Appendix I. Search Strategies and Results

Search	Keywords/MeSH terms	# hits
1	Animals/	4306360
2	medical informatics/ or medical informatics applications/ or decision making, computer-assisted/ or diagnosis, computer-assisted/ or therapy, computer-assisted/ or drug therapy, computer-assisted/ or radiotherapy, computer-assisted/ or radiotherapy, conformal/ or radiotherapy, intensity-modulated/ or radiotherapy planning, computer-assisted/ or surgery, computer-assisted/ or information systems/ or clinical laboratory information systems/ or decision support systems, clinical/ or hospital information systems/ or medical order entry systems/ or integrated advanced information management systems/ or management information systems/ or ambulatory care information systems/ or clinical pharmacy information systems/ or database management systems/ or decision support systems, management/ or healthcare common procedure coding system/ or operating room information systems/ or radiology information systems/ or medical records systems, computerized/ or reminder systems/ or medical informatics computing/	90182
3	(electronic record or information record or electronic medical record or electronic patient record or patient order entry or computer-based patient system or clinical decision support systems or decision support system or expert system or clinical information system or Nursing Information system or electronic health record or computerized provider order entry or computerized physician order entry or CPOE or information technology or health IT or health information technology).mp.	10217
4	3 or 2	94315
5	4 not 1	91472
6	limit 5 to (English language and yr="2003 - 2009")	32877
7	limit 6 to "review articles"	2644
8	limit 6 to (comment or editorial or letter or "review")	4282
9	limit 6 to (addresses or bibliography or biography or classical article or comment or congresses or dictionary or directory or duplicate publication	5053

Search	Keywords/MeSH terms	# hits
	or editorial or lectures or legal cases or legislation or letter or news or newspaper article or periodical index or published erratum or "review" or "scientific integrity review")	
10	6 not 7 not 8 not 9	27824
11	10 and (clinician or clinicians).mp.	1081
12	10 and (dentist or dentists).mp.	64
13	10 and (nurse practitioner or nurse practitioners).mp.	72
14	10 and (nurse or nurses).mp.	966
15	10 and (occupational therapist or occupational therapists).mp.	14
16	10 and (pharmacist or pharmacists).mp.	190
17	10 and (physical therapist or physical therapists).mp.	12
18	10 and (physician or physicians).mp.	2598
19	10 and (provider or providers).mp.	1063
20	10 and (psychologist or psychologists).mp.	11
21	10 and (radiologist or radiologists).mp.	399
22	11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21	5202
23	(evaluation or impact or technology acceptance or technology adoption or usability or human computer interaction).mp. [mp=title, original title, abstract, name of substance word, subject heading word]	1043986
24	Task performance and analysis/ or human engineering/ or user-computer interface/ or attitude to computers/	40427
25	23 or 24	1076973
26	22 and 25	2025

Appendix II. MeSH terms for Stage 2 study identification.

MeSH Term
1. Diagnosis, computer-assisted
2. Image processing, computer-assisted
3. Image interpretation, computer-assisted
4. Radiographic image interpretation, computer-assisted
5. Medical records systems, computerized
6. Radiotherapy planning, computer-assisted
7. Surgery, computer-assisted
8. Magnetic resonance imaging
9. Pattern recognition, automated
10. Vocabulary, controlled
11. Predictive value of tests
12. Sensitivity and specificity
13. Observer variation
14. Algorithms
15. Terminology
16. Mammogram
Total = 283

Appendix III. Included studies

Stage 1: (n=42)

1.   Austin T, Kalra D, Tapuria A, Lea N, Ingram D. Implementation of a query interface for a generic record server. *International Journal of Medical Informatics.* Nov 2008;77(11):754-764.
2.   Cesta A, Bajcar JM, Ong SW, Fernandes OA. The EMITT study: development and evaluation of a medication information transfer tool. *Ann Pharmacother.* Jun 2006;40(6):1074-1081.
3.   Chatburn RL. Computer control of mechanical ventilation. *Respir Care.* May 2004;49(5):507-517.
4.   Cho I, Park H-A. Development and evaluation of a terminology-based electronic nursing record system. *Journal of Biomedical Informatics.* Aug-Oct 2003;36(4-5):304-312.
5.   Doran DM, Mylopoulos J, Kushniruk A, et al. Evidence in the palm of your hand: development of an outcomes-focused knowledge translation intervention. *Worldviews Evid Based Nurs.* 2007;4(2):69-77.
6.   Fuchs C, Quinzio L, Benson M, et al. Integration of a handheld based anaesthesia rounding system into an anaesthesia information management system. *International Journal of Medical Informatics.* Jul 2006;75(7):553-563.
7.   Fung CH. Computerized condition-specific templates for improving care of geriatric syndromes in a primary care setting. *Journal of General Internal Medicine.* Sep 2006;21(9):989-994.
8.   Handler SM, Hsieh VC, Nace DA, Sciulli L, Fridsma DB, Studenski SA. Development and evaluation of a charge capture program for long-term care providers. *Journal of the American Medical Directors Association.* Sep-Oct 2004;5(5):337-341.
9.   Hao AT-H, Huang L-F, Wu L-B, et al. Building an innovation electronic nursing record pilot structure with nursing clinical pathway. *Studies in Health Technology & Informatics.* 2006;122:279-283.
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13.   Jalloh OB, Waitman LR. Improving Computerized Provider Order Entry (CPOE) usability by data mining users' queries from access logs. *AMIA Annu Symp Proc.* 2006;Annual Symposium Proceedings/AMIA Symposium.:379-383.
14.   Jaspers MWM, Steen T, van den Bos C, Geenen M. The think aloud method: a guide to user interface design. *International Journal of Medical Informatics.* Nov 2004;73(11-

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15.   Johnson KB, Fitzhenry F. Case report: activity diagrams for integrating electronic prescribing tools into clinical workflow. *Journal of the American Medical Informatics Association.* Jul-Aug 2006;13(4):391-395.

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18.   Lapane KL, Hiris J, Hughes CM, Feinberg J. Development and implementation of pharmaceutical care planning software for nursing homes based on the Fleetwood Model. *American Journal of Health-System Pharmacy.* Dec 15 2006;63(24):2483-2487.

19.   Leslie SJ, Hartswood M, Meurig C, et al. Clinical decision support software for management of chronic heart failure: development and evaluation. *Computers in Biology & Medicine.* May 2006;36(5):495-506.

20.   Lobach DF, Silvey GM, Macri JM, Hunt M, Kacmaz RO, Lee PP. Identifying and overcoming obstacles to point-of-care data collection for eye care professionals. *AMIA Annu Symp Proc.* 2005;Annual Symposium Proceedings/AMIA Symposium.:465-469.

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Appendix IV. Study Design and Data Analysis

	Study type	Study design	Subj/Obj	Data analysis	#
S4 (68)	Quantitative (54)	RCT post only	Subjective	descriptive, comparative, multivariate	1
			Objective	descriptive, comparative	6
				descriptive, comparative, multivariate	3
		RCT pre/post	Subjective	descriptive, comparative	1
			Objective	descriptive, comparative	2
				descriptive, comparative, multivariate	1
		RCT crossover	Subjective	descriptive	3
				descriptive, comparative	2
			Objective	descriptive, comparative	5
		RCT repeated measure	Subjective	descriptive, comparative	1
			Objective	descriptive, comparative	1
		Two group post only	Subjective	descriptive	1
			Objective	descriptive, comparative	5
		Two group pre/post	Objective	descriptive	1
				descriptive, comparative	1
		Two group repeated measure	Objective	descriptive, comparative	1
		One group post only	Subjective	descriptive	11
				descriptive, comparative	4
			Objective	descriptive	3
				descriptive, comparative	2
		One group pre/post	Subjective	descriptive	1
				descriptive, comparative	2
			Objective	descriptive	1
				descriptive, comparative	4
		One group repeated measure	Subjective	descriptive, comparative	1
			Objective	descriptive	2
				descriptive, comparative	3
		Removed treatment design	Objective	descriptive, comparative	1
		Repeated treatment	Objective	descriptive, comparative	1
		Three group post only	Objective	descriptive	1

	Study type	Study design	Subj/Obj	Data analysis	#
S5 (196)	Quantitative (170)	RCT post only	Objective	descriptive, comparative	1
				descriptive, comparative, multivariate	1
		RCT pre/post	Subjective	descriptive, comparative	1
			Objective	descriptive, comparative	1
				descriptive, comparative, multivariate	4
		RCT repeated measure	Objective	descriptive, comparative	2
				descriptive, comparative, multivariate	1
		Two group post only	Objective	descriptive, comparative	6
				descriptive, comparative, multivariate	2
		Two group pre post	Objective	descriptive	1
				descriptive, comparative	3
				descriptive, comparative, multivariate	4
		Two group repeated measure	Objective	descriptive, comparative	1
		One group post only	Subjective	descriptive	19
				descriptive, correlational	1
				descriptive, comparative	13
				descriptive, comparative, multivariate	4
			Objective	descriptive	13
				descriptive, correlational	1
				descriptive, comparative	8
				descriptive, comparative, multivariate	3
		One group pre/ post	Subjective	descriptive	3
				descriptive, correlational	1
				descriptive, comparative	12
				descriptive, comparative, multivariate	1
			Objective	descriptive	1
				descriptive, correlational	1
				descriptive, comparative	27
				descriptive, comparative, multivariate	2
		One group repeated measure	Subjective	descriptive	12
				descriptive, comparative	1
				descriptive, comparative, multivariate	1
			Objective	descriptive	1
				descriptive, correlational	1
				descriptive, comparative	12
				descriptive, comparative, multivariate	8
		Three group post only	Objective	descriptive, comparative, multivariate	1

Appendix V. Theory/Model/Framework

Model/framework	Purpose	References	Example
General system development/design			
GASTON framework	Facilitates all stages in the clinical guideline development process.	(de Clercq, Hasman, Blom, & Korsten, 2001)	(van Oosterhout, et al., 2003)
CDSS development process model	Three-phase development and evaluation process of a medical expert system.	(Wyatt & Spiegelhalter, 1990)	(Marcy, et al., 2008)
DSS development framework	Identifies and integrates the major stakeholders in the development of a DSS.	(Sprague, 1980)	None
Case-Based Reasoning (CBR)	Problem solving paradigm for system development. CBR attempts to solve a given problem within a specific domain by adapting established solutions to similar problems.	(Aamodt & Plaza, 1994)	(Sefion, Ennaji, Gailhardou, & Canu, 2003)
Ecological interface design	Interface design based on skills, rules, and knowledge taxonomy of cognitive control.	(Vicente & Rasmussen, 1992)	(Effken, Loeb, Johnson, Johnson, & Reyna, 2001)
Formative evaluation in instructional design	Provides a decision-making template for designing an effective formative evaluation.	(Weston, Mcalpine, & Bordonaro, 1995)	(Street, et al., 2007)

Model/framework	Purpose	References	Example
Agile software development methodology	Proposes a light and fast system development process based on iterative development. Four principles are: 1) Individuals and interactions over processes and tools; 2) Working software over comprehensive documentation; 3) Customer collaboration over contract negotiation; 4) Responding to change over following a plan.	(Boehm, 2002; Williams & Cockburn, 2003)	(Narasimhadevara, Radhakrishnan, Leung, & Jayakumar, 2008)
Coiera's theory of clinical communication space	Evaluates the impact of health IT on clinical communication.	(Coiera, 2000)	(Cashen, et al., 2006)
Activity-based computing (ABC) framework	Investigate how to create computational support for handling parallel, mobile, collaboration and distributed activities	(Bardram, 2009)	None
Human-computer interaction			
Health human-computer interaction framework	Identifies the major components of health human-computer interaction, including users (e.g., clinicians, patients, or other groups), computer, context or environment, task, information, information, interactions, and time.	(Staggers, 2001)	None
Human factors model	Investigates interaction between humans, the tools used, the environments in which they work, and the tasks performed.	(Karwowski, 2006)	(Alexander, Rantz, Flesner, Diekemper, & Siem, 2007)
Fit between Individuals, Task, and Technology (FITT)	IT adoption depends on the fit between the individual users (e.g., computer anxiety, motivation), the technology (e.g., usability, functionality,	(Ammenwerth, Iller, & Mahler, 2006)	(Ammenwerth, et al., 2006)

Model/framework	Purpose	References	Example
	performance), and the clinical tasks and processes (e.g., organization, task complexity).		
Norman's theory of action	Defines several stages of activity associated with the interaction between human and machine.	(Norman, 1986)	(Horsky, Kaufman, & Patel, 2003)
Action Identification Theory	Identifies human actions from low-level identities, such as how the action is performed, to high-level identities, such as why the action is performed.	(Vallacher & Wegner, 1987)	(Weir, et al., 2007)
The distributed resource model of human-computer interaction	Describes how information structures are used as resources for actions performed.	(Wright, Fields, & Harrison, 2000)	(Horsky, et al., 2003)
Human-centered distributed information design model	Proposes analysis of human-computer interaction through four levels of analysis: user, functional, task and representational.	(J. J. Zhang, Patel, Johnson, Smith, & Malin, 2002)	(C. M. Johnson, Johnson, & Zhang, 2005)
Technology acceptance			
Technology Acceptance Model	Suggests that perceived usefulness and perceived ease of use influence users' attitudes toward using a technology and contribute to their behavioral intention to use the technology	(Davis, 1989)	(Barker, van Schaik, Simpson, & Corbett, 2003; Dykes, et al., 2007)

Model/framework	Purpose	References	Example
Technology Acceptance Model 2	Includes additional constructs related to social influence processes (e.g., subjective norm, voluntariness, and image), and cognitive instrumental processes (e.g., job relevance, output quality, and result demonstrability).	(Venkatesh & Davis, 2000)	(Tamblyn, et al., 2006)
Theory of Reasoned Action (TRA)	Suggests that human's attitude about the behavior and their beliefs (subjective norms) determine their behavioral intention.	(Fishbein & Ajzen, 1975)	Reference in Duyck (2008)
Theory of Planned Behavior (TPB)	Proposes that, in addition to behavioral attitude and subjective norms, self-efficacy was shown to influence behavioral intention.	(Ajzen, 1991)	Reference in Duyck (2008)
Combined TAM and TPB (C-TAM-TPB)	Integrates TAM and TPB to identify the determinants of behavioral intention.	(Chau & Hu, 2002)	Reference in Duyck (2008)
Motivational Model	Proposes that human's behavioral intention is influenced by both extrinsic motivation (perceived performance) and intrinsic motivation (perceived enjoyment).	(Davis, Bagozzi, & Warshaw, 1992)	Reference in Duyck (2008)
Model of PC Utilization	Identifies factors influencing computer utilization, including long-term consequences, job fit, complexity, affection, social factors and facilitating conditions of PC use.	(Thompson, Higgins, & Howell, 1991)	Reference in Duyck (2008)

Model/framework	Purpose	References	Example
Unified Theory of Acceptance and Use of Technology (UTAUT)	Combines theories of TAM, TRA, TPB, C-TAM-TPB, motivation model, and model of utilization, innovation diffusion theory, and social cognitive theory.	(Venkatesh, Morris, Davis, & Davis, 2003)	(Duyck, et al., 2008)
Information System success model	Identifies the processes that influence information system success, from system quality information quality, use and user satisfaction to individual impact and organizational impact.	(DeLone & McLean, 2003)	(Golob, et al., 2008; Jen & Chao, 2008)
Perceptual structure	Investigates how users perceive the desired functionalities of a new system: internal coordination and external coordination.	(Currim, Gurbaxani, LaBelle, & Lim, 2006)	None
Technology adoption			
Diffusion of Innovation	Explores how, why, and at what rate new ideas and technology spread through certain channels over time, among the members of a social system.	(Rogers, 1995)	(T.-T. Lee, Mills, Bausell, & Lu, 2008; Ruland & Ravn, 2003)
Lewin's change theory	Proposes three stages of behavioral change, including motivated to change (unfreezing), change (changing) and permanent change (refreezing).	(Lewin, 1951)	(Bozak, 2003; T. T. Lee, 2006)

Appendix VI. Methods for Usability Specification and Evaluation

Method	Purpose	Reference	Examples
System specification			
Log analysis	Utilization analysis.	NA	NA
Literature review/ Guidebook	Identifies existing knowledge for user needs.	NA	NA
Expert review	Provides a gold standard to evaluate the accuracy of the system.	NA	NA
Wizard-of-Oz approach	Used for simulation of high-level functions in an interactive system. Users interact with a computer system that behaves as if it was automonous but which is actually being wholly or partially operated by a human being.	(Green & Wei-Haas, 1985)	(Alapetite, 2008)
Developmental Trajectory Approach	A group-based approach that uses a multinominal modeling strategy to identify relatively homogenous clusters of devepmental trajectories.	(Nagin, 1999; Nagin & Tremblay, 2001)	(Kai Zheng, Padman, Johnson, & Diamond, 2005)
The Failure Modes, Effects and Criticality Analysis (FMECA)	Identifies and eliminates known and potential failures and errors from the system, process, or technology design.	(Institut for healthcare improvement)	(Bonnabry, et al., 2008)
Interface design			
Card sorting	Investigates how users group items to inform the process of structuring information and displays in interface design.	(Rugg & McGeorge, 1997)	(Saleem, et al., 2007)
Cognitive work analysis	A systems-based approach to the analysis, design and evaluation of systems. It consists of five levels of	(Vicente & Rasmussen, 1999)	(Effken, et al., 2001)

Method	Purpose	Reference	Examples
	contraints (work domain, task, strategies, social-organizational, and user skill) support ecological interface design.		
Task/Workflow identification			
Use-Case Analysis/Use-Case modeling	A text description of user-system interaction.	(Ratcliffe & Budgen, 2001)	(Estrella, et al., 2007; Furey, Conway, O'Keeffe, & Lyons, 2007)
Standardized patient	Assists in the usability evaluation of health IT to be used during a patient interview.	Not found	(Linder, et al., 2006; Peabody, Luck, Jain, Bertenthal, & Glassman, 2004)
Workflow analysis/Activity diagram	Models both computational and organizational processes.	(Dumas & ter Hofstede, 2001; Workflow Management Coalition, 1998)	(K. B. Johnson & Fitzhenry, 2006; Rose, et al., 2005)
Observer agreement	Measures observer agreement for system reliability.	(Kundel & Polansky, 2003)	None
User-system-task interaction analysis			
Cognitive Walkthrough (Expert-based)	Identifies actions and goals needed to accomplish a task and elucidates potential problems associated with task completion.	(M. W. Jaspers, 2009; Polson, Lewis, Rieman, & Wharton, 1992)	(Cohen, et al., 2004; Peute & Jaspers, 2007)
Heuristic Evaluation (Expert-based)	A usability engineering method using ten heuristic principles to evaluate a user interface design.	(M. W. Jaspers, 2009; Nielsen, 2005)	(Graham, et al., 2004; J. Zhang, Johnson, Patel, Paige, & Kubose, 2003)
Think aloud protocol/Verbal protocol analysis (User-based)	Encourages users to express out loud what they are looking at, thinking, doing, and feeling, as they perform the task.	(Ericsson & Simon, 1980; M. W. Jaspers, 2009; Lewis, 1982)	(M. W. M. Jaspers, Steen, van den Bos, & Geenen, 2004; Wu, Orr, Chignell, & Straus, 2008)

Method	Purpose	Reference	Examples
Field observation			
Time-and-motion study	Measures time spent on a certian activity/task.	(Finkler, Knickman, Hendrickson, Lipkin, & Thompson, 1993)	(Lo, et al., 2007; Pizziferri, et al., 2005)
Task analysis	Breaks down tasks into subtasks for examining processes of given work activity.	(Kirwan & Ainsworth, 1992)	(Rose, et al., 2005)
Cognitive Task Analysis (CTA)	The extension of traditional task analysis techniques to yield information about the knowledge, thought processes, and goal structures that underlie observable task performance.	(Schraagen, Chipman, & Shalin, 2000)	(Horsky, Gutnik, & Patel, 2006; Weir, et al., 2007)
Work sampling	Measures the proportion of time spent on a task.	(Pelletier & Duffield, 2003) (Finkler, et al., 1993)	(Doran, et al., 2007; Hakes & Whittington, 2008; Korst, Eusebio-Angeja, Chamorro, Aydin, & Gregory, 2003; T.-T. Lee, Mills, & Lu, 2008)
Critical incident technique	Collects direct observations of meaningful human activities.	(Flanagan, 1954)	(Westbrook, Coiera, Sophie Gosling, & Braithwaite, 2007)
Zheng's workflow analysis	Assess workflow fragmentation and patterns with data visulization	(K. Zheng, Haftel, Hirschl, O'Reilly, & Hanauer, 2010)	None
Results mapping/ Journey mapping	Uses a story to guide participants going through the process for the purpose of understanding behavior and assessing participants' behavior on a rating scale based on the result principles.	(Kibel, 1999)	(Westbrook, et al., 2007)

Method	Purpose	Reference	Examples
Statistical process control	Tests and monitors for systematic performance changes over time.	(Benneyan, Lloyd, & Plsek, 2003)	(Sandberg, et al., 2008)
Card ranking for comparison of multi-device interaction techniques	Experimental comparison of multi-display itnerfaces	None	(Alsos, 2006)
Data analysis			
Queuing theory method	Evaluates human multitask performance, such as messages to be handled or tasks to be completed.	(Chen & Yao, 2001)	(Alapetite, 2008; Jiang & Giachetti, 2008)

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