforce training. (Allen, 2006) This 5-step process served as the framework for requesting training documents, and is reflected in the structure of the document surfacing tool shown in Appendix III.

The Document surfacing tool was used to aid in the surfacing of training documents. This tool was pilot tested prior to the study, on 2012 EHR training materials at the University of Missouri Hospital. The tool was designed to be "clinician neutral", that is it is based on the ADDIE stages, and not specific to any clinical professional discipline or department / service. At each hospital the tool was provided to the CIO and the individual responsible for EHR training in advance, to allow for initial gathering of relevant information prior to the PI's on-site visit.

Documents were surfaced in a step-wise fashion, beginning with those related to any analysis of training needs conducted prior to training design, and proceeding through each of the five phases. The goal of ADDIE is to be a effective and efficient method to prepare individuals to meet their work requirements (Smith, 2005).

Figure 8 below, is adapted for use here from a public domain figure, and depicts the use of the ADDIE framework in the design of a training program, specifically including ALT principles.



**Figure 8:** Creating a Training Programs Using ADDIE Model

Note: Adapted from Public Domain Model

It should be noted that alternatives to the ADDIE model do exist. Writing in *Advances in Developing Human Resources*, Cowell et al. conduct a thorough review of both ADDIE and its alternatives. They conclude that ADDIE is still the "most commonly used," is "highly effective," and they identify seven alternatives in three categories, which they offer as useful in specific situations and environments (Cowell, Hopkins, McWhorter, & Jorden, 2006).

These strengths and weaknesses of ADDIE compared to alternative models are summarized in Table 3 below.

ADDIE STRENGTHS	ADDIE WEAKNESSES
Fit to wide range of training types and settings	Applies better to entire courses than individual lessons
Considers training from analysis (pre-design) to evaluation (post assessment)	More difficult for retrospective use for trainers inheriting a training program
More suited to training program	Less suited to projects
More suited to trainees of varying expertise	May be cumbersome for simple, individual training needs

**Table 3:** ADDIE Model versus Alternative Design Models

### **ADDIE Alternatives**

Alternatives to ADDIE have been evaluated and described (Cowell et al., 2006). There are the “Instructional Development Focus” frameworks, such as “Instructional Design Method” by Knirk and Gustafson (1986) and Systematic Design of Instruction by Dick, Carey, and Carey (2001) Criticism of the instructional development alternatives point out that compared to ADDIE, they are often too focused on task at the expense of higher level think and learning (*Principles of instructional design, 5th ed,* 2004).

Cowell et al. also described “Performance Focus” frameworks, such as “Performance-Based Instruction” by Brethower and Smalley (1998), “Training for Performance

System" by Swanson (2002) and "Training for Impact" by Robinson and Robinson (1989)

The Performance Focused alternatives offer more promise as a framework for surfacing the key documents needed for the RALP, due to their "learner-based focus" (Holton, Bates, & Naquin, 2000). The drawback to these frameworks is that in being more process oriented, they contain more steps, up to twelve in some cases. These additional steps, such as "design tracking systems" in the Training for Impact model, make their use as a simple organizing framework unduly complicated.

ADDIE is commonly used and judged still effective and is often associated with Adult Learning Theory (Stern & Kaur, 2010). It was found to be the simplest, most accessible framework for use in this study.

#### **Data Collection Protocol**

It is an important distinction that for the purpose of this study, "documents" included not only paper documents, but electronic files, web pages, slide presentations, videos; and any other print or electronic media used to convey EHR training. Therefore, the specific document categories requested, and the criteria for their acceptance reflected the ADDIE model as follows:



**Analysis:** All documents related to the analysis of EHR training needs at the specific training site. Examples might include survey questions, interview questions, data collection forms, and other documents used to aid in systematic analysis of the EHR training needs of an implementation site prior to training occurring, regardless of format or media type.

**Design:** References, manuals, and guides used to aid in the design of EHR training programs for the specific training site. Examples would include sample lesson plans, syllabi, and other documents intended to assist the training designer, regardless of format or media type.

**Development:** All training documents and materials actually developed for the EHR trainer(s) for each specific training site. These are the actual lesson plans, syllabi, and other documents provided for use at a specific training site, regardless of format or media type.

**Implementation:** All training documents and materials implemented by trainers currently in use at each training site. These are the actual lesson plans, syllabi, and other documents that were actually used by trainers, regardless of format or media type.

**Evaluation:** All training documents and materials used by trainers to evaluate the training, at each training site.

(Not to include the training evaluation results.) These documents might include tests, surveys, feedback forms, and other evaluation documents, regardless of media type. At each hospital, the PI adhered to a standard format for data collection. An example is depicted in Figure 9.

Task Days															
Task Name	Start	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Meet with CIO	2/4														
Work with Lead EHR trainer	2/7														
Wrap-up meeting with EHR trainer	2/14														

**Figure 9:** Example Data Collection Protocol

The data collection was performed in the same manner and sequence at each of the four ACH study sites. First, the PI met with Chief Information Officer or nearest equivalent, reviewed the study and identified key personnel. The PI signed a confidentiality agreement, if requested by the individual hospital, restricting the use of the hospital's identity.

Next, the PI met with individual directly responsible for EHR Training; hereafter referred to as "Trainer." The PI and Trainer reviewed all pre-assembled documents. Then the Trainer demonstrated CPOE training to PI. The purpose of

this demonstration was to aid in identifying any trainer guides, or CPOE demonstration "screen shots" that should be included.

Next, the PI and Trainer together used a document surfacing tool to attempt to include any documents not pre-assembled by the Trainer. The PI reached an agreement with the Trainer to provide documents, not provided while onsite, to PI within one week. Most documents were provided on site, and/or access was granted to online storage. In no case did Trainer request more time before considering document provision to be complete.

#### Contextual data collection

In an attempt to understand each hospital's EHR training "within the social, cultural, economic and political environment" contextual data were also reviewed (Hentschel, 1999). This data were collected solely overcome any preconceptions of the chief trainer as to what might constitute an EHR training document. Examples of documents collected that were not included in the RALP scoring, but were helpful to the PI in surfacing all training documents included training rosters and policy information concerning "opt out," that is hospital policies about whether or not a physician could delegate use of CPOE to another hospital employee. The use of contract, 3<sup>rd</sup> party, and/or consultant

trainers and training designers was considered, as was the use of "train the trainer," "super-user," or other mentoring / modeling strategies.

The secondary purpose of this review was to make one last attempt to assure all training documents had been included. In some cases the exercise did call to the Trainer's mind additional documents.

### **Rater Selection Process**

The intent of the rater recruitment and selection process was to result in a pool of raters that would be similar in professional and educational background to those encountered in the pilot and study hospitals. Recruitment of the raters was accomplished by postings in the buildings associated with schools of education, nursing, life sciences, and computational sciences. Raters were selected at random, accepting volunteers on a first come, first serve basis, as long as they promised to complete the process within one week, agreed to follow the directions in the web portal, and consented to a post rating interview. According to the guidelines for an EHR Trainer from the Community College Consortia to Educate Health Information Technology Professionals, EHR trainers should be developed from essentially this same range of backgrounds to fill the

needs of the future (<http://www.healthit.gov/policy-researchers-implementers/community-college-consortia>).

The general description of the role calls for a previous background of health professionals, health information management specialists, or medical librarians. Experience as a trainer in the classroom is also desired, with a need to utilize ALT. Matching the backgrounds of the raters to the EHR trainers in the field was an important basis for the following discussion of rater training needs. The study's evaluation and recommendations for rater training needs is predicated on this determination of the likely end-user of the instrument.

By agreement between the PI and the study hospitals, and in keeping with the IRB application, demographic data were not recorded on an individual or hospital basis, thus limiting additional analysis.

#### Post rating qualitative data collection

A standardized qualitative "debriefing" of the raters in this study was developed and is described here. Referred to as the "Structured Interview," this document was developed by the PI to assure consistency in the post-rating interviews with each rater.

Each rater agreed to, in addition to performing the RALP rating, a debriefing interview to be conducted by the PI. Each agreed to be available by phone or in person for a period of 15 to 30 minutes. Each interview was conducted using standard guide questions. If the interviewee wished to make comments unrelated to the questions it was allowed and recorded. The debriefing, along with comments entered into the RALP Worksheet, formed the basis for a qualitative evaluation to address the second and third research questions. The debriefing source document is provided as Appendix I.

#### Rater data collection

Figure 10 below, depicts a screenshot of the EHR-RALP Rater Web Portal used to provide access to Training Documents, the RALP Scoring Tool and General Instructions to the raters.

# EHR-RALP RATER PORTAL

Everything You Need to Review and Score Your EHR Training Content.

## RATER RESOURCES

### Help with Adult Learning Principles

The links below open brief basic primers on the principles of Adult Learning Theory, written specifically about clinician learners. If you need a quick "primer" on Adult Learning Theory, you may find them useful. They are not required.

#### Adult Learning Theory References

- [ABCs of Learning and Teaching in Medicine from BJM](#)
- [ANA's Concise Principles of Adult Learning Theory](#)
- [Adult Learning Theory and Principles for Clinicians](#)

## RALP RATER INSTRUCTIONS

### Important, read this section first!

The complete "Introduction to RALP" can be found, [BY CLICKING HERE](#).

A "Document Review Guide" should be viewed here, [Document Review Guide](#) with instructions on organizing your review.

As a RALP Evaluator for this study, you will be looking for evidence of the application of Adult Learning Principles in the content of Computerized Provider Order Entry (CPOE) training documents at an individual acute care hospital.

For the purpose of this study "documents" will include training materials of any media type, such as paper, Word documents, PDFs, videos, websites, and interactive learning modules.

You will not be evaluating survey results, or descriptions of training by trainers or learners.

RALP consists of nine standard questions for which you will assign a value of "good" (2 points), "fair" (1 point), or "poor" (0 points) for each question. Each question will have its own unique instructions to guide you in assigning a score.

## Quick Links

- [HOSPITAL TRAINING CONTENT](#)
- [RALP WORKSHEET](#)
- [RALP TOOL CLICK HERE](#)

[Training Content](#)
[Rater Worksheet](#)
[RALP Scoring Tool](#)

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**Figure 10:** EHR – RALP Rater Portal

The study **EHR-RALP RATER Portal** was designed by the PI. It was designed to provide a working environment similar to how it would be used in the "real world" context. That is, the training designer, developer, hospital staff charged with evaluating the EHR training program, or other user of the RALP, would be able to access training documents,

instructions, references and the RALP all from one online location.

The development of the Study Rater Portal is an additional, but important, product of this study. Certainly the EHR-RALP Rater Portal could be produced in a hard copy format, perhaps in a workbook format. In every instance during this study, the ACH EHR trainers and training designers preferred to work in an online environment. Most, if not all, of their training content existed solely online. Their personal references were stored in the same general location as the training documents.

#### EHR-RALP rater portal functionality

As displayed in Figure 10 above, the RRP opens to a home page. This page is public access. Displayed in the center position is the RALP Rater Instructions. These instructions are clearly labeled "Important, read this first." This link led to the instruction page.

#### Rater Document Review Decision Instructions

The entire "Rater Document Review Instructions" document is included below, exactly as it appears in to the raters.



## **Rater Document Review Instructions**

### **General Instructions:**

1. The total time required prior to using the scoring tool (RALP) is estimated to be between one and two hours, depending on the individual, and the amount of EHR training material for the particular training site you are rating. Total time spent in preparation is not expected to exceed three hours. Please track your total time spent in preparation and in the actual scoring.
2. Although the RALP tool can be completed in far less than the estimated 30 minutes, please take some time to add your comments and observations to each question. This feedback is extremely helpful. Please make a note about any of the nine (9) RALP questions you found difficult to score. Remember to note the reason or evidence for each score.

### **Instructions for Material Review:**

#### **1. Orientation to Training Materials.**

All raters should begin document review by familiarizing themselves with the available documents, videos and other training materials for the hospital they are rating. This can be accomplished by observing the content file names in each category; ADDIE Phase, Media Type and Training Content Type. Some materials will appear in multiple categories, but have a look at each category list.

#### **2. Introductory Materials.**

The rater should begin by viewing, in their entirety, any documents in the EHR Training Category labeled INTRODUCTION. These documents consist of basic overviews of the hospital's training process for the CPOE system.

#### **3. Interactive Media.**

Materials in the Interactive Media category should be assessed next, if any exist. Any interactive materials, requiring input on the part of the learner in order to proceed, will be included in this category. Not all hospitals provide Interactive Media Training.

#### **4. Basic CPOE Training Materials.**

Then review the category of Basic CPOE Training Materials. These materials provide the basic CPOE training that all CPOE users need.

#### **5. Other Categories.**

Then review the Advanced Training Materials Category. Specialized or advanced training for more specific user needs will be here. Finally, look at the ADDIE Evaluation Category for evidence of post training evaluation, and the ADDIE Design and Development Categories for evidence of user input or involvement into the training program.

#### **6. Use the Scoring Worksheet.**

Use the scoring worksheet to gather evidence for actual scoring. If you are unsure about a question, look back in more detail at the training materials to attempt to ascertain the appropriate scoring evidence. You do not need to make judgments about the quality of the material. Use the comments section of the worksheet to note the reason or evidence that you used to assign the score that you gave for each question. The scoring worksheet can be saved or printed at any time.

**Figure 11:** Rater Document Review Instructions

### Quick links section

This section, also seen in Figure 10, provides home page access to the training content, the rating worksheet, and the RALP scoring tool.

These links are password secured. Each rater has access to only the two hospitals' training materials they have been assigned to, and no one other than the raters can access any hospital training material.

### Rater worksheet

The Rater Worksheet, although intended to be useful to the raters, has a primary function of recording information about the raters' decision processes. In the following example of the RALP rater Worksheet, the rater has made the appropriate notes about the reasons or evidence for the yes or no for each part of RALP question number one.

The RALP rater worksheet, example with rater feedback included is provided as figure 12 below.

**1. To what extent does the training program enable learners to be active contributors to their learning?**

RALP is looking for evidence of the following:

- a. learners identify/choose a question OR
- b. actively contribute to finding the answer OR
- c. teach the results of their learning to others

<u>ITEM</u>	<u>NOTES</u>	<u>Y/N</u>
A. Learners identify/choose a question	Learners can choose from references that may match their question.	y
B. Learners actively contribute to finding the answer	Yes in the interactive modules	y
C. Learners teach the results of their learning to others	No examples found	n

**Figure 12:** RALP Rater Worksheet Example

### Worksheet purpose

The purpose of the worksheet is to provide the PI with information about the evidence gathered by the rater in making their rating. Secondly, it allows the rater a means of working through the RALP Tool questions at their convenience, allowing the rater to save or print out the work they have done at any given point.

### The RALP scoring tool

The RALP instrument asks the rater to find and report the existence of adult learning principles, but it does not presuppose the rater has knowledge of ALT. It does this by asking raters to verify the existence of a particular "trait" or attribute of the training materials, which is defined for the rater within the context of the category. The original users of the RALP did not have prior training in ALT, nor receive any preparation other than that provided by the tool itself.

The entire RALP scoring tool is reproduced in Appendix II. In the actual web-based tool, all questions required an answer to proceed to another question, or to submit ratings.

## **Data Security and Privacy**

Documents from each study site were coded with an ID number, with the actual site identity blinded to the panel. Two hospitals were assigned for scoring among panels of four, randomly chosen from the eight raters, such that each rater rated two hospitals, and each hospital was rated four times.

In keeping with the agreements made with each hospital, data given to the PI, whether in hard copy or digital format, was managed and secured. If hard copy, the data were scanned into PDF format. Scanned documents were saved on the PI's dedicated research laptop. The scanned documents were de-identified for hospital and vender. One copy was made to the PI's dedicated research desktop computer in a locked office at the Center for Health Care Quality at the University of Missouri. The original document is stored in that office, to be destroyed at the conclusion of the study.

All digital files were downloaded and saved on the PI's dedicated research laptop. The saved documents were de-identified for hospital and vender. One copy was made to the PI's dedicated research desktop computer in a locked office at the Center for Health Care Quality at the

University of Missouri. The original files are to be destroyed at the conclusion of the study.

The de-identified files' hospital identities remain known to the PI by their arrangement in file folders. The de-identified files are then used in the Secure Web Portal designed and built by the PI, for use by the Rater Panel. The raters do not know the identity of the hospital whose documents they are rating. Raters were assigned a unique ID and password to sign in to the Web Portal to perform the RALP ratings. Rater's access was limited to the two hospitals they are assigned to. Rater's access was removed when they completed their ratings.

The Web Portal was taken off-line at the completion of the study. Rating results are stored in a password secured database, with access only by the PI.

#### **Independent RALP Scoring by the PI**

The PI, who has extensive experience in the use of EHRs, and Doctoral level coursework in ALT, independently scored each hospital training program. This action was taken to uncover potential strengths and limitation of the RALP tool, by providing a rating by someone with expertise in both EHRs and ALT to compare to those of the raters.

### **Rater Selection, Training, and Performance**

The source document scoring with the RALP instrument was conducted by means of panels of eight evaluators. These evaluators were recruited from students at the University of Missouri, Columbia. Because the training documents originated in an ACH, the IRB-H claimed jurisdiction. IRB approval for the rating phase of the study was secured under review number 112266. One amendment was required to increase the number of raters from four to eight.

A very general population of students was used because there is not a standardized background for ACH EHR trainers and training designers. The educational backgrounds of trainers and designers in the study and pilot hospitals varied widely including those with and without undergraduate and graduate degrees.

#### Rater training

The RALP instrument was designed not to require extensive rater training or a separate manual, to achieve inter-rater reliability (IRR). According to the RALP's author, IRR was achieved using only the self-contained instructions provided for each rating category. (Private email, Dr. Boonyasai, June 26, 2012)

By self-contained, it is meant that the creators of the RALP embedded instructions for each question, rather than

general instructions or training for the RALP as a whole. For example, question number one includes the instructions following the question.

**To what extent does the training program enable learners to be active contributors to their learning?**

GOOD - Two or more of the following: learners identify/choose a question OR actively contribute to finding the answer OR teach the results of their learning to others

FAIR - Only one from "GOOD" or none but the training program employed partially active learning methods such as interactive lectures or group discussions

POOR - None of the criteria from GOOD or FAIR

Targeting training to anticipated RALP end-users

The anticipated end-users of the RALP, once demonstrated as feasible for use in EHR training, would include designers of EHR training Programs, EHR Training Program Trainers and PhD researchers in the field of EHR Training.

Understanding the identities of the anticipated users of the RALP for the purpose of EHR Training is a critical concept in this study, with important implications for the methodology of the study. One way to appreciate these



implications are to consider the similarities and differences between the anticipated users.

In terms of similarities, all of the anticipated users would have some post-secondary level of education. Most of the anticipated users would have some basic familiarity with healthcare, computers, and workforce training, by virtue of their current positions.

In terms of differences, a subset of anticipated users may have advanced formal education ranging from Master's degree to PhD. Raters used by another researcher may not be similar to the likely end-users found in the workplace.

Raters used in a research study that were not taken from a population of end-users could be of a different background, affecting the results.

The RALP instrument does not ask the rater any questions about technical aspects of the EHR system, or any questions requiring knowledge of a clinical area, specialty or medical terminology.

If the RALP instrument is to prove useful to the designers and providers of EHR Training, it is preferable that it does not require training beyond the ability of the user to understand it, and follow its directions, given the variety of users and the time constraints most of them already face.

A standardized qualitative "debriefing" of the raters in this study was conducted and is described here. Referred to as the "Rater Debriefing Protocol," this document was developed by the PI to assure consistency in the post-rating interviews with each rater.

### **Rater Debriefing Protocol**

Each rater agreed to, in addition to performing the RALP rating, a debriefing interview to be conducted by the PI. Each agreed to be available by phone or in person for a period of 15 to 30 minutes. Each interview was conducted using standard guide questions. If the interviewee wished to make comments unrelated to the questions it was allowed and recorded. The debriefing, along with comments entered into the RALP Worksheet, formed the basis for a qualitative evaluation to address the second and third research questions; what is the level of effectiveness of the RALP's self-contained user training, and what are the time demands of the RALP? The structured interview questions were designed to inquire into the raters' reasons for their decisions. The PI could then evaluate the degree of evidence based decision making employed by the raters making these decisions. The structured interview questions are provided in their entirety as Appendix I.

## **Identification of Potential Training Issues**

Potential factors that may affect the feasibility of the RALP in the context of EHR Training Programs were identified by the PI to help guide planned qualitative analysis. The first issue identified was the rater's knowledge level of clinical terms used in the naming or content of the training program materials. How might this affect ability to assign a rating? Next, was the rater's level of knowledge of EHR terminology and operation. What effect might this have? Finally, was the raters' understanding of the ALT principles behind the RALP questions. Would the raters find this factor to be important?

The PI, as the expert rater, compared not only his ratings with those of the panelists, but his comments on a question-by-question basis. These comparisons were included in the qualitative analysis contributing the feasibility study of the RALP and the EHR-RALP Rater Portal.

## **Analysis Plan**

The RALP Scoring Tool data were analyzed according to the Mixed Methods Exploratory Design Study Model, beginning with the quantitative data analysis block at the end of Phase I.

### Inter-rater reliability

Inter-rater reliability was calculated for the eight raters alone, and for the eight raters and the PI together. The PI served as an “expert” rater, given his previous experience as a clinician and EHR project manager, and his graduate training in both informatics and ALT.

Ratings for each hospital are expected to vary with the quality and design of the training programs at each study site, but the individual hospital scores are not the subject of this study.

### Number of raters, number of sites, and IRR

Although sometimes used interchangeably, IRR should be considered as referring to the relative consistency in ratings provided by multiple judges of multiple sites, and IRA should be used to refer to the absolute consensus in scores furnished by multiple judges for one or more sites (LeBreton & Senter, 2008). In this evaluation, reliability, or consistency, of the tool, will be important, in order to make initial observations about the tool itself (Kozlowski & Hattrup, 1992).

### Determining the number of raters and subjects

The decision to use the RALP meant that the number of items and the rating scale are fixed. The initial plan of research, called for four acute care hospital sites, and

four raters, with each rater rating four hospitals. It became apparent that at allowable incentive levels, raters could not be recruited that were willing to rate four hospitals each. Therefore, the number of raters was increased to eight, each rating two hospitals.

This compromise, though not optimal, was the best solution given the funding constraints of the study, taking into account the exploratory, foundational nature of the study, and understanding the potential limitations it may impose on research publication and grant funding.

#### IRR in ill-structured measurement designs

The resulting structure of raters and rates posed some technical challenges for the calculation of IRR. While it is important to assess the reliability of judgments made by raters, unreliable measurements and their use in analyses can frequently violate statistical assumptions. Intra-class correlations are often used to provide measures of reliability, but many forms exist and each is appropriate only in specific circumstances (Shrout & Fleiss, 1979).

This study model is best described as in statistical terms as an “Ill-Structured Measurement Design” that is not fully crossed or nested (Putka, Le, McCloy, & Diaz, 2008). Putka and coauthors developed and validated a specific analysis approach for such studies,  $-G(q,k)-$  that resolves problems

with traditional estimators and is appropriate for ill-structured designs. This approach is used for calculating IRR in this research. Specifically, the method used involved summing up the individual question scores. The resulting calculation was designated RALPS, where the "S" stands for score. The method was chosen to focus on IRR for the overall score assigned by the raters, rather than an analysis of the individual RALP questions.

#### Qualitative methods

For the qualitative portion of the evaluation, comments from the individual raters, and the expert rater, made on the RALP Scoring Tool, and responses from the structured debriefing interview were matched, stored and coded using NVivo 10© software.

NVivo is a comprehensive qualitative data analysis software package. The software can be used to organize and analyze interviews, field notes, textual sources, and other types of qualitative data. The researcher may use pre-constructed coding schemes, but a "bottom-up" approach was used in this study by creating codes on the fly, allowing themes to arise from the data.

This approach, often referred to as Grounded Theory Method (GTM) is well established in qualitative research as a

means of limiting the effects of researcher bias (Zarif, 2012).

This coded qualitative data were classified according themes, and reported in the findings in terms of the structured interview questions, and in answer to the research questions. In the Data Synthesis and Combined Data Analysis phase, quantitative data derived from the NVivo database, such as calculations of evidence based rating based on comment coding, were combined in analysis with previously derived quantitative data, such as percentage agreement between PI Standard rating and Panel Rating.

#### Use of NVivo for qualitative analysis

Currently, institutions in the forefront of qualitative research design, such as the University of Massachusetts Lowell, are using NVivo as the primary software tool.

(<http://continuinged.uml.edu/qualitativeresearch.htm>)

The University of Massachusetts Lowell cites QSR International's NVivo software, as "widely-recognized as an industry standard software application for qualitative research."

According to QRS, NVivo is intended to help users organize and analyze non-numerical or unstructured data. It allows users to classify, sort and arrange information; examine

relationships in the data; and combine analysis with linking, searching and modeling.

NVivo supports data formats such as audio files, videos, digital photos, Word, PDF, spreadsheets, rich text, plain text and web data. This flexibility made it an ideal tool for use in managing the unstructured and non-numeric data collected in the qualitative phases of the study.



## **Chapter Four: Results**

### **Introduction**

The study results are presented in this chapter. The data reflect the mixed methods approach, outlined in the Diagram for Mixed Methods Exploratory Design Study. In the initial data collection and analysis phase, subjective data concerning the EHR training practices of each hospital were collected. Then, quantitative data collection and analysis was collected in the form of the actual RALP ratings, and the statistical analysis of the ratings.

In phase II, "Data Synthesis and Interpretation", secondary qualitative data collection and analysis was employed by conducting interviews and soliciting post-rating feedback from the raters. Analysis was performed using NVivo to code and categorize the interviews and comments of the raters. Finally, to complete phase II, combined data analysis, utilizing both qualitative and quantitative results, was used to uncover new insights and triangulate conclusions.

## **Initial Qualitative Data**

The study began with extensive field work at the selected ACH study sites. This consisted of preparatory work conducted by phone and email, and culminating in every case with a full day at the study site, as described in the methods section. The findings of the pre-rating hospital visits and interviews informed the design of the study. In regards to information about the structure and execution of the EHR Training Programs at each ACH, there are important similarities and differences. In terms of similarities all four hospitals took primary responsibility for the EHR Training Programs, as opposed to contracting them out to the EHR vender, or a third party. All four hospitals, by the time they had reached the level of general EHR implementation required to implement CPOE, had made the decision to focus training resources on one-on-one sessions with physicians.

In terms of differences, the four hospitals varied widely in the amount and scope of training materials that existed in some tangible format. Two of the four study sites had difficulty locating training materials in either hard copy or digital format. Training at these hospitals was performed by a specific individual, who held the training almost entirely in her memory. At one of the two, once prompted, the trainer was able to locate original documents she had used to plan and initially deliver training. Limited written training materials were later identified for trainees, but they had fallen into disuse. At the other hospital lacking in tangible training materials, few hard copy or digital records were ever located. This range of tangible training materials is illustrated in table 4.

<b>Hospital Number</b>	<b>Number of Training Documents</b>	<b>Number of Media Types</b>	<b>ADDIE Levels</b>
<b>One</b>	6	2	1
<b>Two</b>	12	2	4
<b>Three</b>	6	3	2
<b>Four</b>	16	2	5

**Table 4:** Range of Training Documentation

### Summary of pre-rating qualitative findings

All study hospitals had in-house EHR training programs. All study hospitals employed one-on-one physician EHR training. All study hospitals recognized that some of their EHR training programs were undocumented, resulting in institutional memory risk and difficulty in conducting program evaluation. Lack of EHR training program documentation, evident in at least two of the hospitals, was identified as a potential factor in the scoring of training content by the RALP Tool.

The potential effects of this variation in the number of documents that would become available to the raters, the media types, (Video, PDF, etc.) and the ADDIE Levels to which the documents pertained noted here will be discussed in Chapter Five.

### **Quantitative Data Collection, RALP Scoring Tool Results**

#### Use of RALP score (RALPS) to calculate IRR

As introduced in the methods section, the primary quantitative outcome from the RALP in this study was about a single quantitative score computed by summing the individual questions. This score is designated RALPS, where the S stand for Score.

Table 5 below depicts the raw scores for each rater for each hospital, the standard rating by the PI for that

hospital, and The RALPS number across the lower row. The RALP questions are available in Appendix II.

RALP Question	Hospital 1					Hospital 2					Hospital 3					Hospital 4				
	R1	R4	R6	R8	PI	R1	R2	R6	R8	PI	R2	R3	R5	R7	PI	R3	R4	R5	R7	PI
<b>1</b>	0	0	1	0	2	0	1	1	2	2	1	1	2	0	2	0	1	2	1	2
<b>2</b>	1	2	1	1	1	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1
<b>3</b>	0	2	1	1	0	1	2	1	1	2	2	2	2	1	0	1	2	2	2	2
<b>4</b>	0	0	1	0	1	2	1	0	1	1	1	1	1	1	2	2	1	2	0	1
<b>5</b>	2	1	1	0	2	2	2	1	1	2	2	0	2	1	1	1	1	2	1	1
<b>6</b>	1	1	1	1	1	1	1	0	2	2	2	1	2	2	1	1	2	1	1	2
<b>7</b>	0	0	0	0	1	1	1	0	1	2	1	0	2	1	1	0	0	1	2	1
<b>8</b>	0	1	1	0	1	0	0	1	1	1	1	1	2	1	1	1	1	2	2	2
<b>9</b>	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	2	1	1	1
<b>RALPS</b>	4	7	7	3	10	10	10	7	12	15	13	9	16	10	11	7	12	15	12	13

**Table 5:** Consolidated RALP and RALPS Data

### **Inter-Rater Reliability**

The reliability measure is  $G(q,k)=0.824$  with raters alone, and  $G(q,k)=0.785$  including the PI expert rater. This measure,  $G(q,k)$ , can be interpreted like an ICC, which is categorized as follows (Landis & Koch, 1977). IRR is calculated based on RALPS, not its individual components.

A range of 0-0.2 indicates *poor* agreement. A range of 0.3-0.4 indicates *fair* agreement. A range of 0.5-0.6 indicates moderate agreement. A range of 0.7-0.8 indicates *strong* agreement and a range of  $>0.8$  indicates *very strong* agreement.

According to the authors, "This value [ $G(q,k)$ ] reflects the reliability of the mean rating for each ratee—that is, the proportion of expected observed score variance attributable to true score variance" (Putka et al., 2008).

For the raters alone,  $G(q,k)=0.824$ , when averaging across raters, which means that 82.4% of the variability in the mean score is due to the ratee (i.e., hospital). This indicates a high level of reliability.

### Results for Calculation of $G(q,k)$

Table 6 lists the results for calculation of  $G(q,k)$ .

The symbol "q" represents a multiplier that scales the contribution of variance attributable to rater main effects (e.g., leniency/severity differences). The symbol "k" represents the harmonic mean number of raters per ratee.

VarT represents ratee main effects (true score), and Var r represents rater main effects. VarTre represents the combination of the Ratee \_ Rater interaction and residual effects (which are confounded).

$G(q,k)$	q	k	VarT	VarR	VarTre
0.824	0.167	4	7.532	2.7	4.63

**Table 6:** IRR for Raters Only

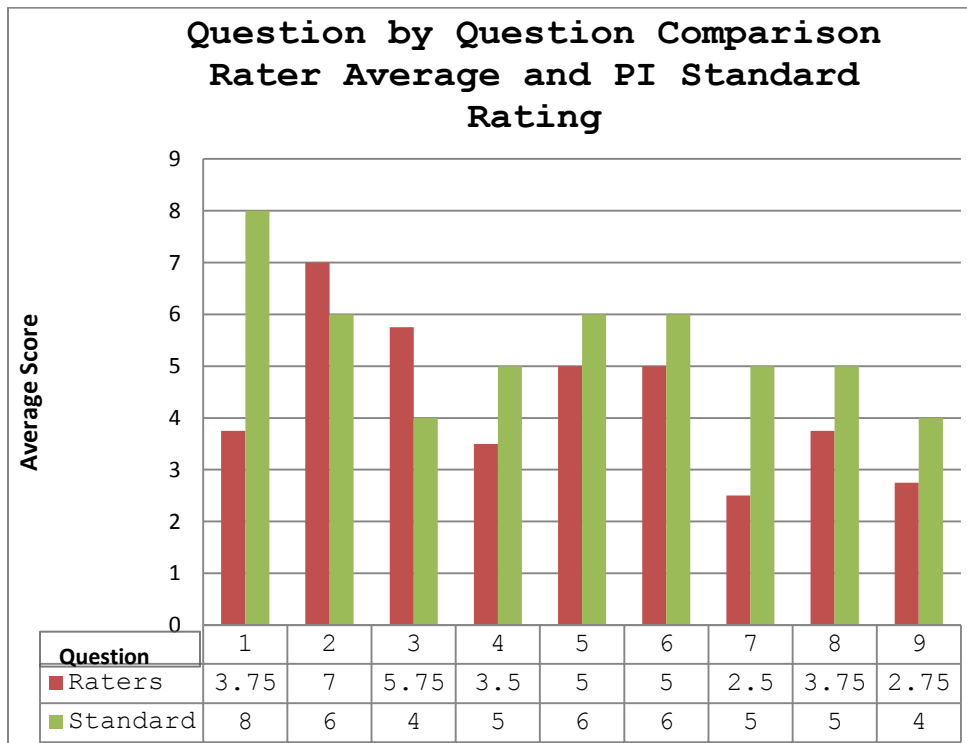
$G(q,k)$	q	k	VarT	VarR	VarTre
0.785	0.107	5	4.813	3.723	4.605

**Table 7:** IRR for Raters and PI

For the raters and the PI together,  $G(q,k)=0.785$ , when averaging across raters, means that 78.5% of the variability in the mean score is due to the ratee



(i.e., hospital). This also indicates a high level of reliability.



**Figure 12:** Question Comparison Rater and PI

On a question-by-question basis, questions one and seven stand out at having more difference between raters and the PI standard than the other question. This is explored further in Chapter Five.

#### Summary of quantitative findings for the RALP

A high level of reliability was measured between raters. No significant difference in IRR is evident when including the PI expert rater in the raters. Implications of this agreement between raters and PI

will be discussed in Chapter 5. Two RALP questions displayed more disagreement between raters and PI rater than other questions. These were questions #1 and #7.

### **Data Synthesis and Interpretation**

The raters were instructed to keep track of time spent preparing to use the RALP Tool including filling out the worksheets and entering the RALP scores. It was not possible to use the time that raters were logged into the computer because raters could independently determine their own work pace, including when to start, stop, or pause in the review process. Thus time required to use the RALP represents raters' estimates.

Descriptive statistics concerning the time required by the raters to use the RALP, including preparing to rate and actual rating time, is depicted in table 8.

<b>Rater</b>	<b>Prep Time</b>	<b>RALP Tool Time</b>		<b>Total Time</b>	
R1 (H1,H2)	90	10		100	
R2 (H2,H3)	75	25		100	
R3 (H3,H4)	45	12		57	
R4 (H1,H4)	75	15		90	
R5 (H3,H4)	90	15		105	
R6 (H1,H2)	90	15		105	
R7 (H3,H4)	75	15		90	
R8 (H1,H2)	40	15		55	
<b>Averages</b>	<b>73</b>	<b>15</b>		<b>88</b>	
<b>Prep Time</b>		<b>RALP Time</b>		<b>Total Time</b>	
Mean	73	Mean	15	Mean	88
Median	75	Median	15	Median	95
Mode	90	Mode	15	Mode	100
Standard Deviation	20	Standard Deviation	4	Standard Deviation	20
Minimum	40	Minimum	10	Minimum	55
Maximum	90	Maximum	25	Maximum	105
Count	8	Count	8	Count	8

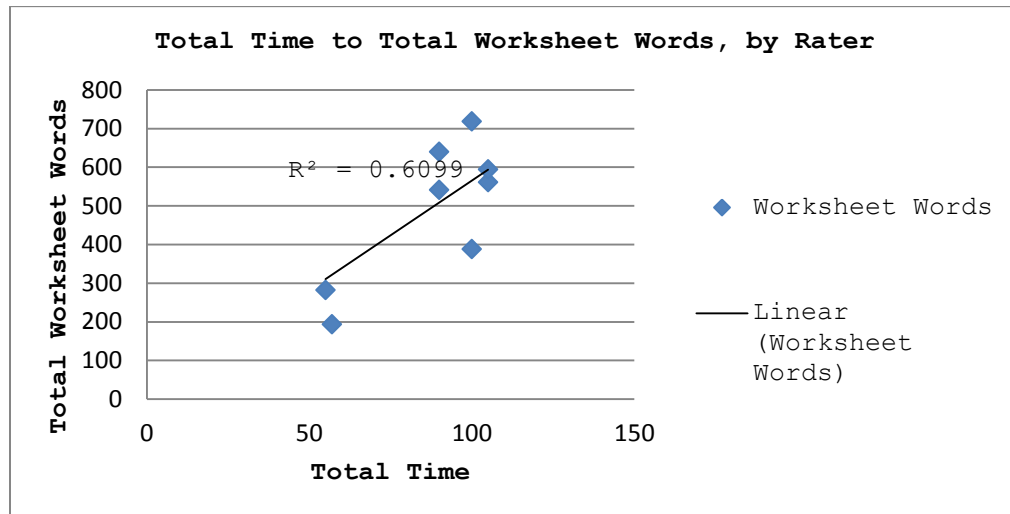
**Table 8:** RALP Rater Time Characteristics

Total Comment Word Count was also calculated. This count is the total number of words used by each rater to comment on their ratings.

<b>Rater</b>	<b>Word Count Worksheet</b>
R1	388
R2	718
R3	193
R4	541
R5	561
R6	594
R7	640
R8	282
<b>Average</b>	<b>490</b>

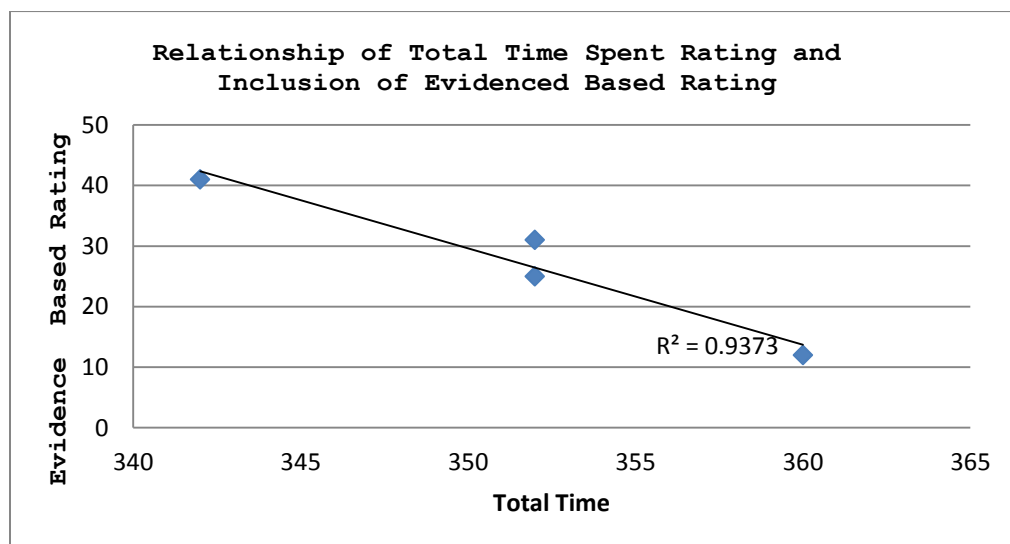
**Table 9:** RALP Rater Effort Characteristics

The apparent variability of time spent, and word counts by different raters, was explored and the results are displayed in Figures 13 and 14 below.



**Figure 13:** Worksheet Time to Words Commented

Figure 13 demonstrates the amount variance of time spent explained by total words commented.



**Figure 14:** Total Time to Inclusion of Evidence-based Rating

In Figure 14, we see that total time is inversely related to the use of Evidence Based Rating. Rater feedback indicated that this is due to how time consuming, and fruitless, it was to search for evidence in some hospital's training content.

### **Coding of RALP Comments for Evidenced Based Rating**

All rater comments from the Rater Worksheet were scored by the PI on the degree to which the comment cited the evidence for the rating given. The scoring rubric is shown below in tables 10 and 11.

<b>Classification</b>	
<b>1.</b> Comment does not describe the evidence, or the rationale, for the rating.	1
<b>2.</b> Comment gives general, non-specific, evidence or rationale for the rating.	2
<b>3.</b> Comment gives some specific evidence or rationale for the rating. (gives an example)	3
<b>4.</b> Comment cites specific document or documents as evidence or rationale for the rating.	4
<b>5.</b> Comment cites specific document(s) and specific example(s)	5

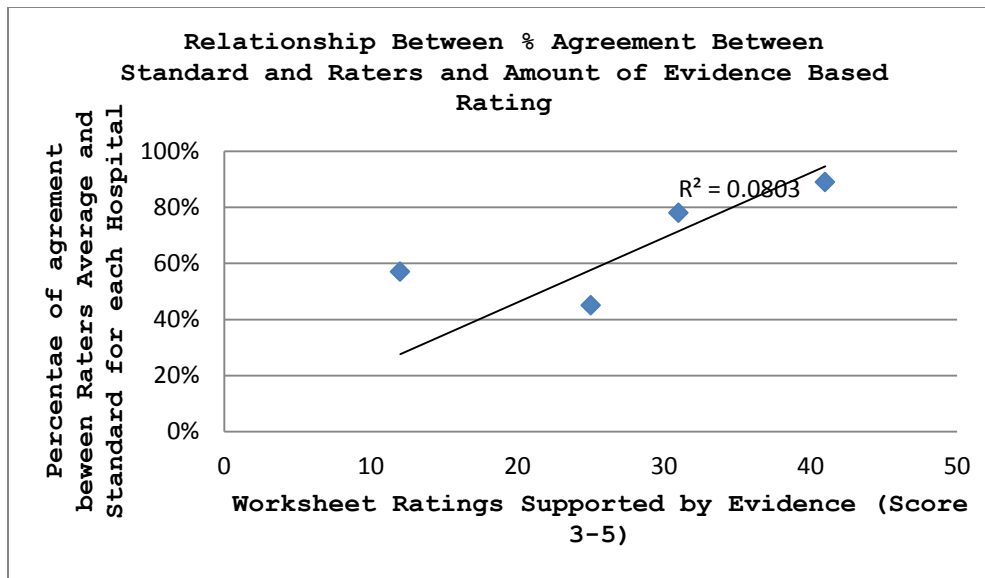
**Table 10:** Comment Scoring Rubric

Classification		
1.	Comment does not describe the evidence, or the rationale, for the rating.	1 - 30
2.	Comment gives general, non-specific, evidence or rationale for the rating.	2 - 30
3.	Comment gives some specific evidence or rationale for the rating. (gives an example)	3 - 32
4.	Comment cites specific document or documents as evidence or rationale for the rating.	4 - 48
5.	Comment cites specific document(s) and specific example(s)	5 - 29

**Table 11:** Comment Scoring Results

In table 11, we see the number of comments in each evidence-based category. 64% of comments cite some level of specific evidence for the raters' choice of score. The concept of evidence based rating also proved revealing in analyzing the reasons for lack of agreement between the raters and the PI standard ratings.

Figure 15 depicts the relationship between evidenced based rating and percentage agreement between raters and PI standard for each hospital.

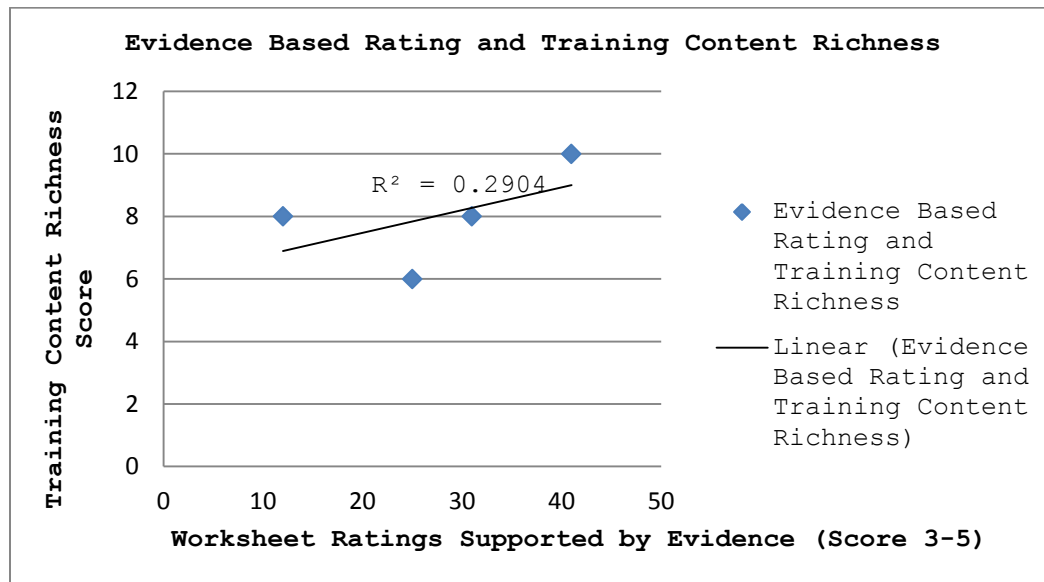


**Figure 15:** Percent Agreement and Evidence Rating

As shown in Figure 15, the percentage agreement between raters and PI standard is significantly ( $p < 0.05$ ), positively related to ratings backed up by higher evidence scored comments.

There were differences between Hospitals in the variety of training content, as evidenced by the number of different media types represented, such as videos or pdfs, and breadth of training content, measured by number of ADDIE stages included. Figure 17 depicts the relationship between a "Training Content Richness Score" calculated as number of media types (1-5), plus the number of ADDIE stages represented (1-5), plus number of skill categories (1-3) and the

inclusion of evidence based rating comments for each hospital.



**Figure 16:** Relationship of Evidence Based Rating and Training Content Richness Score

This approximation of training content richness accounts for only three factors of training richness, but points to a potential factor in lower ratings, which can be expressed as “training delivered by fewer media types, with less range of skill levels, and based on fewer ADDIE levels is 29% more likely to receive ratings that lack evidence for the choice of rating.” Further research must determine more precisely how effects of training content richness effects scoring.



### Post-Rating Structured Interviews

Each Rater was interviewed by the PI within 2 days of completing their ratings. All raters were interviewed using a standard interview of structured questions.

The standard interview questions are provided in Appendix I. Responses by each rater are summarized below.

When asked to talk about their experience as a rater, question responses included "the website functionally fine" and "it was easy to find things that I needed." Suggestions included "needs updating for further use" and "all links should open new window." Table 12 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
easy	9	13.64
clear	4	6.06
functional	4	6.06
needed	3	4.55
website	3	4.55
find	2	3.03
links	2	3.03
portal	2	3.03
<b>Totals</b>	<b>29</b>	<b>43.95</b>

**Table 12:** Interview Question One

When asked how you would describe the usefulness of the instructions on the home page, question responses included that there was "good front and center

placement” and that the website was “easy to navigate.” Suggestions included that “the instructions could have explained a little more of what to expect” and “at first I wasn’t grasping how the rating was being done, but I had not read the directions carefully.” Table 13 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
easy	3	8.33
directions	3	6.94
clear	2	5.56
explained	2	5.56
good	2	5.56
center	2	4.17
<b>Totals</b>	<b>14</b>	<b>36.12</b>

**Table 13:** Interview Question Two “A”

When asked how you would describe the usefulness of the way the training materials were organized on the training content page, question responses included that it “was not clear at 1st that the documents would be in repeated in multiple categories, and “the materials were easy to access and organized in a systematic fashion.”

Suggestions included “I think the organization of the training content needs clarification” and “I preferred

the basic to advanced structure,” and “I really liked the ADDIE structure.” Table 14 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
organized	6	8.82
categories	4	5.88
easy	3	4.41
ADDIE	3	4.41
advanced	2	2.94
helpful	2	2.94
structure	2	2.94
basic	1	1.47
clear	1	1.47
confusing	1	1.47
<b>Totals</b>	<b>25</b>	<b>36.75</b>

**Table 14:** Interview Question Two “B”

Asked to focus on the RALP Worksheet, and specifically, how useful was it in preparing to use the RALP scoring tool, question responses included that it “was useful; I made comments at each question box,” and “I used it first as overview and then to make notes, and “I like the opportunity to include notes on the worksheet.” Table 15 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
good	4	7.69
instructions	3	5.77
useful	3	5.77
allowed	2	3.85
clear	2	3.85
easy	2	3.85
helpful	2	3.85
need	2	3.85
note	2	3.85
page	2	3.85
process	2	3.85
<b>Total</b>	<b>26</b>	<b>50.03</b>

**Table 15:** Interview Question Three

The raters were then asked once you were ready to enter your scores; can you tell me about your experience with the RALP in general? In what ways was it easy or difficult? How often did you find it hard to make a rating choice? How well did you understand the RALP questions?

Question responses included "there were one or two difficult choices," and "the challenging part was the unfamiliarity of the material," and "I would say 25% of the time it was hard to assess the hospitals." Suggestions included "sometimes afraid to say no whether it really wasn't shown in the curriculum or I just misread it or had trouble finding it," and "liked that each question had own instructions," and "one

hospital had poor documents.” Table 16 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
difficult	5	4.27
easy	3	3.66
detailed	2	2.44
hard	3	2.44
difficulty	2	1.83
afraid	1	1.22
challenging	1	1.22
choices	1	1.22
confident	1	1.22
<b>Totals</b>	<b>19</b>	<b>19.52</b>

**Table 16:** Interview Question Four “A”

The raters were asked; how confident were you in your ratings? Comments Included “very confident” and “80% confident” and “I am confident of my ratings.” Table 17 displays counts and percentages of key response words.

Word	Count	Weighted Percentage
confident	7	53.85
fully	1	7.69
Totals	8	61.54

**Table 17:** Interview Questions Four “B”

Finally, the raters were thanked for their important contribution to this research, and asked if there was

anything else they would like to comment on, or suggest? All comments, each from a different rater follow.

One commented she was "generally disappointed and surprised by the poor quality of hospital education materials." Another felt it "seemed like each hospital had some good materials, but inconsistent quality." One "really appreciated the ALT references." Another offered that "I should have looked at the ALT references before rating."

#### Summary of raters' RALP effectiveness comments

The coding process revealed areas of agreement and disagreement between the raters concerning their use of the RALP. Table 18 below depicts them in three categories as agreement rated as yes, no and mixed, and uses their own words to describe their confidence in the ratings.

Rater	Worksheet Usefulness	Training Content Organized	RALP Tool Questions Clear	Rating Confidence
R1	Yes	Mixed	Mixed	Very
R2	Yes	Yes	Mixed	Very
R3	Yes	No	Mixed	Fully
R4	Yes	Mixed	Yes	80%
R5	Yes	Yes	No	Yes
R6	Yes	Yes	Yes	Yes
R7	Yes	No	No	Very
R8	Yes	Yes	Yes	Yes

**Table 18:** Agreement / Disagreement Matrix

The table emphasizes that the worksheet was an area of universal agreement among raters. They found it useful and easy to use. Organization of the training content within the web site and the clarity of the RALP questions displayed mixed reactions. Rating confidence was high, but there may have been some bias caused by the “in-person” nature of the interview question. However, careful review of the worksheet comments did not surface any additional concerns about rating confidence.

### **Data Synthesis and Interpretation Findings**

All raters expressed that the portal was functional, easy to navigate, and a convenient way to conduct the rating portion of the study. Two raters commented that the placement of each hospital’s Training Content in

each of the categories was somewhat confusing; two others found it useful to use different categories depending on the RALP question. Three raters specifically cited the use of ADDIE as appropriate to evaluating training content for ALT principles.

The raters universally found the RALP Worksheet to be useful. None of the eight raters found the requirement of to use the worksheet and make comments unduly burdensome, although one rater failed to comment every question.

Two of eight stated that all the questions were clear, and two stated that they were generally unclear. All raters liked the format consisting of each question having its own unique instructions, but half felt the rating scheme of "poor, fair and good" was too narrow. Two raters felt that it was difficult to give a score of "poor," and only 15% of the total scores were "poor." Most raters chose the middle ground rating, with only 28% of the ratings being "good."

Two raters commented in the interviews that "one hospital's materials were too poor to rate." This was the same hospital, and these were the lowest two scores in the entire study, at 4 and 3, compared to



the overall average of 10.5 and the average of the other two raters for that hospital at 7.

All of the raters expressed confidence in their ratings. One qualified the answer to be "80% confident." Nearly 2/3 (64.5%) of the rating comments cited evidence to some degree. (evidence-based rating score of 3-5)

The PI Standard Rating agreement with the raters was significantly related to the degree of Evidence Based Rating. ( $R^2 = 0.691$  p-value = 0.05)

## **Chapter 5: Discussion**

This chapter will discuss the results of the study. The results will be discussed according to the following outline.

- I. Mixed methods discussion;
- II. "CME/Research" tool as "real-world HRD" tool;
- III. Assessment of rater's scoring agreement;
- IV. Comparison of PI's vs. Rater's scoring;
- V. Selection and training of raters;
- VI. Discussion of factors for effective training.

### **Mixed Methods Discussion**

Mixed research techniques can be employed to describe the progression from an interdisciplinary review of the literature to the evaluation of an instrument using crossover analyses (Onwuegbuzie, Bustamante, & Nelson, 2010). This study employs a constructivist stance, where multiple, but equally valid, accounts of the same phenomenon prevail. Analysis to examine the structure of themes that emerge from qualitative data is undertaken to yield "clarification, development or expansion" of the quantitative data (Collins, Onwuegbuzie, & Sutton, 2006).

Ultimately, this study used mixed methods as triangulation, using the findings from one method to help inform the other, or expanding the reach of the study by using multiple methods for different study phases.

For example, the decision to code for evidence-based rating arose from the initial grounded theory coding of comments and interviews. In this case, the qualitative technique of using a grounded theory approach was used in a complimentary manner to inform and expand on the traditional hypothesis approach of measuring IRR.

We know from the results of the quantitative analysis that agreement between raters and between raters and the PI was at a high level. In Phase II, the study employed qualitative techniques to analyze the comments and interview responses of the raters to inform and expand understanding of the reasons for this agreement, and to better understand areas of disagreement.

When the word frequency analysis was performed, no hypothesis for these reasons had yet been formed. The use of mixed methods allowed for the qualitative use

of grounded theory along with the quantitative hypothesis approach. The results of this qualitative analysis led to the development of an evidenced-based rating scale, upon finding that the largest single category of rater comments centered on words related to "evidence." Finding that the largest single category of rater comments centered on words related to "evidence," lead to an understanding that the raters shared a concern about finding evidence for their ratings, and differentiated between ratings based on evidence and ratings lacking evidence.

In terms of similarities all four hospitals took primary responsibility for the EHR Training Programs, as opposed to contracting them out to the EHR vender, or a third party. It is possible that hospitals using contracted third party training would have different training material content. This is most like to result in the content being more structured and "richer."

Content that was more extensive and richer was commented by the raters in this study to be easier to score. This potential advantage for hospitals to use third party training is a possible subject for future research.

All four hospitals, by the time they had reached the level of general EHR implementation required to implement CPOE, had made the decision to focus training resources on one-on-one sessions with physicians. Other hospitals may not make this decision, and this study cannot evaluate the impact of that decision.

#### Coding RALP worksheet for evidence-based rating

There were 144 (8x2x9) comment sections available to the rater panel. Only four of these did not contain a comment, and because in some instances raters made more than one comment per section, there were a total of 169 comments coded and analyzed with NVivo.

An initial word frequency scan of all 169 comments revealed that of the top 50 words used, 25 of them were, or were related to, judgment, evidence, support, decide, or other similar words. These 25 words were used a total of 301 times.

All 169 comments were then coded by a scoring rubric designed for this study to make a criteria-based assignment of the comments according to the degree to which they supported a rating decision by citing evidence.

Once all the comments were coded 1-5, they could be analyzed and grouped using the NVivo database functions. The comments could now be re-grouped according to score, rater, and hospital. This synthesized data became critical to the conclusions and recommendations. For example, included in the results section are data showing an inverse relationship between evidence-based coding and time spent by the rater. This finding is more easily understood in light of the associated comments by raters about the "time consuming" and "fruitless" effort expended to find evidence for ratings where it ultimately did not exist.

#### **Assessment of Rater's Scoring Agreement**

For the raters alone,  $G(q,k)=0.824$ , suggests that 82.4% of the variability in the mean score is due to the ratee, indicating a high level of reliability. This finding greatly expands the range of potential future research. For example, the RALP can be used in a larger study, as is, or adapted to highly specific uses. Focused study on the effects of rater training, training material organization, and training material media type can be undertaken, now that IRR of the basic tool has been established in the EHR training

context. Correlation of the RALP's assessment of ALT principles with that of existing perception survey instruments can begin.

### **Comparison of PI's vs. Raters' Scoring**

For the raters and the PI together,  $G(q,k)=0.785$ , suggests that 78.5% of the variability in the mean score is due to the rater, also indicates a high level of reliability. There is little difference between the  $G(q,k)$ , with and without inclusion the PI rater. This suggests that RALP's existing self-contained instructions, at least in conjunction with the RALP Web Portal, are sufficient for use by the likely end-users or by researchers using a similar rating pool. The PI rater and the rating panel did not significantly differ, despite the PI's greater familiarity with the RALP instrument, specific prior training in ALT and previous experience using EHRs. A measurement tool that does not require additional training time to use, even when the professional and educational backgrounds of the users vary, has a practical and cost-effectiveness advantage over one that would require additional training to use.

## **CME / Research to "Real World" Tool Discussion**

The study sites' decision to keep the training inside led to key training personnel being hired, or often re-deployed, from within the organization. This meant that the designers and trainers came from a mixed background of IT professionals, clinical nurses, and human resource professionals. This finding, that EHR trainers in the field came from a range of professional backgrounds, led to the study design decision to use raters of similarly varied backgrounds. This decision to model the RALP's study raters on likely end-users in the real world enhances the likelihood that the study's results will apply in the real world. It creates a caution for future researchers to assure that their raters are of like backgrounds, or control for that variable.

The common focus on one-on-one physician training meant that the study training programs all became highly individualized, trainer-centric, and ad hoc. In each hospital, training became centered on a particular individual that demonstrated excellent rapport with the physicians, and who would be available for one-on-one sessions. In each case, much of the training planning, execution and evaluation



became something residing primarily in the tacit knowledge of that particular employee. This has important risk management implications in terms of loss of institutional memory in the real world.

### **Selection and Training of Raters**

In the four study hospitals, EHR training designers and trainers were a diverse group. On an aggregate basis, these individuals were predominantly female, often with prior employment at the study hospital as a clinician, usually as a nurse, but also in allied health. Of the non-clinicians, most had previously worked in information technology (IT) in some capacity. This might be anything from software developers, to application specialists, to systems technicians. There were also human resource specialists, medical records specialists, and one individual with a master's in education.

This process resulted in a rater pool of individuals including professional backgrounds in nursing, computers, education, biology, and business. Five individuals were upper-class undergraduates and three were in a master's program. This composition was identical to that encountered in the field. This composition is also likely to continue, as HITECH

incentives to Community Colleges to develop future EHR trainers recommend much the same background.

The rater's knowledge of EHR terminology and operation used in the naming or content of the training program materials for non-IT or EHR trained raters should also be considered. No raters commented on this potential difficulty. The PI did not find the use of technical terms to be outside the common vocabulary of college degree education level. Therefore, the addition of a glossary of EHR terminology to the web portal should prove to be an effective and efficient safeguard against this potential source of rater bias.

The rater's knowledge of ALT principles behind the RALP questions for non-educators could also be considered a potential source of bias. Two raters commented on this potential difficulty, and both stated that the ALT references included in the Web Site were adequate for the purposes of the task. The RALP, as currently exists, may not be as clear in describing the evidence required to meet the ALT principles in the training content as the raters believed it to be. Disagreement by two scale levels occurred 11 times out of 36 opportunities among the panels of four. A competency tested self-study using

the existing, or similar, ALT primer references, might prove to be a worthwhile addition to the web portal.

This would alleviate the potential rating bias of a rater who would fail to use the ALT references if not required to.

These enhancements, including an example question with instructions, are found in the recommendations section. It must be emphasized that the study does not find these enhancements to be necessary, but they are listed purely as potential ways to improve upon the RALP tool even beyond its currently acceptable performance level.

### **Discussion of Factors for Effective Training**

The Effectiveness of the RALP's self-contained training was evaluated in terms of professional and educational background differences. Rater's knowledge of clinical terms used in the naming or content of the training program materials, for the non-clinicians, was the first concern.

Only one rater commented on this potential difficulty, and this rater did not judge this to be a significant difficulty. The PI also did not find the use of clinical terms to be outside the common vocabulary of college degree education level.

Therefore, no action is deemed necessary, but the simple addition of a glossary of clinical terms in the web portal would be an efficient safeguard against this potential source of bias between raters, if some action was desired.

The rater's knowledge of EHR terminology and operation used in the naming or content of the training program materials, for non-IT or EHR trained raters, was considered. No raters commented on this potential difficulty, and the PI did not find the use of technical terms to be outside the common vocabulary of college degree education level.

Therefore, although no action is required, the addition of a "FAQ" on EHR terminology and operation to the web portal should prove to be an effective safeguard against this potential source of rater bias, if one is desired.

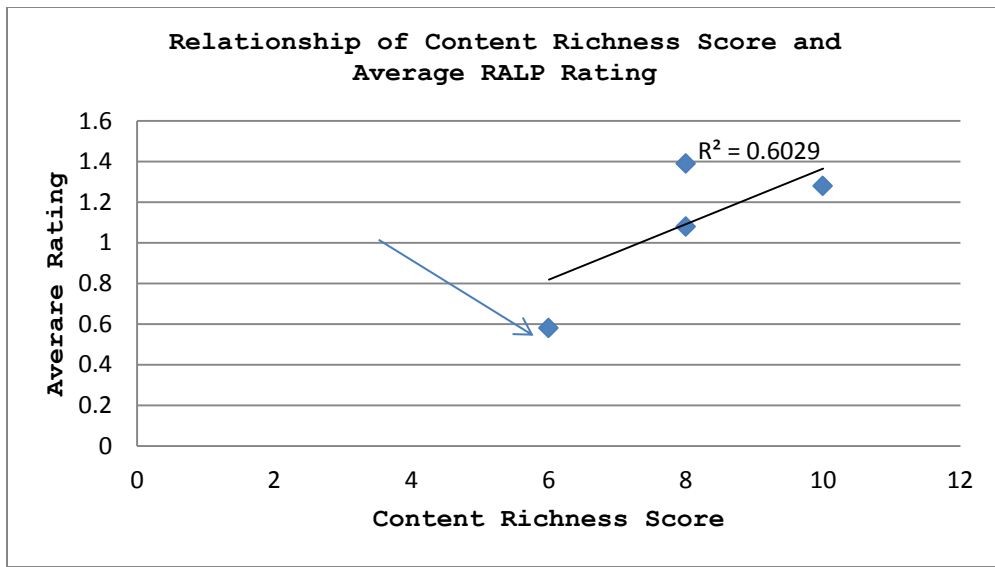
Rater's knowledge of Adult Learning Theory principles behind the RALP questions for non-educators was next considered. Two raters commented on this potential difficulty, and both stated that the ALT references included in the Web Site were adequate for the purposes of the task. However, the RALP, as currently exists, may not be as clear in describing the evidence

required to meet the ALT principles in the training content as the raters believed it to be. Disagreement by two scale levels occurred 11 times out of 36 opportunities among the panels of four.

Therefore, a competency tested self-study using the existing, or similar, ALT primer references, might prove to be a worthwhile addition to the web portal. This would alleviate the potential rating bias of a rater who would fail to use the ALT references if not required to.

Because of the noted disagreement by two scale levels that occurred, changes to the RALP in describing the evidence required to meet the ALT principles in the training content as the raters may be desired. These changes, including an example question with instructions, are found in the recommendations section.

Although the purpose of this study was not the actual scoring of the hospitals training programs, it is striking that the hospital with the lowest content richness score, based on number of media types and ADDIE levels, had the lowest RALP score. See figure 17 below.



**Figure 17:** Content Richness and RALP SCORE

Figures 18 and 19, on the following page, demonstrate the range of training content the study sites used, using two of the hospitals as examples. The lack of consensus among EHR training designers and trainers, at the study hospitals, about EHR training content best practice was evident to the raters. It can be seen that one hospital had about twice the volume and breadth of training content as the other in this example.

## Hospital # 1 Training content categories

### Media type

Interactive media (NA)

Simulation example screenshots

1. Order entry
2. Signing orders

Video (NA)

PDF

1. Updates newsletter
2. Speech recognition (advanced)
3. Finding information (introductory)
4. Documentation (introductory)

### Addie phase

Analyze (NA)

Design (NA)

Develop (NA)

Implement (NA)

1. Order entry
2. Signing orders
3. Updates newsletter
4. Speech recognition (advanced)
5. Finding information (introductory)
6. Documentation (introductory)

Evaluate

**Figure 18:** Hospital One Training Organization

## **Hospital # 2 Training content categories (part one)**

### **Media type**

#### Interactive media

1. Emergency dept. Training example simulation
2. CPOE simulation training example

#### Video (NA)

#### PDF NA)

1. Building favorites (advanced)
2. Training manual (reference) (basic)
3. Ed admission process (advanced)
4. Physician training timeline (design)
5. Physician training competency (evaluation)
6. Physician support document
7. Physician transfer orders (basic)
8. Quick reference cards (basic)
9. Sample training needs assessment
10. Weekend ultrasound (advanced)



## **Hospital # 2 Training content categories (part two)**

### **Addie phase**

#### Analyze

1. Sample training needs assessment

#### Design

1. Physician training timeline

#### Develop (NA)

#### Implement (NA)

1. Building favorites (advanced)
2. Training manual (reference) (basic)
3. Ed admission process (advanced)
4. Physician support document
5. Physician transfer orders (basic)
6. Quick reference cards (basic)
7. Weekend ultrasound (advanced)
8. Emergency department simulation training
9. CPOE simulation training

#### Evaluate

1. Physician training competency

**Figure 19:** Hospital Two Training Organization

Figures 18 and 19 depict the individual hospitals' training content organization as seen by the raters in the RALP Web Portal. The hospitals' own organizational schemes ranged from the ones in the RALP Portal (Media Type, ADDIE and Training Category) to none at all in

one case. Presenting the EHR Training Content in multiple organizational formats, such as Media Type and ADDIE, may require more detailed explanation in the future, but should not be abandoned. Additional research should consider the importance of multiple presentations of training content. The relationship between an ADDIE-driven focus on all phases of training, not just implementation, should be investigated.

## **CHAPETR 6: Conclusion and Recommendations**

This chapter summarizes the answers and recommendations for each of the study's research questions.

### **RQ-1: What is the Degree of IRR among Raters?**

The IRR for the RALP, used in the context of EHR training in ACHs, was acceptable, whether including or excluding the PI standard rater. This finding supports the use of the RALP, in this same context, in other studies. This finding, in light of the previously published CME context studies, supports researching the use of the RALP in other contexts. Finally, this finding supports future research into adaptations of the RALP, using the RALP as a proven starting point.

### **RQ-2: What is the Effectiveness of RALP Self-Contained User Training?**

All Raters felt that the self-contained RALP Tool instructions were adequate to understand the rating task. Difficulties in assigning ratings were attributed not to the instructions, but to the narrow (three-point) Likert scale and rater perception that some EHR Training Content was inadequate or poorly designed.

There were no identifiable differences in the comments of the raters concerning the RALP self-contained instructions. The reliability measure of  $G(q,k)=0.824$  with raters alone, and  $G(q,k)=0.785$  including the PI expert rater, suggests that variation in scores was caused more by differences in the hospitals training content than by the variations of rater scores. On the other hand, the rater with the highest total had training both in nursing and education. This highest total at 31, significantly skewed the group, and removing it decreased the range of the rater scores from 17 to 9, and the skewness from 1.20 to 0.59.

Though not conclusive, this suggests that training in both educational and clinical disciplines may lend insight to the rater, resulting in awarding higher scores. This possibility is further bolstered by the scoring of the PI. The PI's total for 4 hospitals was 49, making the two hospital relative score for the PI 24.45. This score is also higher than seven of the eight raters.

Given these findings, it is suggested that future research include investigation of the possible effects of training background and additional training on

rater scores. This future line of research does not preclude the RALP being used as is, but serves as a guide to any efforts to develop an even more effective or widely applicable tool.

Ideally a prospective randomized controlled study, controlling for prior training differences, could be conducted.

### **RQ-3: What Are the Time Demands of the RALP?**

No rater found the process of evaluating and rating the EHR Training Content too time consuming. The actual time was never more than 120 minutes per hospital.

The study finds that the time requirements of the RALP were acceptable to the raters. The time requirements are reasonable for the workplace, as judged by the PI. These time requirements have not been evaluated by a large sample of EHR trainers. It is not yet known how they would view them. In future work, time requirements of two versions of the RALP, with and without expanded training requirements, should be conducted and compared in terms of user perception.

### **RQ-4: What is the Level of Effectiveness of the EHR-RALP Rater Portal?**

All raters found the portal easy to use and functional. Raters suggested a more modern "look" would add to the professional appearance. No rater required additional or separate training to use the Portal, or complete worksheet and RALP Tool. No rater errors of any kind were detected. The RALP Tool was completed by all eight raters without incident or need to clean the data.

This study finds the use of a web-based portal to be an effective presentation format for the RALP. Future researchers may want to conduct randomized comparisons of web-based and paper based presentations of the RALP.

#### Extrinsic factors in effective training

There are extrinsic factors in EHR training that might be considered in improving the understanding the evaluation of ALT in EGR training materials. There appeared to be substantial variance in training investment by ACHs. Quantitative data was not available to verify this assumption. Variance in training requirements by ACHs was evident, as seen in the training materials. Variance in trainer qualifications by ACHs was established through the study site interviews. Quality of training materials

was judges to be variable by raters and by the PI. The quality of training documentation was observed to be variable by the PI, and attested to by the study site staff. Use of training frameworks, such as ADDIE, was found to range from rigorous to non-existent by the PI. Inclusion of ALT principles appears to be variable among the study site ACHs, based on the RALP scores. Further study will be needed to determine how generalizable this finding is.

EHR training differences among hospitals related to the inclusion of ALT principles in EHR training may result in raters delivering consistent, but undervalued ratings. Many of the above findings are related to the scope and execution of the EHR training at each hospital. These differences may be manifest accurately in the scores, if they result in a lack of inclusion of ALT principles. They may also result in under-valued ratings, if the training materials are difficult to understand, appear unprofessional or do not document all of the hospital's training efforts. For example, two raters commented in the interviews that "one hospital's materials were too poor to rate." This was the same hospital, and these were the lowest two scores in the entire study, at 4 and 3, compared

to the overall average of 10.5 and the average of the other two raters for that hospital at 7.

If the EHR training exists, but is not documented, then under-valuing of the ratings is a serious risk. This lack of documentation also poses a serious risk to the hospital in terms of institutional memory. Identification of missing documentation therefore has a value in itself to the hospital.

Lastly, the inclusion of ALT principles varies among the study hospitals. The literature reviewed in this study strongly supports the argument that inclusion of ALT principles will enhance EHR training, but this has not yet been proven in any quantitative analysis.

This exploratory, and foundational, study is designed to evaluate the RALP instrument in the context of electronic medical record training in acute care hospitals. It has laid the groundwork for future researchers to fully succeed in providing a gold standard "EHR Training Content" assessment tool for EHR training designers, trainers, and researchers. The study has identified an instrument, the RALP, and obtained critical qualitative and quantitative data about the RALP's efficiency and effectiveness. In



addition, preliminary data about the design and execution of ACH EHR Training Programs and trainers was collected.

### **Recommendations**

Based on this work, future research should be conducted on the assessment ALT principles using EHR training materials, rather than solely with perception surveys of trainers and trainees. This study demonstrates that this research could be conducted using the RALP instrument in its current form, as long as it is presented in a context like the EHR RALP Web Portal.

This study also demonstrates that the RALP instrument is a sound foundation for future efforts to further develop and refine the science of EHR training material content assessment. Utilizing a specifically developed and validated instrument, closely based on the RALP, and benefiting from the insight gained from this study, a full range of research can proceed. This may include correlation of the modified RALP to trainer and trainee perception surveys, and studies evaluating the effect of ALT principles on EHR Training Program outcomes.

### **Use of the RALP in its Current Form**

The highly reliable findings for the rater panel and the panel plus PI expert rater suggest that a larger study, using the RALP and RALP Portal concept, would be of value.

This approach has the advantage of proceeding directly to a large scale study, without the need for adapting the RALP instrument, and conducting a new validation. It would retain the efficiencies of the current RALP, and allow for the focus to be on the subtleties of training variation. Given the RALP's performance in two different applications, CME and EHR training, it may be possible to use the RALP in other contexts. Potential related studies might include areas such as patient safety training, quality improvement training, and other such contexts involving adult clinician learners.

### **Possible Enhancements to the RALP**

Based on the comments of the raters and my own experience, a change to a 5-point Likert scale might be considered by some researchers. This adaption, along with wording to make the RALP more specific to EHR training content, may produce a new tool that is highly specific to EHR training. Future research could

evaluate the advantages and disadvantages of this new tool compared to the RALP.

An example of RALP question one, adapted to a 5-point Likert scale and re-worded specifically for EHR training, is included below to aid in new research design.

EXAMPLE: RALP question one, revised to be more specific to EHR training, and with 5-point Likert scale.

1. To what extent does the curriculum enable learners to be active contributors to their learning? RALP is looking for the following examples of active contribution:
  - a. Training Content describes how the learner may identify and choose a question of their own about the training. Examples might include:
    1. Ability to submit test questions
    2. A searchable query function
    3. A FAQ

b. Training Content describes how the learner actively contributes to finding the answer to their own questions or to questions or demonstrations of learning concerning the curriculum. Examples might include:

1. "Help" function in a self-paced learning module
2. Description of a search function of common questions
3. List of references for further learning

c. Training Content describes how the learner actively contributes to teaching the results of their learning to others. Examples might include:

1. Information about becoming a "super user, coach or mentor."
2. Classroom activity involving individual or team presentations.
3. Mechanism for the learner to describe informal teaching experiences to training evaluators.

Please base your rating for Question # 1 on the following criteria:

- Award 1 point for: EHR training Content does not specifically describe anything from a, b, or c.
- Award 2 points for: EHR training Content specifically describes only one item from a, b, or c.
- Award 3 points for: EHR training Content specifically describes at least one item from both a and b, a and c, or b and c.
- Award 4 points for: EHR training Content specifically describes one item from a, b, and c.
- Award 5 points for: EHR training Content specifically describes multiple items from a, b, and c.

### **Limitations of the Study**

This study was self-funded by the PI. The number of volunteer raters was limited by the expense involved in the stipend required to secure volunteers. By agreement of the Dissertation Committee, the number of raters was limited to eight. Similarly, the number of ratings per rater was limited, by funding and also by unwillingness of raters to commit more than 4-5 hours

to the work. Increasing the number of raters to 16 and having each rater rate all four hospitals would have greatly improved the power of the statistical analysis. It should be understood that this work is limited in intent to an exploratory, foundational study.

There were small, but potentially significant limitations on the provision of training content by some of the hospitals, based on legal restrictions of the hospital's vendor, or internal policies regarding the web-based distribution of the training content. Every effort was made to mitigate these restrictions, but it is possible that some of the content might have been rated differently had it been available in its original and unedited form.

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## **Appendix I**

### **Rater Debriefing Standard Interview**

1. Tell me about your experience as a rater. First I want to focus on the RALP Rater Portal. Can you tell me about your experience using it? How was it easy or hard to use? How easy was it to find what you needed?
2. Retracing you steps through the rating exercise:
  - a. How would you describe the usefulness of the instructions on the home page?
  - b. How would you describe the usefulness of the rater instructions for reviewing the training materials?
  - c. How would you describe the usefulness of the way the training materials were organized on the training content page?
3. Now focus on the RALP Worksheet. How useful was it in preparing to use the RALP Scoring Tool?
4. Once you were ready to enter your scores, can you tell me about your experience with the RALP in general? In what ways was it easy or difficult? How often did you find it hard to make a rating choice? How well did you understand the RALP

questions? How confident were you in your ratings.

5. Now I want to ask about time this took you.

a. How much time did you spend preparing to use the RALP Scoring Tool?

b. How much time did you spend using the RALP Scoring Tool?

Finally, I want to thank you again for your important contribution to this research. Is there anything else you would like to comment on, or suggest?



## **Appendix II**

### **1. To what extent does the training program enable learners to be active contributors to their learning?**

GOOD - Two or more of the following: learners identify/choose a question OR actively contribute to finding the answer OR teach the results of their learning to others;

FAIR - Only one from "GOOD" or none but the training program employed partially active learning methods such as interactive lectures or group discussions;

POOR - None of the criteria from GOOD or FAIR.

### **2. To what extent does the training program relate to learners' current work or life experiences?**

GOOD - Learners would recognize the training program as having practical or immediate value to their work or lives

FAIR - Learners would recognize the training program as having theoretical or future value to their work or lives

POOR - Learning addresses an issue that the learners would not recognize as having value to their work or lives OR the training program's relevance to the learners is not clear.

**3. To what extent is the training program tailored to learners' current or past experiences?**

GOOD - Authors describe a needs assessment AND describe how the training program is tailored towards the needs of the learners.

FAIR - Authors describe only one of the criteria from "GOOD"

POOR - Authors NEITHER describe a needs assessment NOR do they describe how the training program is tailored towards the needs of learners.

**4. To what extent does the training program allow learners to identify their own learning goals and direct their education?**

GOOD - Learners received complete freedom to pursue independent studies or projects during part or the entire training program.

FAIR - Learners may choose from a range of learning methods or projects, but the range is limited.

POOR - Learners are limited to a single training program plan OR not described.

**5. To what extent does the training program allow learners to practice what they learn?**

GOOD - Learners engage in applied or simulated activities during at least 50% of training program time.

FAIR - Learners engage in applied or simulated activities during <50% of training program time.

POOR - The training program does not provide opportunities for practicing knowledge or skills OR not described.

**6. To what extent does the training program provide support to self-directed learners?**

GOOD - Training program specifically allots faculty time/resources for supporting learners during independent learning of projects.

FAIR - Training program provides only self-learning materials (e.g., online library or bulletin boards) OR faculty are available for but not dedicated to supporting self-directed.

POOR - Training program provides none of the criteria in "GOOD" or "FAIR" or not described.

**7. To what extent do learners receive feedback from teachers and/or peers during active learning?**

\* Formative feedback is defined as feedback that is intended to help learners adjust their learning or activities prior to completion of the training program.

\* Summative feedback is defined as feedback intended to inform learners of their progress upon completion of the training program.

GOOD - Curriculum includes mechanisms for providing formative feedback to learners, and curriculum includes mechanisms for providing summative feedback to learners

FAIR - Training program only includes mechanisms for providing one from "GOOD"

POOR - Feedback to learners is not provided OR is not described.

**8. To what extent does the training program allow learners to reflect on their learning?**

GOOD - Training program describes mechanisms that are specifically intended to help learners reflect on their learning. These may include structured reflection time and debriefing meetings.

FAIR - Training program describes learning sessions, such as debriefing meetings or summary presentations, which are not specifically intended for reflection on learning but are likely to involve some reflection by learners.

POOR - Opportunities for self-reflection are not included in the training program OR are not described.

**9. To what extent can learners observe the faculty role-model behaviors?**

GOOD - Learners observe role models actually practicing goal behavior in clinical settings.

FAIR - Learners observe role models in simulated settings.

POOR - Role modeling is not used OR is not described.

### Appendix III

DOCUMENT TYPE	ADDIE PHASE				
	ANALYSIS	DESIGN	DEVELOPMENT	IMPLEMENTATION	EVALUATION
Bulletin Board Topics	X	X	X	X	X
Discussion Board Topics	X	X	X	X	X
EHR Trainee DVD				X	
EHR Trainee FAQs				X	
EHR Trainee Lesson Plans			X	X	
EHR Trainee Pre and Post-tests	X				X
EHR Trainee Pre and Post-training Survey Questions	X				X
EHR Trainee Schedules		X	X	X	
EHR Trainee Self-Assessment Forms					X
EHR Trainee Web Sites				X	X
EHR Training Evaluation Forms					X
EHR Training Goals / Objectives		X	X	X	
EHR Training Help Desk Support Guides		X	X	X	
EHR Training Materials: print, A/V		X	X	X	
EHR Training Skills / Task Check-off Forms				X	X
EHR Training Skills List		X	X	X	X
EHR Training Super-User Support Guides		X	X	X	
EHR Training Sample Lesson Plans		X	X		
Sample EHR Training Syllabi		X	X		
Structured EHR Training Assessment Forms	X				X

## Permissions

### 1. RALP

Hi Mr. Beach.

I'd be happy to share the instrument although it may a some time to look for it. As I recall, we found good inter-rater reliability with the instrument, but the association with outcomes was less strong.

Romsai Tony Boonyasai, MD MPH

Assistant Professor of Medicine

Johns Hopkins University School of Medicine

### 2. Hospital Adoption of Electronic Health Record Technology to Meet Meaningful Use Objectives: 2008-2012 ONC Data Brief.

Mr. Beach, any information that you find on the web is public and can be used. All we ask is that you do what you say - cite the source.

Peter Ashkenaz

Office of Communications

Office of the National Coordinator for Health Information Technology

U.S. Department of Health & Human Services

Office: 202.260-6342

### 3. RE: Meta-analysis of the effectiveness of four adult learning methods and strategies

You are more than welcome to include the figure in you dissertation and this email constitutes permission to do so. if you need a written permission other than this email, please let me know and I will be more that glad to send you one as an email attachment to this email with my signature.

**From:** Carl Dunst cdunst@puckett.org

**To:** Beach, William J. (MU-Student)

[mailto:williambeach@mail.missouri.edu]

**Sent:** Saturday, May 25, 2013 3:52 PM

**Subject:** Meta-analysis of the effectiveness of four adult learning methods and strategies

### 4. Summary of Adult Learning Assessment Instruments (Compiled from Holton (2009))

June 12, 2013 3:15 PM

From: Ed Holton [eholton2@lsu.edu]

To: Beach, William J. (MU-Student)

Mr. Beach,

You may use the figure with citation.

## **Vita**

William Beach was born in St. Louis Missouri, and has lived in Arizona, Maryland, Turkey and Panama. He earned an Associate's degree in Respiratory Therapy at Biosystems Institute in Arizona, a Bachelor's degree in Health Services Management at the University of Missouri - Columbia, an MBA from the University of Louisville in Kentucky, an MLA from Johns Hopkins University in Maryland, and a PhD in Health Care Informatics at the Missouri Informatics Institute at the University of Missouri - Columbia.

Dr. Beach had an extensive career as a health care administrator, including ten years at Johns Hopkins Healthcare and Johns Hopkins International. He is currently serving as Program Chair of Health Services Administration at Hodges University in Naples Florida.