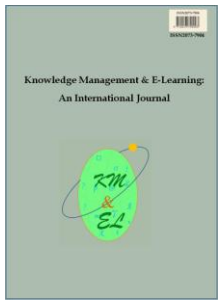
Knowledge Management & E-Learning



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On-the-job training of health professionals for electronic health record and electronic medical record use: A scoping review

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Abstract: The implementation of electronic health records (EHRs) or electronic medical records (EMRs) is well documented in health informatics literature yet, very few studies focus primarily on how health professionals in direct clinical care are trained for EHR or EMR use. Purpose: To investigate how health professionals in direct clinical care are trained to prepare them for EHR or EMR use. Methods: Systematic searches were conducted in CINAHL, EMBASE, Ovid MEDLINE, PsycINFO, PubMed and ISI WoS and, the Arksey and O'Malley scoping methodological framework was used to collect the data and analyze the results. Results: Training was done at implementation, orientation and post-implementation. Implementation and orientation training had a broader scope while post-implementation training focused on proficiency, efficiency and improvement. The multiplicity of training methods, types and levels of training identified appear to suggest that training is more effective when a combination of training methods are used.

Keywords: Training; Electronic health records (EHR); Electronic medical records (EMR); Healthcare organizations; Health professionals; Healthcare providers

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Dr. Andre Kushniruk is Professor and Director of the School of Health Information Science at the University of Victoria in Canada and he is a fellow of the American College of Medical Informatics. Dr. Kushniruk conducts research in a number of areas including usability engineering, electronic health records, evaluation of the effects of information technology and human-computer interaction in healthcare. His work is known internationally as he has published widely in the area of health informatics and he has advised on variety of national and international committees and projects. Dr. Kushniruk has held academic positions at a number of Canadian universities and worked with many major hospitals and hospitals in Canada, the United States and internationally. He holds undergraduate degrees in Psychology and Biology, as well as a MSc in Computer Science and a PhD in Cognitive Psychology from McGill University.

1. Introduction

The implementation of EHRs or EMRs is supported with many written evidence in health informatics literature yet, very few studies focus predominantly on how health professionals in direct clinical care are trained for EHR or EMR use. Using the "P" and "R" labels of the "PQR"[1] formula in soft systems methodology to create a definition of training (Checkland & Scholes, 1999): Training in this paper is defined as, the process of teaching or learning that is provided by employers to employees - whether on-the-job or, in collaboration with external agencies like academic institutions, consultancies, other healthcare organizations, professional associations or vendors, for the purpose of educating, developing and equipping staff with the tools, skills, knowledge or behaviours required for their respective positions.

Historically, training has progressed dramatically over the past 30 years "in terms of both the science and practice of training". It is no longer a "stand-alone event" in organizations, but "a fully integrated strategic component" with new training-related approaches that include "action learning, just-in-time training, mentoring, coaching, organizational learning and managing skill portfolios" (Salas & Cannon-Bowers, 2001, p. 472).

[1] The building of 'root definitions' using the "PQR" formula - "do P by Q in order to contribute to achieving R". P answers the question "what to do", Q answers "how to do it" and R answers "why do it" (Checkland & Scholes, 1999, p. A23).

Similarly, information technology (IT) has played an important role in health care for over 30 years - with the first use of computers in hospitals in the 1960's serving administrative and fiscal tasks (Berner, Detmer, & Simborg, 2005; Hammond, 2001). Later, this use was expanded to "collate and analyze patient data" (Otto & Kushniruk, 2009, p. 62). In Australia, Austin Health Victoria successfully implemented a bed management system that colour codes patients based on their estimated discharge date (Moritz, Scordel, Braitberg, & Hart, 2004). In the United States, Hartford Hospital Connecticut successfully implemented the bed management dashboard (Rosow, Adam, Coulombe, Race, & Anderson, 2003) and in the United Kingdom, the bed occupancy management and planning system was successfully used by a London teaching hospital for decision support on bed management (Wyatt, 1995).

In Canada, the organization mandated by the Canadian Government to ensure the establishment of a nationwide interoperable electronic health record system (iEHR) has been collaborating with Provinces, Territories, health care providers and technology solution providers to accelerate the use of EHRs and many Regional Health Authorities (RHAs) like the Regina Qu'Appelle Health Region (RQHR), Saskatoon Health Region (SHR), Alberta Health Services (AHS), Fraser Health and Island Health have several Canada Health Infoway projects either in progress or completed. Moreover, many of these RHAs are academic health sciences centres and provincial referral centres, serving local and non-local residents across Canada.

Irrespective the type of training to be undertaken, good practice dictates that organizations must decide prior to any training, who and what should be trained, where the intended training sits within the strategic goals and objectives of the organization, what the learning objectives of the training would be, the description of the work functions to be performed, the conditions under which the job will be performed and the knowledge, skills and attitudes required to perform those tasks (Goldstein & Ford, 2002). Furthermore, health informatics literature asserts that IT can potentially improve patient safety, organizational efficiency and overall quality of care (Poon et al., 2006; Warm, Thomas, Heard, Jones, & Hawkins-Brown, 2009; Smedley, 2005). Moreover, Southon, Sauer, and Dampney (1997) indicated that training was a contributing factor to a failed computer information systems (CIS) implementation while Jenet et al and Snyder-Halpern pointed to training as a "significant finding related to implementation readiness in other studies" (as cited in Piscotty & Tzeng, 2011, p. 652). In addition, other studies pointed to the potential unintended consequences the introduction and use of new technologies may pose (Kuperman & McGowan, 2013; Ash et al., 2007).

The purpose of this scoping review therefore is to investigate how health professionals in direct clinical care are trained to prepare them for EHR or EMR use, with a view to identifying what measures, if any, have been taken to ensure that healthcare professionals undergo the right level of training, so that they provide the right information for use at the right time.

2. Methods

The Scoping Framework: We used the Arksey and O'Malley (2005) scoping methodological framework to collect the data and to analyze the results in this paper. The five stages and an optional sixth stage in the framework are summarized in Table 1 below and they provided a useful way to identify the "extent, range and nature" of all relevant literature irrespective of study design (p. 21).

Table 1
Scoping methodological framework. Source: Arksey and O'Malley (2005)

SCOPING METHODOLOGICAL FRAMEWORK	
Stages	**Description**
Stage 1	Identifying the research questions in order to determine which aspects of the questions are important for the literature search.
Stage 2	Identifying relevant studies that would comprehensively answer the central research question(s) and for which consideration would have to be given to time, budgetary constraints, publication dates, language and the range of available literature sources.
Stage 3	Study selection - adopts methods similar to the systematic review process but with greater flexibility for inclusion and exclusion criteria as researchers may, based on increasing familiarity with research data, redefine their search terms.
Stage 4	"Charting" the data in terms of key issues and themes via a "narrative, descriptive-analytical" framework.
Stage 5	Collating, summarizing and reporting the results through an analytic or thematic framework but with no attempt to "weight" the evidence.
Stage 6	Optional consultation exercise with key stakeholders for potential added value such as additional references and valuable insights to the literature review.

2.1. Research questions

This scoping review sought to answer the following research questions: (1) what types of training are typically done with health professionals for the EHR or EMR? (2) What types of training methods are the right fit for health professionals in EHR or EMR training and what types of training methods or strategies do health professionals end up receiving? (3) What types of content are covered in EHR or EMR training?

2.2. Literature search and search strategy

We used the research topic and research questions to determine the main concepts for the search and conducted systematic searches in CINAHL, EMBASE, Ovid MEDLINE, PsycINFO, PubMed and ISI WoS. We based our search strategy on four concepts - "training", "health professionals", "electronic health records" and "electronic medical records". We combined similar concepts with OR, must-have concepts with AND, and excluded search results that were not needed with NOT. There was no publication year limit set in this search.

We conducted an advanced search and a basic keyword search for each database. We performed an advanced multi-field search in ISI WoS and an advanced thesaurus search in the remaining five databases where search terms mapped to the controlled terms of the respective databases. The actual search terms used in the advanced thesaurus search varied slightly as not all databases use the exact same subject term. We checked

the scope notes in the respective databases to confirm the semantic meaning of the terms and used wildcards to capture variations of the search terms in the advanced multi-field search performed in ISI WoS. An example of the search strings used in ISI WoS is shown below:

- TS=(train*)
- TS=(health professional* OR health personnel*)
- TS=(electronic health record* OR electronic medical record*)

We performed the exact same basic keyword search shown in Table 2 below, in all six databases and used the asterisk wildcard symbol to capture variations of the search terms, expand the search and increase the number of results retrieved. Screenshots of the search history of the six databases searched were captured in a word document and are included in Appendix A of this paper.

Table 2
Basic keyword search strings for all databases

BASIC KEYWORD SEARCH STRINGS		
Concept Number	Concept Word	Search String
1	Training	train* OR teach* OR educat* OR learn*
2	Health Professionals	health professional* OR health care person* OR health care provider* OR health care worker* OR medical professional* OR medical person* OR medical provider* OR medical worker*
3	Electronic Health Record	electronic health record* OR electronic medical record*
4	Electronic Medical Record	

We obtained additional references for background information and discussion by checking the reference lists of identified studies and locating resources in the business and education disciplines. We used the CADTH PRESS Checklist[2] (Canadian Agency for Drugs and Technologies in Health, 2013) to assess our search strategy for completeness and accuracy. Fig. 1 illustrates the types of searches done in this scoping review.

Studies were included if they (1) examined the training of health professionals for EHR or EMR use; (2) discussed and evaluated the training methods used in health professional EHR or EMR training; (3) focused on the content covered in health professional EHR or EMR training; (4) were qualitative and quantitative peer-reviewed studies. Studies were excluded if they (1) focused only on the design of the EHR or EMR; (2) did not have an evaluation component; (3) were an editorial, a comment, a letter to the editor, a survey, an abstract, a book review or a case report; (4) were in non-English language; (5) did not focus on health professional EHR or EMR training; (6) were not peer-reviewed.

[2] Canadian Agency for Drugs and Technologies in Health Peer Review Checklist for Search Strategies.

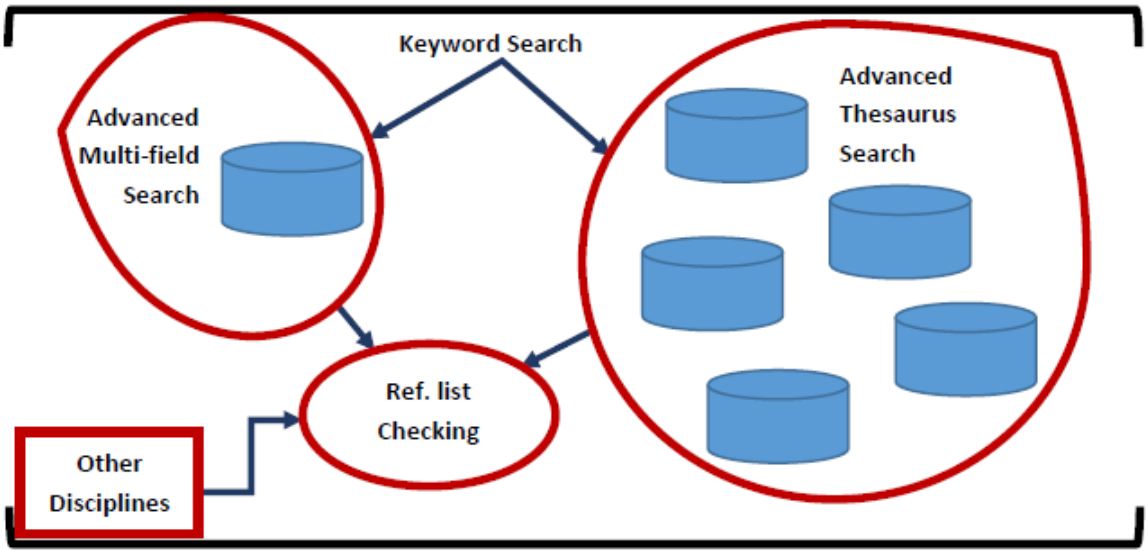

Fig. 1. Search types

2.3. Study identification, selection and review

Three researchers reviewed and discussed the titles and abstracts of the studies identified in the literature search to determine whether the inclusion criteria have been met. All disagreements between the reviewers regarding the articles were resolved through discussion and a consensus on each article. Articles that met the inclusion criteria were pulled for full manuscript review. The full text of the articles was obtained and the full manuscripts reviewed by the three reviewers for a final decision on which studies to include.

Selection of studies was based on the criteria indicated above and the determination by the three researchers on whether the inclusion criteria have been met. The selected studies were also examined for redundancy and duplicates were removed. Again all disagreements were resolved through discussion and a consensus on each article. RefWorks Citation Manager was used to manage the included and excluded studies retrieved.

2.4. Analysis

The three reviewers extracted relevant data and themes from the included studies. These themes are outlined in greater detail in the results section of this paper.

3. Results

Search Statistics and Included Studies: The literature search produced 3335 results with the following breakdown - 601 from CINAHL, 609 from EMBASE, 342 from MEDLINE, 249 from PsycINFO, 634 from PubMed and 900 from ISI WoS. 214 duplicates were removed and a further 3079 studies were excluded, based on a review of the titles and abstracts of the studies. Of the 42 remaining studies, 27 were excluded and

15 studies met the inclusion criteria set for this research (see Fig. 2). Table 3a, 3b, 3c, and 3d presents the findings from the included studies and the references of the included studies are in Appendix B of this document. The median publication year for the included studies is 2011 (with a publication year range of 2004 - 2013). Fig. 3a and 3b illustrate the included studies retrieved per publication year.

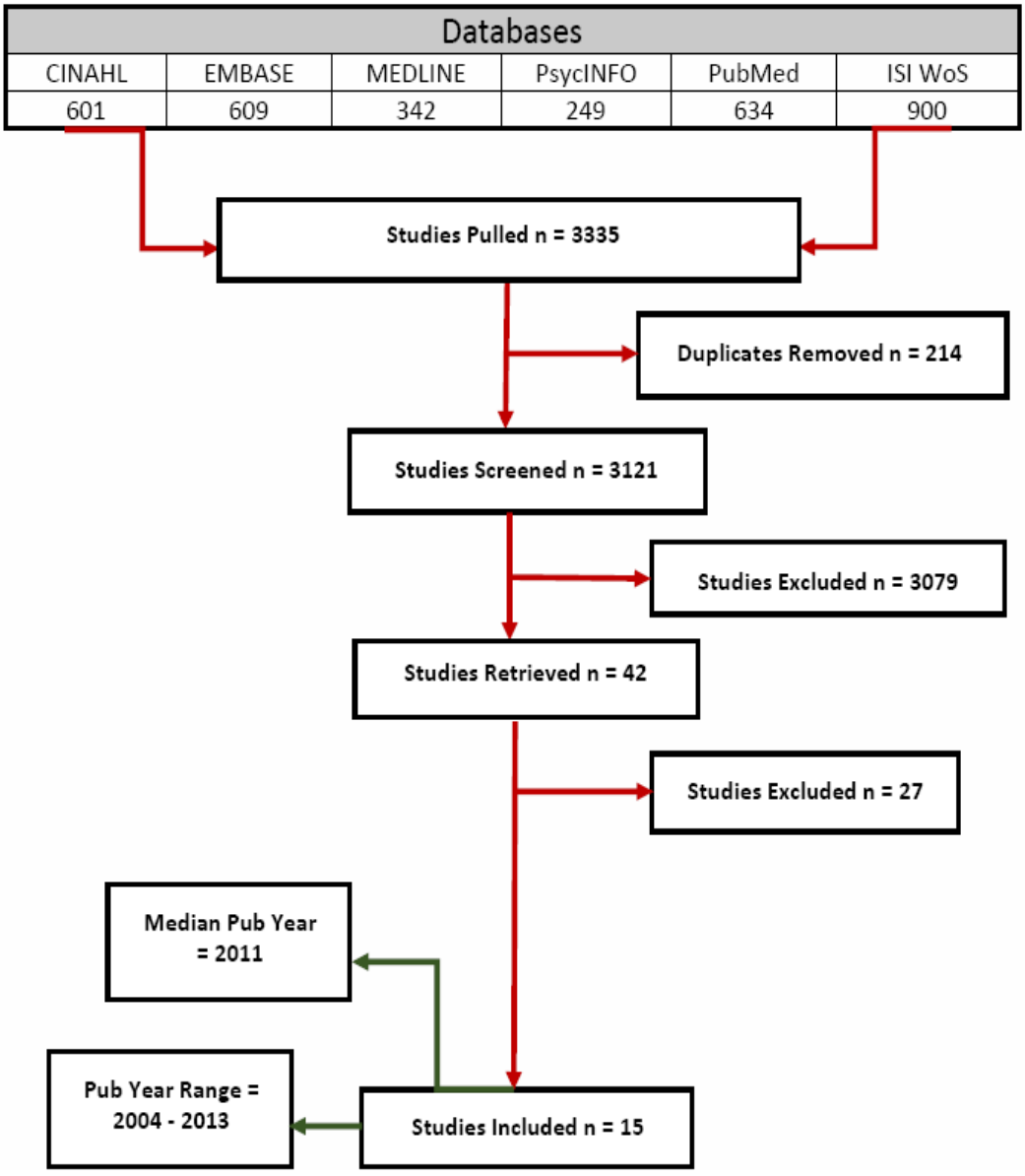

Fig. 2. Illustration of included studies

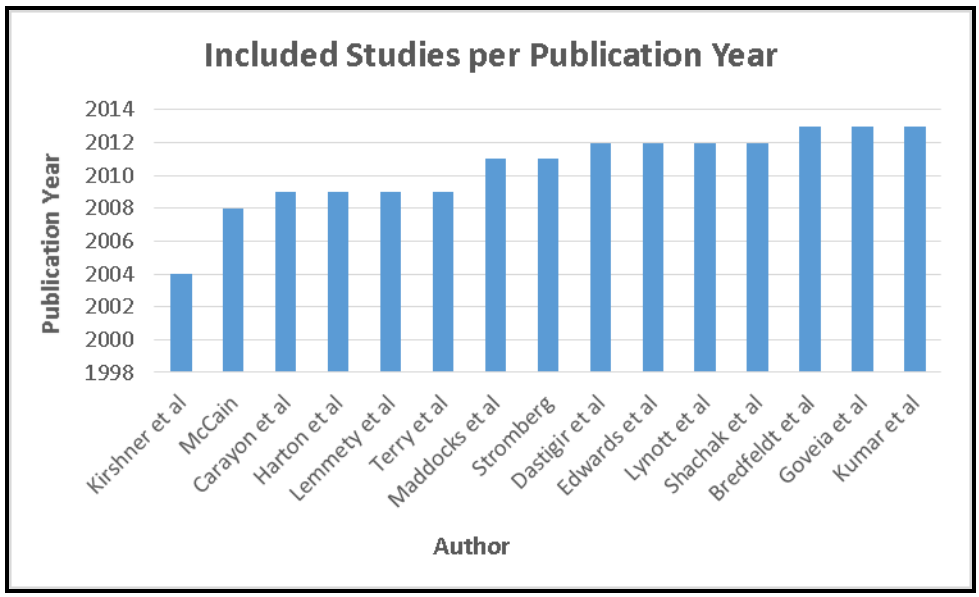

Fig. 3a. Included studies retrieved per publication year - Column view

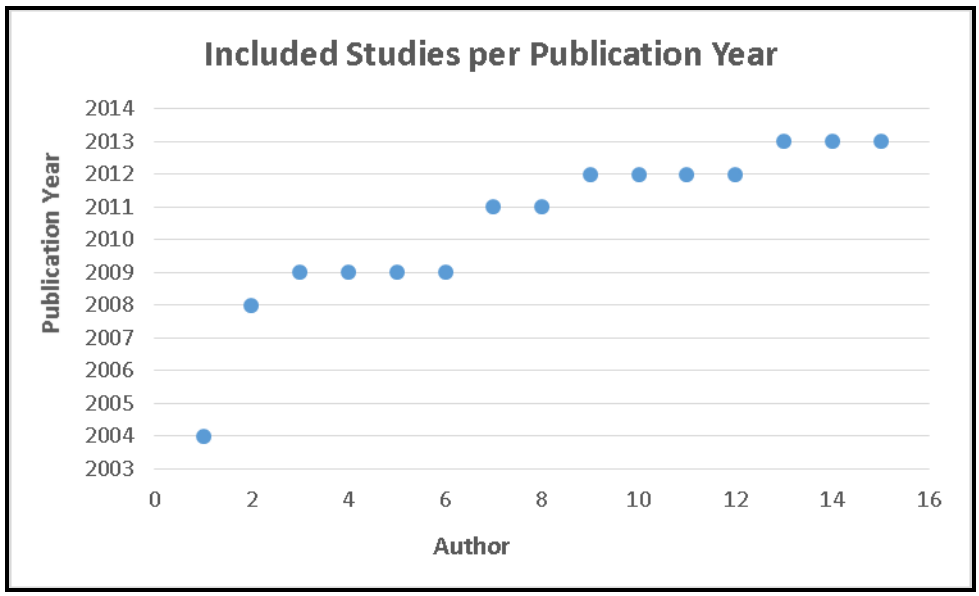

Fig. 3b. Included studies retrieved per publication year - Scatter view

Table 3a
Findings of included studies (References in appendix B)

Author	Bredfeldt et al., 2013	Carayon et al., 2009	Dastagir et al., 2012	Edwards et al., 2012
Study Design	Mixed-methods; Case control; Survey	Observational longitudinal prospective; Survey; Interviews; Work analysis	Descriptive; Survey	Mixed-methods; Retrospective comparative descriptive secondary data analysis
Subjects	Training (N = 36); Training evaluation included participants (N = 36) and non-participants (N = 144)	(N = 25)	(N = 155)	(N = 85)
Type of Health Professionals	Primary care providers; Specialists	Family medicine faculty; Resident physicians; Medical support & office staff	Clinicians who are advanced EHR users (Physicians, Physician Assistants, Nurse Practitioners)	RNs (Registered nurses); Nursing assistants; Unit coordinators
Setting	KPMAS (Kaiser Permanente Mid-Atlantic States) - Non-specific outpatient primary & specialty care	Family Practice Clinic (University of Wisconsin) Madison, Wisconsin	KPNW (Kaiser Permanente North West) (in Oregon & Southwest Washington) ; Ambulatory & Hospital settings	2 EDs same healthcare system (70-bed level 1 trauma centre; 36-bed community ED)
Training	Classroom; Blended (lectures & demos 20-40 minutes, concrete scenarios, hands-on exercises, take-home materials); 2 classes 4-5h Saturdays; CME (Continuing Medical Education) credits; Post-implementation	Classroom; 2 sessions; Expert user 8h; Others 4h; Groups with similar needs trained together - hands on; Implementation	Classroom; Intensive (teaching & practice sessions); Offsite, 3 days; 5 sessions (3 outpatient, 2 inpatient); P2P (Pathway to Proficiency); Post-implementation	2 types; Classroom TIL (Traditional Instructor-Led) Apr to Aug (120-180 min face-to-face demo; 30-60 min unstructured practice). Classroom BL (Blended Learning) Sept to Mar (less instructor-led 90- 120 min, more practice, self-structured 60-90 min); Mentor, one-on-one coaching; Training period not indicated.
Findings	Likely usage increase medication list & problem list after training ($p<0.05$); AVG increase PL: 2%; AVG increase ML: 4%	Easy to learn; Well planned & delivered; Tech support available	Effective; Strongly agreed over 90%; EHR & training ($p < 0.001$); EHR outside work ($p = 0.012$); EHR & computers ($p < 0.0001$; p	Satisfied - TIL & BL. more practice; Scores not significant; TIL (mean, 42.12); BL (mean, 41.48)

			= 0.003); Job satisfaction/work life balance (p = 0.016)	
Key Themes	Offer training more frequently - wider range of topics; Hands-on most useful	Pay attention to EHR project implementation; Can provide information on training & help anticipate work impact	More training; Will recommend P2P; Improved efficiency; Offsite preference; Too much information too short a time	More hands-on practice; HIT (Health Information Technologies) training influence; Positive training experience
Outcome Variables	Medication list & problem list management improvement; Future training enterprise-wide	Perceived ease of use; Planning & delivery of training; Tech support availability	Training effectiveness; Efficiency; EHR satisfaction; Work life balance; Job satisfaction	Satisfaction; User acceptance; New training delivery methods; Staff knowledge and skill improvement
Notes	Class 1 - PL & ML management, patient history, chart review. 3.5 CME credits; Class 2 - documentation, efficiency tools, order entry, preference list; Live EHR & Production EHR. 4.25 CME credits; Physician-led & Assistant; May not be inpatient appropriate; Assessment: evaluation form	Hands-on; Training content type & details N/A (Not Provided); Training schedule & support material provided; Training development team: Project team & EHR vendor; Not generalizable; One small clinic	Content type - EHR functions; CPOE (Computerized Physician Order Entry); Physician documentation; Lab results retrieval etc; Peer-led proficiency training; Trainers - Physician super-users & champions; Content details N/A; Assessment: Survey	Training period N/A; Training content alluded to but details N/A; Content: Purpose of using application, general module overview, general navigation and review of most common functions used; Log in, navigate to various screens; Pre-defined data entry, online learning modules & posttests; Text & graphical content; Production EDIS (Emergency Department Information System); BL flexible; Less time to complete; Next steps: BL scenario-based training, develop HIT mastery measures; Assessment: survey

Table 3b
Findings of included studies (References in appendix B)

Author	**Goveia et al., 2013** Study 1 (Lemmetty et al, 2009)	Study 2 (McCain, 2008)	Study 3 (Stomberg, 2011)	Study 4 (Kushniruk et al., 2009)	Study 5 (Kirshner et al., 2004)	Study 6 (Luisgnan et al., 2002)	Study 7 (Porcheret et al, 2004)
Study Design	Review, 7 studies: 2 non-comparative case series; 2 non-comparative observational case series; 1 non-comparative cross sectional study; 1 non-comparative retrospective cohort study; 1 non-comparative prospective cohort study						
Subjects	(N = 138)	(N = 63)	(N = 125)	(N = 5)	(N = 129)	(N = 500)	(N = 7)
Type of Health Professionals	Not indicated	Not indicated	Nurses	Physicians	Clinicians - Experienced CIS users	Primary care physician members of mediplus database	Physician groups in primary care research network
Setting	Central Hospital Finland	Acute care hospital, USA	USA	Internal Medicine Dept., Hospital, USA	HMO	Primary care	Primary Care Practices, UK
Training	Classroom	2h EMR familiarization; 3 classroom sessions; self-directed CBT	Classroom - 23h over 4 days	Classroom - 4h	Individual counselling - Single 3-4h one-on-one training	Feedback on data quality; Hours not indicated	Repeated feedback & training; Hours not indicated
Findings	Combination of classroom training; Computer-based training; Individual counselling (i.e., one-on-one training) and feedback most effective to improve meaningful use						
Key Themes	Tailor training to trainee needs; Self-paced hands-on practice						
Outcome Variables	Learning styles targeted; Satisfaction; Perceived effectiveness						
Notes	Some content - 3/7 (Kirshner Stromberg, Kushniruk); Kushniruk (Session: log in, document & review office visit data, place orders, document complex visit. EHR tasks: document patient history, enter medication, write orders, check alerts, add notes, letters); ASSESSMENT: various (survey, informal verbal/anecdotal, semi-structured interviews, data; Accuracy, frequency & accuracy of recording; QUALITY: Good & poor. Good quality - clear objective and description of data analysis, detailed design & implementation description, good data analysis & study design, clear research design. Poor quality - poor results section, no clear research objective or study design, no statistical evaluation, small study group & unclear objective or data analysis, ambiguous.						

Table 3c
Findings of included studies (References in appendix B)

Author	Harton et al., 2009	Kirshner et al., 2004	Kumar et al., 2013	Lemmetty et al., 2009	Lynott et al., 2012
Study Design	Descriptive; Cases series	Observational cross-sectional; Survey	Qualitative; Case study	Descriptive; Case series; Survey	Observational; Comparative; Ethnographic
Subjects	Sample size not provided	Target; (N = 162); Respondents (N = 129)	(N = 4000)	Target; (N = 290); Respondents (N = 138)	3 healthcare systems - A, B, C; A (N = 10); B starts (N = 12), Ends (N = 11); C (N = 2)
Type of Health Professionals	RNs; Nurse interns; Health Unit Coordinators; LPNs (Licensed Practical Nurses); CNAs (Certified Nursing Assistants)	Experienced CIS (Computer Information Systems) users - at least one year	Nurses; In-house doctors; Visiting doctors; Pharmacy; Quality assurance & control; Secretary; Storekeeper; Front office; Clerks	Type of health professionals not indicated	Physicians; NPs (Nurse Practitioners); (A - Providers; B - All outpatient staff, then Providers; C - Providers)
Setting	Mission Hospitals, Asheville, North Carolina	KPNW (HMO (Health Maintenance Organization)); Clinician's office	Quaternary care hospital, New Delhi, India	Central Finland Hospital	Outpatients; A: DOE (Department of Graduate Education); B: IT Dept.; C: Outpatient Division
Training	OLD: Classrooms & computers (separate locations). 2 weeks moving between locations. Repeat classes as needed; NEW: General introductory group session then roles-based sessions. Classroom and computers - learner-focused, logical sequence. Participants practice after lecture & document simulated experience; Facilitators present; Orientation	CME Credit; Single 3 - 4 hour one-on-one session; Basic core competency evaluations, tailored instruction about features and functions of CIS applications with which they are unfamiliar; Post-implementation	Pilot: (Classroom); Actual: Blended (classroom & e-learning); 120 min (30 min LMS teaching & 90 min doubt clearing & adv. questioning); E-certificate of LMS completion, then EHR online training; Implementation (& future orientation)	Classroom; Implementation	A - 8h, 30min communication; B - 6h, 0 min communication; C - 4h, 15min communication; Training period not indicated
Findings	Positive feedback (verbal and written);	Improved efficiency in all four CIS	Training completed in 25% of estimated	Classroom teaching best way - 44%;	Similar formalized EHR training;

	Most liked: hands-on practice, self-guided computer activities, practice & question time, self-paced, working on own	components - EMR use improved the most (61%); Effective teaching method (mean 4.5); Clinician satisfaction (mean 4.1), time well spent (96%), would recommend (98%); Prefer one-on-one over other training methods	time at 28% of the projected expense; No production loss; Training methods, selection tool right; DRIPDA (Define, Run, Identify, Plan, Deliver, Assess), effective	Personal guidance preference - 45%; More training - 37%	Different patient-provider communication training
Key Themes	Consider participant learning styles; "more hands-on time, more interactive, less lecture learning, documentation class too long", shorten a pharmacy lecture, more practice with simulated medication reconciliation scenarios	Value of having repeat follow-up sessions (34%), printed support materials related to training session (25%), changing session duration (multiple shorter sessions, make sessions longer)	Consider training process, methods, tools, trainer and trainee constraints (e.g., level of computer literacy) and organizational factors	Computer literacy level; More training	Computer literacy level; Communication training for EHR
Outcome Variables	Learning styles targeted; Satisfaction	Perceived effectiveness of one-on-one training; Satisfaction; Usefulness	Resource availability; Flexibility; Learning styles targeted; Enhanced learner retention; Satisfaction	Satisfaction; Perception of more training; Training methods	Consistent practice, inconsistent practice, negative patient-provider relationship
Notes	Content RN & nurse interns: order entry (single and complex), key EMR topics, medication reconciliation, pharmacy system and medication dispensing, documentation of medication profile, admission history and assessment, online references,	Content: material relevant to the four CIS components - the EMR, data retrieval results reporting, e-mail, and medical library; Cannot generalize: one time study, population only clinicians who requested one-on-one training, evaluation only from clinician perspective; Next	Moodle (LMS); EMR training content N/A; Completion date: 45 days from LMS enrolment date; Role-based learning modules (e.g., nurse, doctor, accountant); Training materials, practice sessions, mocks, final test; Assessment: Kirkpatrick model,	Training content details N/A; Assessment: Survey	No standardization; EHR focus all systems: Order entry, patient information look up, documentation, communication within EHR; Assessment: Participant observation

guides, additional information retrieval, medication administration record with self-paced examples and related scenarios; Production EHR; OLD: physically and mentally exhausting; NEW: levels of computer experience, learner-focused, flexible; Assessment: evaluation form & verbal feedback	Steps: determine if one-on-one training is cost effective to KPNW and how effective they are to other teaching methods; Trainer: expert clinician user; Assessment: survey	direct observation, informal interviews, focus groups, online tracking system

Table 3d
Findings of included studies (References in appendix B)

Author	Maddocks et al., 2011	McCain, 2008	Shachak et al., 2012	Stromberg, 2011	Terry et al., 2009
Study Design	Experimental; Randomized	Descriptive; Case series	Observational; Case series; Interviews	Observational; Case Series	Descriptive; Qualitative; Case Series; Semi-structured interviews
Subjects	(N = 9)	(N = 63)	(N = 9)	(N = 125)	(N = 30)
Type of Health Professionals	Physicians	Inpatient staff; Nurses; Physicians; Students	Help desk staff; Trainers; Service managers	Nursing assistants; Care technicians; Unit secretaries; Nurses	Family physicians; Other health professionals (including nurses and medical assistants); Admin staff (receptionists, secretaries)
Setting	PCPs (Primary Care Practices)	310-bed acute care hospital	EMR Vendor	200+ bed general hospital; Rural suburban; Midwest	Family practice; Urban; Rural; Small town
Training	2h intervention (hands-on training, instructional material, feedback); Post-implementation	OLD: Classroom TIL (20 min new info, 10 min process info); 3 classes, roles-based, nurses 12h, others 8h,	3 sessions, onsite (1 week between session 1 and 2; 2 to 3 weeks between session 2 and 3); Tel., help menu, website, user manual, users' conference;	OLD: Classroom - two 9h days, trainees together, hands-on minimal; NEW: Classroom - Instructor guided, discipline specific;	Training hours not provided; Implementation

		physicians 2h, students 8h); NEW: BL, Classroom CBT (2-4h, Physicians 30 min, students 1½ -2h, self-paced, no trainer, tel support); Choice of classroom or BL; Orientation	Follow up training; Support	NAs/CTs 3h. USs 6.5h; Nurses 23h over 4 days; Breaks (i.e., 5 -10 mins) every 45 mins; Orientation	
Findings	Non-significant (16.8% avg. increase intervention, 22.3% avg. increase control practices); Co-intervention govt. program, level of recording tests in EMR	eMAR (Electronic Medication Administration) CBT preview: 2 classes; Positive; OLD: Computer experience varied, long hours, unconducive class times; NEW: 68% preferred BL, self-paced learning	Vendor personnel shortages, client population profile changes, non-service agreement requests, IT staff recruitment & super-user endorsement	Positive results	Computer literacy varied, time / training barriers, problem solvers/messaging system were facilitators, barriers & facilitators influenced EHR adoption level
Key Themes	Training intensity level, more training for data entry and completeness, more ongoing IT support, GP desire and time investment needed to use technology	Unique challenges, training plan should address various roles; Ongoing training, computer literacy skills and attitudes	Super-user endorsement, computer literacy level, communication skills, local IT support, expand service agreement packages	Training that mirrors real life roles & situations, not overwhelming, repeat training	Level of computer literacy & EMR knowledge levels; More time, training; Protected time; Facilitators
Outcome Variables	More training; Time constraint	OLD: Frustration (slowed down, too much too fast); Content overload, burn out. NEW: Resource availability, flexibility, learning styles	Client support delays, different needs/varying computer experience, levels , frustration, EMR effectiveness & practice efficiency, good communication, first line support	Perceived training success	Ease/difficulty of use, knowledge application; Hands-on assistance; Communication

		targeted, enhanced learner retention, satisfaction			
Notes	Training content: Feedback on physicians' current level of preventive care, query EMR database to generate list of patients eligible for preventive care tests; Assessment: DELPHI (Deliver Primary Healthcare Information) database & anecdotal feedback; Anecdotal feedback positive - improvement in doctor's skills and confidence in querying the EMR for better patient care	6 courses in EMR orientation curriculum (4 lectures, 1 blended, 1 independent computer-assisted); Blended strategy permanently included in EMR training plan; Next steps: move 3 classroom courses to blended format; Training content N/A; Assessment: Survey	Content: Functions for patient data entry (including patients' appointments, notes, prescriptions, letters), special functions (e.g., billing), adv. functions (including practice-wide searches); Small sample size (one EMR vendor); Client: Small solo specialist practice, 3 EMR users, small town; Assessment: Interviews, document analysis, non-participant observation	Content: System basics (sign on, off), entering/editing care plans, intervention documentation, barcode scanning in medication administration, keyboard shortcuts, order entry, edits and sign off, electronic ordering and entry of home medication list. Repeat training available every two weeks; Train other staff; Next steps: Interactive online presentation, self-paced learning, flexibility; No statistical analysis; Assessment: Informal reports	Little / no training content; Limited geographic area (SW ON); Assessment: Semi-structured interviews

3.1. Themes

Several key themes emerged from our review of the included studies namely, (1) types of study design; (2) location of training; (3) types of training; (4) types of training content covered; and (5) perception of training. The themes were extracted after study inclusion and are discussed below.

Theme 1: Study Design. The included studies in this scoping review employed a range of qualitative and quantitative research methods. Of the 15 studies reviewed, five were observational, five descriptive, two were mixed methods, one a review, one a qualitative case study and one an experimental randomized control trial, with physicians in primary care practices as the unit of randomization (Maddocks et al., 2011). There were six case series in the included studies - two observational and four descriptive

(among which two used a survey to measure training outcomes). The outstanding descriptive study was a survey (Dastagir et al., 2012), while the remaining observational studies included one comparative ethnographic study (Lynott, Kooienga, & Stewart, 2012), one cross-sectional study (Kirshner, Salmon, & Chin, 2004) and one longitudinal prospective study (Carayon, Smith, Hundt, Kuruchittham, & Li, 2009). In the mixed method studies, one study used case-control survey (Bredfeldt, Award, Joseph, & Snyder, 2013) while the other employed "retrospective, comparative, descriptive, secondary data analysis" (Edwards, Kitzmiller, & Breckenbridge-Sproat, 2012, p. 106).

Theme 2: Location of Training. Training locations varied in size and type. For example, training was held in "small family practice clinics including rural, urban and small town" (Carayon et al., 2009; Terry, Giles, Brown, Thind, & Stewart, 2009). One training location was that of an EMR vendor who discussed support provided to a "small solo specialist practice with three EMR users in a small town" (Shachak et al., 2012). Training was also provided in primary care practices paired by practice size and GP (General Practitioner) (Maddocks et al., 2011).

One study compared training in three different health care systems - a HMO with 421 clinics, a private and publicly subsidized system with a medical university and eight primary care clinics and several specialty clinics and, an open full-spectrum health service provider with over 20 primary care clinics and approximately 30 hospitals in five western states (Lynott et al., 2012). Another study individually reviewed training in seven settings namely, physician groups in a primary care network, primary care members of the mediplus database, physicians in an internal medicine department, a HMO, and three hospitals mentioned below (Goveia et al., 2013).

One service provider - Kaiser Permanente, held training in different states and specific departments or settings namely, non-specific outpatient primary and specialty care, ambulatory and hospital settings and, clinician office settings (Bredfeldt et al., 2013; Dastagir et al., 2012; Kirshner et al., 2004).

Finally, training was held in at least five hospitals - the largest of which was a quaternary hospital in New Delhi, India (Kumar, Bhatia, & Chiang, 2013). Other hospital settings included a general hospital and an acute care hospital (Stromberg, 2011; McCain, 2008), and hospitals for which no specific type of care was indicated that is, "Mission Hospitals" and a "Central Finland Hospital" (Harton, Borrelli, Knupp, Rogers, & West, 2009; Lemmetty, Häyrinen, & Sundgren, 2009).

Theme 3: Types of Training. Training was conducted at the orientation of new hires, at EHR implementation and at post-implementation. Types of training is further divided into training period and training methods.

Training Period. Of the 15 studies included in this research, five were done at implementation (Carayon et al., 2009; Kumar et al., 2013; Lemmetty et al., 2009; Shachak et al., 2012; Terry et al., 2009): four at post-implementation (Bredfeldt et al., 2013; Dastagir et al., 2012; Kirshner et al., 2004; Maddocks et al., 2011) and three at orientation (Harton et al., 2009; McCain, 2008; Stromberg, 2011). There were two studies for which the training period was not stated but which could potentially have been either orientation or continuing education training (Lynott et al., 2012; Edwards et al., 2012). One study did not indicate the training period though four of the seven articles reviewed in that study are part of the 15 included studies that are included in this paper (Goveia et al., 2013).

Implementation and orientation training appeared to have a broader scope and with a focus on getting participants trained in key areas that would allow them to begin

using the system. The post-implementation training built on the existing knowledge of trainees who were generally advanced EHR/EMR users and so the level of training given was more targeted, in-depth, intensive and with a focus on proficiency, effectiveness, efficiency and improvement (Bredfeldt et al., 2013; Dastagir et al., 2012; Kirshner et al., 2004; Maddocks et al., 2011).

Training Methods. Seven types of training methods were identified in these studies - traditional instructor-led classroom training, one-on-one training, familiarization, CBT, blended learning, feedback and support. 12 studies offered some form of classroom training among which 4 offered only classroom training (Carayon et al., 2009; Dastagir et al., 2012; Lemmetty et al., 2009; Lynott et al., 2012). Eight studies offered a mix of classroom and CBT or some form of blended learning while one study offered both traditional classroom training and blended learning independently at specific times in the year (Edwards et al., 2012). Terry et al. (2008) did not indicate the type of training methods used in their study. Kirshner et al. (2004) indicated one-on-one training held in clinician offices. One study provided training from the vendor perspective (Shachak et al., 2012). This training, called support, offered onsite classroom training, telephone consultations for ongoing support, the Help menu within the EMR, the vendor website, the EMR user manual, annual users' conference and follow up training after system updates or at the request of the client.

The length of training sessions varied in terms of the type of training and the methods of training. Training methods varied between two to four hours per session to 6 and 8 hour training days and one study had a 45 day time completion limit for training (Kumar et al., 2013). Classroom sessions appeared to have a longer duration while attendee roles also seemed a factor in the length of training sessions. For example in one study, super-users were trained for eight hours (Carayon et al., 2009), nurses, 23 hours over four days (Stromberg, 2011) and physicians, physician assistants and nurse practitioners, five sessions in three days (Dastagir et al., 2012).

In summary, the multiplicity of training methods, types and levels of training used in these studies would appear to suggest that training is more effective when a combination of training methods are used. This would include methods mentioned earlier in this section and those discussed later on in this section of the paper such as, hands-on training, self-paced training and customized training.

Theme 4: Training Content. Six studies provided no details of training content covered (Carayon et al., 2009; Edwards et al., 2012; Kumar et al., 2013; Lemmetty et al., 2009; McCain, 2008; Terry et al., 2009). One study (Goveia et al., 2013) provided partial content by indicating details of three out of the seven studies reviewed in their paper. Of the 15 studies included in this research, only eight studies indicated the types of content covered in their training (Bredfeldt et al., 2013; Dastagir et al., 2012; Harton et al., 2009; Kirshner et al., 2004; Lynott et al., 2012; Maddocks et al., 2011; Shachak et al., 2012; Stromberg, 2011). The types of content covered are:

- "Problem list management, medication list management, patient history, efficient chart review, documentation, efficiency tools, order entry and preference list" (Bredfeldt et al., 2013, pp. 2-3).
- "Various functions of the EHR including computerized physician order entry, physician documentation, lab results retrieval, etc."(Dastagir et al., 2012, p. 137).
- "Logging in to the system, documenting and reviewing office visit data, placing orders and documenting a complex visit … perform specific EHR tasks such as

documenting patient history, entering medication, writing orders, checking alerts and adding notes and letters" (Goveia et al., 2013, p. e1556).

- Order entry (single and complex), key EMR topics, medication reconciliation, pharmacy system and medication dispensing, documentation of medication profile, admission history and assessment, online references, guides, additional information retrieval, electronic medication administration record session with self-paced examples and related scenarios, "restraint orders/documentation, nutritional documentation, shift documentation, special notations, … integrating knowledge of the documentation system to include the care plan, problem list, discharge instructions, patient education documentation and related topics" and with an option for remediation or practice following a completed assessment (Harton et al., 2009, pp. 231-232).
- "Basic core competency evaluations … (and) tailored instruction about features and functions of CIS applications with which they are unfamiliar". The four CIS components were "the EMR, data retrieval results reporting, e-mail, and medical library" (Kirshner et al., 2004, p. 342).
- EHR features such as order entry, patient information look up, "documentation and communicating with other clinicians within EHR", and in one system, videos showing the "right" and "wrong" way to use computers in the examination room (Lynott et al., 2012, p. 9).
- Feedback on physicians' current level of preventive care, hands-on training on "how to query their EMR database to generate lists of patients eligible for preventive care tests … a toolkit with step-by-step instructions and software screen shots" for reference (Maddocks et al., 2011, p. 149).
- Functions for patient data entry such as setting up patients' appointments for the administrative staff, and with the doctors - notes, prescriptions and letters. Special functions such as billing, "more advanced features for the doctors … messaging for the whole office … scanning and … (getting) their labs working". A last one-day lesson that teaches how to "reconcile their books with the Ministry" and advanced functions including conducting practice-wide searches and reminders "which let them … know how to … deal with the patients in a variety of ways" (Shachak et al., 2012, p. 188).
- System basics like signing on and signing off, "clinical terminology associated with the HCIS (Health Care Information System)", password management; initiating and editing care plans, entering and editing data on allergies, navigating the electronic chart, simulated admission scenarios requiring "assessment findings, patient history, laboratory values, diagnosis and other facts critical to the care plan"; intervention documentation, electronic medication administration record, barcode scanning in medication administration; keyboard shortcuts, order entry, "order sets such as cardiac enzymes and insulin algorithms, medication orders, laboratory tests, radiological procedures, diets, and consultations"; order edits, documenting the collection of specimens ordered and electronically signing off orders, medication reconciliation including the documentation and editing of home medication lists (Stromberg, 2011, pp. 322 - 324).

Kirshner et al. (2004) was the only study that indicated medical library applications as a core component of the CIS applications of the organization. In spite of this difference, there appears to be some similarity in the types of content taught in EHR or EMR training. Goveia et al. (2013), documents these types of EHR training content as

pertaining to "meaningful use" of EHR: that is, the adoption and use of certified EHRs technologies by healthcare providers "in ways that would improve quality, safety and efficiency" in patient care (Classen & Bates, 2011, p. 855). Criteria developed in the United States for meaningful use included core objectives like patient and medication list management, CPOE, the implementation and use of clinical decision support, additional criteria like the implementation and use of drug formulary checks, the incorporation into EHRs of clinical laboratory tests as structured data and the use of EHRs for quality improvement (Blumenthal & Tavenner, 2010, pp. 502-503).

Theme 5: Perception of Training. Evidence of training perceptions was obtained from the results indicated in the studies - many of which used either quantitative, qualitative or a combination of both instruments to measure training effectiveness or satisfaction. For example, five studies used a survey and five others, a combination of instruments. One study used semi-structured interviews (Terry et al., 2009) and another, participant observation (Lynott et al., 2012). Yet one more study used an evaluation form (Bredfeldt et al., 2013), while Stromberg (2011) measured satisfaction with informal reports from unit managers, staff and nurses - a tool that may potentially create room for bias.

Dissatisfaction was expressed in some studies and training perceived as a challenge prior to the change in training format. Comments referred to the constant daily geographical movement between training locations as physically and mentally exhausting (Harton et al., 2009), while others indicated that the long training hours and class times were unconducive to their needs (McCain, 2008). Other criticisms included too much information in too short a time (Dastagir, et al., 2012; McCain, 2008), "documentation class too long, shorten pharmacy lecture" (Harton et al., 2009).

Overall, feedback from training participants in all the studies was generally positive. Common perceptions were that training was successful, hands-on exercises were most useful and for Carayon et al. (2009), user training was thoroughly planned and delivered and the EHR system was easy to learn. In one study, training material was being incorporated enterprise-wide (Bredfeldt et al., 2013). Trainees also appreciated receiving support materials pertaining to the training sessions (Kirshner et al., 2004; Carayon et al., 2009). In studies where training methods included blended learning, trainees recognized the flexibility afforded by this method and expressed their appreciation for self-paced learning and the ability to work on their own (Harton et al., 2009; McCain, 2008). Other training methods for which participants expressed satisfaction were one-on-one training (Kirshner et al., 2004), offsite classroom training (Dastagir, et al., 2012) and onsite classroom training (Lemmetty et al., 2009).

Participants also recognized the need for more training and suggested that more hands-on practice and interactive learning was needed. This recommendation potentially addresses a recurrent theme found in the majority of the studies namely, participant level of computer literacy, which also relates to trainee ability regarding the ease or difficulty of use of the technology. Kumar et al. (2013) advised to consider several issues including trainer and trainee constraints. Lemmetty et al. (2009) indicated a 45% rate of trainee preference for personal guidance. In the McCain (2008) study, participants under the old training method commented on being slowed down or receiving too much content too fast. From the vendor support perspective, Shachak et al. (2013) indicated that client population profile changes reflected different needs with varying levels of computer experience. Terry et al. (2009) on discovering training and time as barriers in their study, concluded that providers should pay attention to computer literacy, commit to protected time for EHR implementation and adoption, engage in training activities and support in

house facilitators, as barriers and facilitators influenced participants' level of EHR adoption.

The blended learning methods adopted in the studies and the feedback from participants of same appear to suggest that participant learning cycles and styles (MacKeracher, 2004) were targeted - and with the potential outcome variables of satisfaction and user acceptance, improvement in staff knowledge and skill (Edwards et al., 2012), resource availability and enhanced learner retention (McCain, 2008).

4. Discussion

4.1. Answers to research questions

(1) What types of training are typically done with health professionals for the EHR or EMR?

We noted that training was conducted at the orientation of new hires, at EHR or EMR implementation and at post-implementation. We further observed that implementation and orientation training appeared to have a broader scope, while post-implementation training generally targeted advanced EHR/EMR users and focused on proficiency, efficiency and improvement.

(2) What types of training methods are the right fit for health professionals in EHR or EMR training and what types of training methods or strategies do health professionals end up receiving?

We determined that there was not a consensus on this question as discussions in health informatics literature pointed to blended learning as a preferred method, a combination of training (namely, classroom, computer-based and feedback), custom and self-paced training and the best way being unclear. Healthcare professionals in this scoping review received a multiplicity of training methods that included traditional instructor-led classroom training, one-on-one training, familiarization, computer-based training, blended learning, feedback and support. We noted that the multiplicity of training methods, types and levels of training used in these studies would appear to suggest that training is more effective when a combination of training methods are used.

(3) What types of content are covered in EHR or EMR training?

We noted that six of the 15 studies in this scoping review provided no details of the content covered in the training and that in those studies that did provide details, similarities in content were identified that were ascribed to "meaningful use" (Goveia et al., 2013). We also noted that basic training content included signing on/off the system, general navigation and review of the most common functions used, pre-defined data entry, entering / editing care plans, online reference guides, medication dispensing, reconciliation, medication profile documentation, keyboard shortcuts, order entry, edits, e-ordering, home medication list entry etc. Advanced training content included problem and medication list management, patient history, efficient chart review, order entry, documentation, preference list management, efficiency tools, lab results retrieval, practice-wide searches etc.

4.2. Study limitations

We excluded grey literature studies from this scoping review and focused only on studies that were available via traditional publishing channels. While we thought that grey literature studies were important, this was not the focus of our search. For the same reason, we did not include studies that discussed the training of students in health professions. We conducted a very broad search and set no publication date limits for the search as we were unsure whether we would find any results. We noted that none of the studies in this scoping review were generalizable and that case series studies, ranked low on the hierarchy of health evidence (Duke University Medical Center Library & Archives, 2015; Glover, Izzo, Odato, & Wang, 2006) were the majority of the included studies in this paper. Studies were limited by demographics (namely rural versus urban and suburban) and by location (for example, emergency care, ambulatory care, specialty care and so on). One study (Maddocks et al., 2011) was limited by a parallel provincial program and another by a one-time occurrence (Kishner et al., 2004). Other studies were limited by sample size and the quality of the assessment tool for training - anecdotal feedback (Stromberg, 2011).

4.3. Recommendations

We made recommendations for detailed training content to be provided, for a consensus development on training methods, for engagement in collaborative opportunities and for the development of training as a core product / strategic asset in healthcare organizations. We recommended the use of strategic business concepts - "strategic networks", "distinctive capabilities" and "core competencies" (Jarillo, 1993; Kay, 1993; Hamel & Prahalad, 1994; Prahalad & Hamel, 1990) and based our recommendations on the fact that:

1. Six out of the 15 included studies reviewed in this paper provided no details about the content of training covered (Carayon et al., 2009; Edwards et al., 2012; Kumar et al., 2013; Lemmetty et al., 2009; McCain, 2008; Terry et al., 2009). Our position is that the inclusion of detailed training content would have helped to better assess the success or otherwise of the studies and to inform healthcare organizations of potential content for consideration or inclusion in actual EHR or EMR training.
2. There did not appear to be a consensus on the best way to train healthcare professionals in the use of health information technologies. We noted that there was a multiplicity of training methods in the studies and that they appeared to suggest that training was more effective when a combination of training methods are used.
3. We found very few research in health informatics literature, pertaining to this type of study, that six of the included studies in this paper were case series (Harton et al., 2009; Lemmetty et al., 2009; McCain, 2008; Shachak et al., 2012; Stromberg, 2011; Terry et al., 2009) and that case series studies rank very low on the evidence hierarchy in health and medical literature (Duke University Medical Center Library & Archives, 2015; Glover, Izzo, Odato, & Wang, 2006).
4. Only two of the 15 studies reviewed for this research indicated the application of continuing medical education credits to the training and both were post-implementation studies (Bredfeldt et al., 2013; Kirshner et al., 2004). One of the two studies also indicated that the training material used in the study was being incorporated enterprise-wide (Bredfeldt et al., 2013). One study stated that the

blended learning strategy was permanently included in the EMR training plan and that three classroom courses were to be moved to the blended format as next steps (McCain, 2008). Only one study indicated that library applications were part of the four core components of their computer information systems (Kirshner et al., 2004).

5. Directions for future research

In a systematic review of health informatics literature, the authors discovered that there was a paucity of results that addressed on-the-job training of health professionals for EHR and EMR use, although calls have been made for healthcare organizations to invest in the training of their employees (Ash, Stavri, & Kuperman, 2003; Lorenzi, Kouroubali, Detmer, & Bloomrosen, 2009; Goldberg, Kuzel, Feng, DeShazo, & Love, 2012; Janois, Lind, Göransson, & Sandblad, 2014). The authors also noted the contributions to health informatics practice by professional organizations like COACH (Canada's Health Informatics Association) and HIMSS (Healthcare Information and Management Systems Society) through program activities like certification and publication of white papers and other reports. Additionally, the authors noted the contribution to health informatics education where schools such as the University of Victoria, University of Arkansas for Medical Sciences and University Hospital "P. Giaccone" include or plan to include EHR/EMR training to students in health professions (Borycki et al., 2009; Hart, Newton, & Boone, 2010; Allegra, Messineo, Migliore, & Alessi, 2010). Potential research enquires could include investigating grey literature studies for this type of training and exploring further, the inclusion of EHR or EMR training to students in health professions.

Advances in health information technology warrant that healthcare organizations should be equipped with the necessary tools to deal with the turbulence that characterizes technology-rich environments and research into all aspects of technology training that prepares healthcare professionals for the changing nature of their work environments should be encouraged.

6. Conclusion

We reviewed 15 studies and used the Arksey and O'Malley (2005) scoping framework as the methodology for this project. Key themes were extracted and discussed and answers to the research questions were provided in the discussion section of this paper.

We conclude this scoping review with the observation that healthcare organizations are aware of the importance of having health professionals trained in health information technologies and that they may be working to close this gap in the continuing professional development of healthcare professionals. For example, in Canada, Prism Economics and Analysis (2014) projected hiring requirements for health informatics and health information management professionals and identified roles at high risk of skills shortages. The Prism report commissioned by Canada Health Infoway, CHIMA (Canadian Health Information Management Association), CIHI (Canadian Institute for Health Information), COACH, ICTC (Information and Communications Technology Council) and ITAC (Information Technology Association of Canada) Health, indicated that as a result of replacement and growth demand, hiring requirements over the next five years in Canada (i.e., 2014-2019) would range from approximately 6,200 to 12,200 persons with more than 70% of the hiring requirements projected to be in information technology and health information management (p.2). The report also revealed the need

to "broaden the skills of current clinical professionals to better support them in clinical informatics roles" - given the dominant trend of the "intensification and optimization of usage of e-health systems and applications …" (p. 66). Furthermore, COACH, Canada's Health Informatics Association has several publications that directly address the skills, knowledge and types of training required for various health informatics roles. These publications include the Health Informatics Professional Core Competencies eBook (COACH, 2012), the Health Informatics Professional Career Matrix (COACH, 2013a), the 2013 Health Informatics Professional Role Profiles (COACH, 2013b) and the Certified Professional in Healthcare Information Management and Systems & Canadian Supplementary Examination (CPHIMS-CA) (COACH, 2015).

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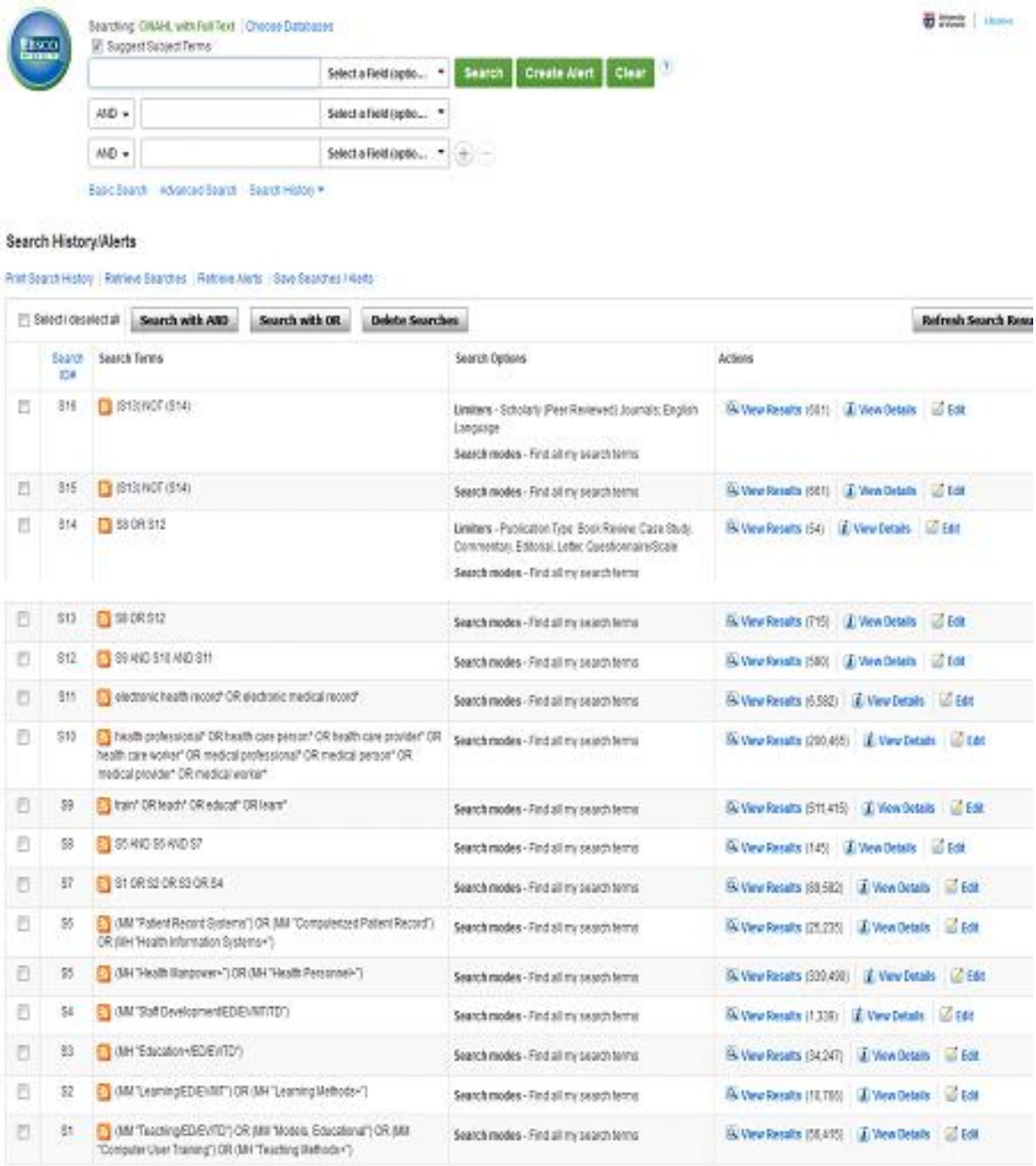
Appendix A - Search history

A-1: CINAHL with Fulltext: Run 29 December 2014



A-2: EMBASE: Run 30 December 2014

Wolters Kluwer Health | OvidSP

Support & Training | Close

Database(s): Embase Classic+Embase 1947 to 2014 December 29

Search Strategy:

#	Searches	Results
1	*teaching/	32139
2	*experiential learning/ or *learning style/ or *lifelong learning/ or *problem based learning/ or *reinforcement/ or *self-directed learning/ or *skill retention/	15166
3	*adult education/ or *continuing education/ or *course content/ or *curriculum/ or *education program/ or *educational model/ or *learning environment/ or *refresher course/	34279
4	exp staff training/ or exp in service training/	23335
5	exp health care manpower/ or exp health care personnel/	1022559
6	exp electronic medical record/	26098
7	exp hospital information system/ or exp medical information system/	32029
8	1 or 2 or 3 or 4	100845
9	6 or 7	55310
10	5 and 8 and 9	347
11	(train* or teach* or educat* or learn*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	1665254
12	(health professional* or health care person* or health care provider* or health care worker* or medical professional* or medical person* or medical provider* or medical worker*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	182524
13	(electronic health record* or electronic medical record*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	30506
14	11 and 12 and 13	593
15	10 or 14	916
16	limit 15 to (conference abstract or editorial or letter or note or short survey)	292
17	15 not 16	624
18	limit 17 to english language	609

A-3: Ovid MEDLINE: Run 17 January 2015

Wolters Kluwer Health | OvidSP

Support & Training | Close

Database(s): **Ovid MEDLINE(R)** 1946 to January Week 2 2015

Search Strategy:

#	Searches	Results
1	*Teaching/mt, td [Methods, Trends]	12495
2	*computer user training/ or *models, educational/	3578
3	*learning/ or *problem-based learning/ or *"reinforcement (psychology)"/	37297
4	exp Education/mt, td [Methods, Trends]	96225
5	exp Inservice Training/	24398
6	exp health manpower/ or exp health personnel/	384322
7	*Electronic Health Records/ or *Medical Records Systems, Computerized/	17364
8	*medical informatics applications/ or *health information systems/ or exp hospital information systems/	28580
9	1 or 2 or 3 or 4 or 5	149924
10	7 or 8	42959
11	6 and 9 and 10	251
12	(train* or teach* or educat* or learn*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1118351
13	(health professional* or health care person* or health care provider* or health care worker* or medical professional* or medical person* or medical provider* or medical worker*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	68091
14	(electronic health record* or electronic medical record*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	13087
15	12 and 13 and 14	118
16	11 or 15	368
17	limit 16 to (case reports or comment or editorial or letter)	9
18	16 not 17	359
19	limit 18 to english language	342

A-4: PsycINFO: Run 18 January 2015

Wolters Kluwer Health | OvidSP

Support & Training | Close

Database(s): **PsycINFO** 1806 to January Week 2 2015

Search Strategy:

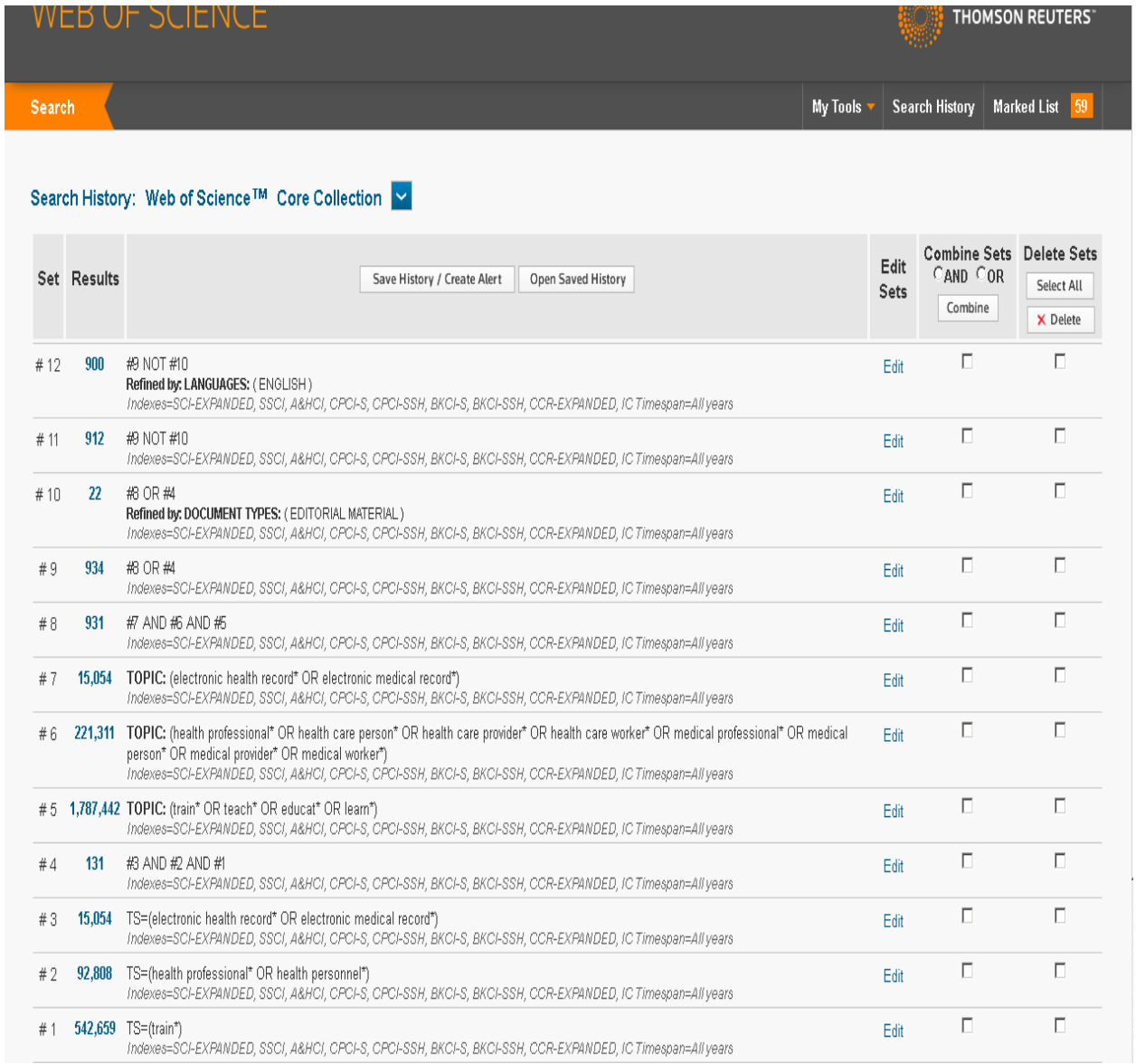
#	Searches	Results
1	*teaching/ or exp teaching methods/	81768
2	exp Inservice Training/ or exp On the Job Training/ or exp Computer Training/ or *Training/ or exp Personnel Training/	20272
3	exp Learning/ or exp Education/	380719
4	exp Health Personnel/	106782
5	exp Information Systems/ or exp Information Technology/	34045
6	exp Medical Records/	2499
7	1 or 2 or 3	415050
8	5 or 6	36296
9	4 and 7 and 8	236
10	(train* or teach* or educat* or learn*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	995799
11	(health professional* or health care person* or health care provider* or health care worker* or medical professional* or medical person* or medical provider* or medical worker*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	41004
12	(electronic health record* or electronic medical record*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	1348
13	10 and 11 and 12	37
14	9 or 13	271
15	limit 14 to ("comment/reply" or editorial or letter or review-book)	21
16	14 not 15	250
17	limit 16 to english language	249
18	from 17 keep 8-9, 11, 15, 21, 24, 30-31...	21

A-5: PubMed: Run 10 February 2015

History Download history Clear history

Search	Add to builder	Query	Items found	Time
#44	Add	Search **(#38 NOT #43)**	659	15:44:17
#45	Add	Search **(#38 NOT #43)** Filters: **English**	634	15:44:16
#38	Add	Search **(#33 OR #37)**	677	15:42:36
#43	Add	Search **(#39 OR #40 OR #41 OR #42)**	18	15:42:14
#42	Add	Search **(#33 OR #37)** Filters: **Letter**	4	15:40:35
#41	Add	Search **(#33 OR #37)** Filters: **Editorial**	9	15:36:25
#40	Add	Search **(#33 OR #37)** Filters: **Comment**	5	15:36:04
#39	Add	Search **(#33 OR #37)** Filters: **Case Reports**	2	15:35:45
#37	Add	Search **(#34 AND #35 AND #36)**	150	15:32:56
#36	Add	Search **(electronic health record* OR electronic medical record*)**	15770	15:31:55
#35	Add	Search **(health professional* OR health care person* OR health care provider* OR health care worker* OR medical professional* OR medical person* OR medical provider* OR medical worker*)**	76322	15:31:10
#34	Add	Search **(train* OR teach* OR educat* OR learn*)**	1461096	15:30:12
#33	Add	Search **(#20 AND #31 AND #32)**	527	15:28:49
#32	Add	Search **(#24 OR #30)**	186583	15:26:50
#31	Add	Search **(#3 OR #6 OR #11 OR #14 OR #17)**	290950	15:25:49
#30	Add	Search **(("Medical Informatics Applications"[Majr]) OR "Hospital Information Systems"[Mesh]) OR "Health Information Systems"[Majr]**	182921	15:24:21
#24	Add	Search **("Medical Records Systems, Computerized"[Majr]) OR "Electronic Health Records"[Majr]**	18352	15:20:57
#20	Add	Search **("Health Manpower"[Mesh]) OR "Health Personnel"[Mesh]**	385019	15:18:33
#17	Add	Search **"Inservice Training"[Mesh]**	24430	15:16:42
#14	Add	Search **("Education/education"[Mesh] OR "Education/methods"[Mesh] OR "Education/trends"[Mesh])**	97014	15:13:31
#11	Add	Search **(("Learning"[Majr]) OR "Problem-Based Learning"[Majr]) OR "Reinforcement (Psychology)" [Majr]**	178815	15:12:25
#6	Add	Search **("Computer User Training"[Majr]) OR "Models, Educational"[Majr]**	3586	15:10:31
#3	Add	Search **("Teaching/education"[Majr] OR "Teaching/methods"[Majr] OR "Teaching/trends"[Majr])**	17203	15:08:41

A-6: ISI Web of Science: Run 07 February 2015



WEB OF SCIENCE THOMSON REUTERS

Search | My Tools | Search History | Marked List 59

Search History: Web of Science™ Core Collection

Set	Results	Save History / Create Alert / Open Saved History	Edit Sets	Combine Sets AND OR Combine	Delete Sets Select All X Delete
# 12	900	#9 NOT #10 **Refined by: LANGUAGES:** (ENGLISH) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 11	912	#9 NOT #10 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 10	22	#8 OR #4 **Refined by: DOCUMENT TYPES:** (EDITORIAL MATERIAL) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 9	934	#3 OR #4 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 8	931	#7 AND #6 AND #5 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 7	15,054	**TOPIC:** (electronic health record* OR electronic medical record*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 6	221,311	**TOPIC:** (health professional* OR health care person* OR health care provider* OR health care worker* OR medical professional* OR medical person* OR medical provider* OR medical worker*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 5	1,787,442	**TOPIC:** (train* OR teach* OR educat* OR learn*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 4	131	#3 AND #2 AND #1 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 3	15,054	TS=(electronic health record* OR electronic medical record*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 2	92,808	TS=(health professional* OR health personnel*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐
# 1	542,659	TS=(train*) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, CCR-EXPANDED, IC Timespan=All years*	Edit	☐	☐

Appendix B - References of included studies

Bredfeldt, C. E., Awad, E. B., Joseph, K., & Snyder, M. H. (2013). Training providers: Beyond the basics of electronic health records. *BMC Health Services Research, 13*: 503. doi:10.1186/1472-6963-13-503

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Goveia, J., Van Stiphout, F., Cheung, Z., Kamta, B., Keijsers, C., Valk, G., & Ter Braak, E. (2013). Educational interventions to improve the meaningful use of electronic health records: A review of the literature: BEME Guide No. 29. *Medical Teacher, 35*(11), e1551–e1560. doi:10.3109/0142159X.2013.806984

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Kumar, A., Bhatia, S., & Chiang, I.-J. (2013). Development of an in-house designed training process in a quaternary care hospital. *Technology and Health Care, 21*(5), 469–478. doi:10.3233/THC-130750

Lemmetty, K., Häyrinen, K., & Sundgren, S. (2009). The impacts of informatics competencies and user training on patient information system implementation. *Studies in Health Technology and Informatics, 146*, 646–659. doi:10.3233/978-1-60750-024-7-646

Lynott, M. H., Kooienga, S. A., & Stewart, V. T. (2012). Communication and the electronic health record training: A comparison of three healthcare systems. *Informatics in Primary Care, 20*(1), 7–12.

Maddocks, H., Stewart, M., Thind, A., Terry, A. L., Chevendra, V., Marshall, J. N., Denomme, L. B., & Cejic, S. (2011). Feedback and training tool to improve provision of preventive care by physicians using EMRs: A randomized control trial. *Informatics in Primary Care, 19*(3), 147–153.

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