

WHAT COMPETENCIES MUST A PHYSICIAN POSSESS
IN ORDER TO USE AN EHR SYSTEM SAFELY?

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A THESIS

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Abstract

Background: EHRs and CPOE promise to improve quality and safety of healthcare, but published evidence suggests the potential for harm as well. Efforts like CCHIT have emerged to develop standards that ensure safety of EHR and CPOE systems, but no standards exist to ensure that users possess the competencies to use these systems safely.

Objective: This thesis address the question: What competencies must a physician possess in order to use an EHR system safely?

Methods: These three phase projects consist of:

- Phase I: Creation of a complete set of competencies developed from four source documents, resulting in a list of 138 competencies
- Phase II: Refinement of the list from phase I using a survey form filled by mid-career informatics trainees. In this phase the lower scored competencies were eliminated resulting in a list of 50 competencies
- Phase II: Ranking of the list from phase II using a survey and national experts in EHR development and implantation. From the resulting ranked list the top 25 competencies were selected.

The analysis of the survey was done using the Kendall-Wei method and the Dominant-Matrix program. This method allowed us to analyze the data even if data was missing and allowed us to rank the list with just one round of questions.

Results: The top competency in the list was the use of key identification to look up a unique patient record. The resulting top twenty five competencies a physician should have in order to use an EHR system safely are mostly involved with medication management, and order entry. Other top competencies topics included: Drug interactions, manage allergy and adverse reaction list, and manage problem list, pharmacy communication, and medication or immunization administration. The coefficient of agreement between the raters was 0.55

Conclusion:

- There is a strong agreement between experts that medication related competencies are the most important competencies.
- Identifying the correct patient record is a top requirement
- There was a strong agreement about the top 25 competencies.

In order to increase safety of EHR systems changes should be made in two areas:

- More focus on safety in use of EHR and CPOE
- Verify that physician users possess these key competencies for safe use
- The certification of EHR systems should emphasize the safety of the identification, medication, and ordering features.

Introduction

The use of computers to improve medical care is a concept that has been gaining momentum since the 1950's when punch cards were introduced for medical record keeping. Since then computers applications in healthcare have been developed and implemented with slow but steady progress, as the technology has become faster, more affordable, easier to use, and more powerful. The advances in networking technology, databases, and the development of the World Wide Web have help to make computer an integral part in many industries, including healthcare[1, 2].

However, the use of computers on clinical settings care has not advanced as rapidly as in other areas. Full implementation of medical information systems has proved a complex task. In the last two decades, attention to medical errors has provided increased incentive and accelerated progress in this area[1, 3-5]. There is a growing consensus that the use of Electronic Health Record (EHR) systems and their components will reduce medical errors, and this has prompted government and private industry to step up efforts to achieve nationwide implementation of EHR in the healthcare system[5-7].

A set back occurred when more recent studies documented potential harms of using EHR systems, showing the potential for new types of medical errors resulting from use of these systems, in particular the computerized physician order entry (CPOE) components[8-11]. It became apparent that there were two main sources of these errors, the EHR systems themselves and the users of the systems. To help address the problem

of system-related errors a new organization was created, the Certification Commission for Health care Information Technology (CCHIT) whose purpose was to “create an efficient, credible, sustainable mechanism for the certification of health care IT products.”

This certification initiative could prove helpful to reduce the potential for *system-related* errors of a CPOE system, but they do not address the problem of *user-related* errors. Improved user training and demonstration of competency by users of EHR and CPOE systems are potential solutions to address this area, but to date the competencies to be acquired and demonstrated have not been defined. Thus there is a current need to identify the skill set required for safe operation of EHR and in particular CPOE systems, as well as a method to accurately assess the skill level of users. To help meet this need the current project is focused on the following research question

What competencies must a physician possess in order to use an EHR system safely?

Preliminary Work

In the education and training of future physicians, there are many challenges. When medical students reach the residency level of their training, these challenges become more complex as residency training often requires that residents work in different hospital settings which may include, urban, rural, academic, and community sites. At Oregon Health & Science University (OHSU) in Portland, Oregon, residents in surgery and other programs rotate through multiple hospitals with different EHR systems in each one, using as many as 4 different EHR systems during their residency training! Training in the use of these varied EHR systems requires a significant investment of residents' valuable time, and a method to reduce this investment of time and increase the accuracy of the use of these systems is vital. A study was conducted in 2006 at OHSU to further examine this concern.

The adoption of EHRs, and the number and variety of EHR systems on the market has created a new challenge for teaching hospitals [12]. Residency programs in teaching hospitals have adjusted to this phenomenon by scheduling additional time to train the residents in use of the EHR, sometimes training in as many as three or four different systems, depending on the number of institutions in which the residents have rotations. This time dedicated to EHR training was formerly available for more traditional medical and surgical curriculum or for direct patient care. A decrease the time residents devote to medical education and direct patient care is an undesirable side-effect, and ways to reduce the number of EHR training hours for residents and other physicians without compromising the users' knowledge of the systems is a logical step to increasing

the quality of the training while adjusting to technological changes in the current resident learning environment.

To better understand this problem, OHSU residents' education was examined to determine the type and amount of EHR system training that was undertaken during their course of study. In addition EHR systems were examined in the various types of health institutions in which residents receive training. Similarities and differences between health information systems used at Providence Health System (a tertiary care community hospital), Kaiser Permanente (a closed staff model HMO), the Portland Veterans Administration (VA) Medical Center (a federal hospital) and OHSU University Hospital (a teaching hospital) were studied in terms of the EHR related training required for a resident to work at that particular institution. .

The institutions studied differed greatly in the type of care and services they provided, and even when two organizations used the same vendor's EHR system, the implementation and experience with the system was found to vary greatly. OHSU is a large teaching hospital that implemented an EHR system in its clinics in stages beginning in 2005, with hospital implementation occurring in 2008. An “off-the-shelf” system has been highly customized to fit the institution’s needs.

Kaiser Permanente is a large HMO which implemented an EHR system in its ambulatory settings in the mid 1990s. The EHR system of Kaiser Permanente is the same “off-the-shelf” system used at OHSU, and it has also been highly customized to fit that organization's requirements. In addition, the Kaiser implementation and customization is more mature, with a web site dedicated to enhancing the knowledge and competencies of users with step-by-step informational documents and videos in support of that software.

The third organization examined was Providence Health System, including Providence St. Vincent Hospital, which is a large tertiary referral hospital which was found to use multiple systems in a hybrid electronic record system. Providence Health System differs in that physicians are not required to use the EHR systems, although they are highly encouraged to do so. The Providence Health System uses a “best of breed” approach rather than depending on a single vendor, and these systems are also customized to meet the institution’s needs.

The final medical system examined was the Portland VA Medical Center, a large federal hospital. This institution uses the Department of Veteran’s Affairs electronic health record, the Vista implementation of CPRS (Computerized Patient Record System), an extensively customized and revised system that has been internally developed over decades.

By the summer of 2006, the system had undergone over 100 modifications.

Table 1 summarizes the various EHR systems used by residents in these four institutions at the time of the study. The imaging and results reporting systems used in these institutions were not part of the basic EHR training, and in some cases residents were required to do on-line training or schedule special training in addition to the basic EHR training.

Table 1: Comparison of EHR Systems across Sites

Site	Outpatient	Inpatient	Order Entry	Imaging	Results
OHSU	Epic	None	Epic	PACS	LCR
Kaiser Permanente	Epic	None	Epic	PACS	Epic, RRS
Providence Health System	Portal	Centricity	ProvExpert	PACS	Portal
Portland VA Medical Center	Vista	Vista	Vista	Vista	Vista

Note: This study was focused primarily on the EHR system as it applied to inpatient care and it also examined order entry systems. Two sites had no outpatient system at the time of this study. LCR = "Lifetime Clinical Record, a locally developed web-based portal with results reporting and other features; RRS = results reporting system.

The training approach and content was examined in each of these institutions. In every site the primary focus of the training was how to navigate that particular EHR system. Each training session began with an assessment of users' computer knowledge so that training was tailored to the trainees' general level of computer skill. Instructions on how to login to the system and an overview of the toolbars and menus were common in all the trainings; site-specific training focused on how to navigate the systems in accordance with the workflows of that institution.

All trainings sessions were conducted in a classroom environment equipped with computers and overhead projectors so the users could follow the trainer's step-by-step instruction visible on an overhead screen. During one-on-one training the user would work on the computer while the trainer gave instructions on how to use the system. Handouts, competency checklists, and case scenario exercises were given to users at OHSU, Providence, and Kaiser, but not at the VA. Table 2 summarizes the training provided at each site. This summary does not include the substantial "on-the-job"

informal training (non-classroom learning) that residents and students acquire from one another throughout their clinical rotations at these sites.

Table 2: Training Across Institutions

Site	Length of Training in Hours	Type of Training	Training Materials	Include other Training	Type of Support
OHSU	14 (Basic, advanced, intermediate and expert)	Classroom hand on training	Hand out	No	1 week in site support and power user subsequently
Kaiser Permanente	20 for physicians 9 for residents	Classroom hand on training	Hand out and case scenario practice sheet	Yes (PACS and RRS)	Power user and web support
Providence Health System	15 (1 hour Portal, 5 hours Logician, and 9 hours ProvExpert)	Most one on one training some small group	Hands out and case scenario practice sheet	Basic computer training	Power user, and technical support
Portland VA Medical Center	2	Classroom hand on training	Non	Yes	Web support

Although training methodologies are very similar between institutions, the language and tools used by the systems revealed inconsistent standards; some of the systems fail to follow Windows conventions (e.g. highlighted text indicating a clickable link, right mouse clicks initializing a list of options/properties). Also, when systems are customized for each institution, the terminology used by the system (e.g. names given to

tests) is changed to match the institutional terminology. These issues make any attempt to create a generic training more difficult. As a consequence, skills acquired in the use of one system translate poorly to another system.

Discussion

Hours of training for residents are a precious commodity. In 2003, the Accreditation Council for Graduate Medical education (ACGME) instituted the “80 hour work week” mandate for residents for all their accredited residency programs, which limit the number of hours a resident can work in a week to 80. This mandated significant reduction in resident training hours as the 80 hour limit replaced the conventional more than 100 hours per week that residents were formerly expected to work.

The 80 hours limit includes all training, including clinical, technical, and classroom experience. This requires a prioritization of how these hours will be used, and a need to streamline all education activities where possible. If creating a generic training for EHR systems proves too difficult, it would be helpful to at least limit the training to include only the most essential competencies residents need to use an EHR system. Some institutions limit their training to the basic use of the system so the resident can log in and navigate and find the information they need. Because of the training hour limitations, many institutions expect their residents to rely heavily on peer-to-peer and on-the-job learning. As errors in using EHR systems have been identified as a problem, this is hardly an ideal training system. The most basic training often provided to residents includes knowing of how to navigate the system and how to find information. These are important aspects of using EHR systems, but this basic training is insufficient to assure the safety of the patient.

In summary, this examination of the training of residents in use of the EHR found a high degree of variability in the amount and the content of the training, with a focus on navigation and institution-specific workflow related skills. What is not clear from this preliminary work is how it can be assured that residents possess the competencies required for safe use of the EHR, including CPOE. Nor is it clear from this preliminary study or the published literature what competencies or skills should be covered to ensure safe use of the EHR and CPOE.

The benefit of defining competencies to safely use an EHR system extends beyond the resident level in healthcare systems. Identification and development of efficient teaching protocols for EHR competencies extends to all clinicians using that system, although the finite training hours experienced by residents justifies a focus on their skill sets initially. At the administrative level of a health care entity is imperative that the administration is confident that their residents and clinicians have the resources necessary to safely use the selected EHR system in order to safeguard the safety of the patients.

Therefore, the goal of this project is to comprehensively identify what competencies a physician must possess in order to use an EHR system safely.

Research Plan

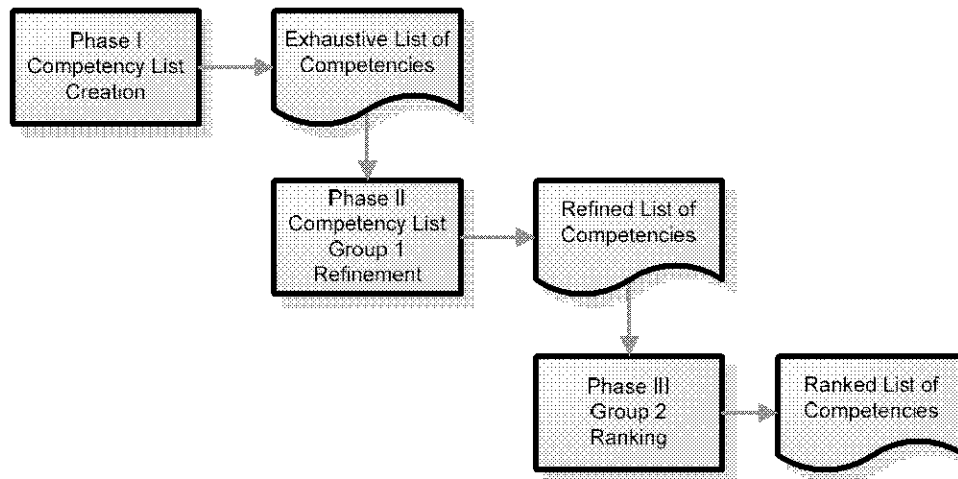
Preliminary Designs

The question addressed by this study was to define the competencies clinicians should possess to use an EHR system efficiently. To answer this question, one option would be to compare more effective users of the systems to less effective users, and see what differences were found to exist between the two groups. The first phase of such a study would be to distinguish effective users from less effective users. Although attractive in theory, in reality this task proved to be more difficult than expected, primarily because the systems in use have no clear way to tell how effective the users are. A second option would be to ask the users to rate themselves as beginner, intermediate, advance or expert users, and then ask the users to complete a series of increasingly complex tasks and determine the skills sets that separated the experts from the beginners. This option depends heavily on reliability of the self ratings by users of their expertise, which may not be accurate. Furthermore, from both the patient perspective and the administrative stand point, it is more important to focus on the identification and definition of competencies for the *safe* use of EHR systems, instead of focusing on the *effective* or *efficient* use of the system. Classification of clinicians as safe or less safe may be more problematic than classification of clinicians as efficient or inefficient. Safe use of a system implies no errors, very few errors, or harmless errors. Some user errors could be detected by the systems themselves, but many errors that could be associated with unsafe use of the system, such as entering information in the wrong patient record, are not automatically detected by the system or by the users.

Because of these difficulties in finding a reliable means of distinguishing users according to safe or effective use, an expert consensus approach was chosen. The research design would then focus on expert opinions regarding what competencies clinicians should possess in order to safely use an EHR system, rather than ask the users themselves. The research question of this study thus evolved to identify what competencies EHR experts believe a clinician should possess in order to safely use an EHR system.

Research Design

Research plan Diagram



Design overview

The design of this study consists of three phases; each phase builds on the results of the previous phases. Phase I, consists in the creation of a complete list of competencies. Phase II, with the help of students, decision makers and users of EHR systems, is to reduce the list developed in Phase I to shorter list that would be feasible for expert review. Phase III, with the help of EHR experts, ranks the shortened list of competencies from Phase II to identify the top 25 competencies for safe EHR use.

When the design of a study calls for the expert consensus, the most common method used is a Delphi study. The Delphi method can be used to develop a group consensus through a series of “rounds” where a summary of the results from the previous “round” is given to the participants. The “rounds” continue until the group reaches a consensus. In the case of a list of competencies, the goal would be to reach a consensus

on the top ranked competencies. This commonly includes ranking of items and computing the median or mode of the ranks to allow quantitative comparisons of items and produce a numeric expression of expert agreement and prioritization.

Considering the limited time availability of the experts being considered for this study, it was deemed that the Delphi method with its series of rounds would not be the most appropriate method. Another issue identified when using the Delphi method, is that when reaching agreement the raters may feel led by the results of the previous rounds. Also, if data is missing from one or more respondents when calculating the mode or median, the results would be based on a different number of respondents. Because of these potential shortcomings alternative methods of data collection and analysis were considered for the study.

The first decision considered in this alternate design selection was to determine if it was preferable to collect the preliminary data through a questionnaire (asking experts to list what competencies they thought were important for patient safety) or if it would be a better option to begin with a preliminary list of competencies from which raters could pick the best options or rate them as how critical they are for the patient safety. The development of a preliminary list of competencies soon emerged as the preferred method, as it offered as a beginning point a common mindset among the raters, and it offered the flexibility to allow the raters to add more items to the list. As a survey could not offer the flexibility and efficiency that a preliminary list would offer, the list development was the selected method to proceed. A pilot study would be necessary to create a preliminary list of competencies.

Aim

Identify the most important competencies a clinician should possess to safely use an EHR system.

Definitions and Assumptions

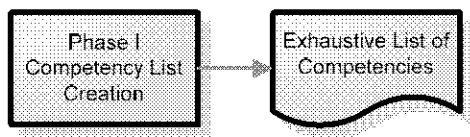
This study adheres to the definition of an EHR system from Lehmann et al., [13] which defines an EHR system as an “interoperable electronic patient record that collects information about a person from ... systems that resides in various provider settings. An electronic health record system (EHR-Ss) is the broadest term.” Such systems include tools for the collection (over time) of electronic health information for a patient, immediate electronic access to a person's (medical history); decision support (e.g., warnings for adverse drug interactions or drug-allergy interactions), and support for efficient health care delivery.

For purposes of this study focusing on the competencies of users of an EHR system, the following assumptions will be made:

1. The system itself is safe, with Certification Commission for Healthcare Information technology CCHIT approval;
2. The user has the adequate medical knowledge; and
3. The user is an adult primary care physician.

These assumptions help eliminate ambiguity about the “user” role and knowledge, which will allow raters to have a more clear idea of the “user” to focus on rating the competencies the user must have to safely use an EHR system.

Phase I: Competency List Creation



Aims

Create an exhaustive list of competencies users should have when using an EHR system.

Process

When creating the preliminary list, the first option was to compile a list from training documents that were provided in the trainings mentioned in the preliminary work section.

These included:

- Kaiser’s HealthConnect Ambulatory Training: “Check your competencies – Clinician”
- Epic@OHSU’s Competency Checklist
- Providence’s ProvExpert Competency Checklist

Subsequently, a more comprehensive list, the “Ambulatory EHR 2007 Functionality Criteria from the Certification Commission for Healthcare Information Technology” (CCHIT), was recommended for use in this study. This document lists all the functionalities an EHR system must possess to earn a “certified” classification. This list was developed to check the functionality of the software (not the competencies of the user) but with modification was a useful starting point for the list development.

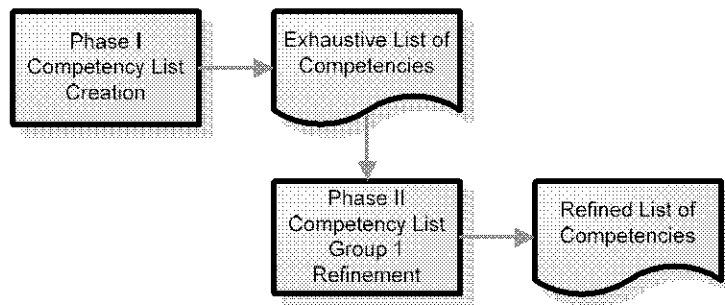
The proposed competency list was created using section headings from the CCHIT. The first step was to remove sections that were only pertinent to the software, such as “The system shall create a single patient record for each patient.” This left items that were pertinent to the physician users, such as “The system shall provide the ability to display medication history for the patient.” Each item that could be completed by a physician was included in the list; and those items that were specific to the software were excluded. The end goal was to glean from this pool of items, an exhaustive list of competencies that physicians could perform. After the list was complete, the wording was modified to replace the instances of “the system shall” to “the physician should know how to”. Those items which endured this modification (about 50%) were retained and minor grammatical modifications were made as needed for clarification.

Next the original competency documents from the Kaiser, OHSU and Providence training, were examined to ensure that their contents were reflected in the preliminary list. Competencies that were not present were added at this point. These training lists included tasks to be performed by the trainee, and as some of the required tasks listed were specific for each system, the competencies necessary to complete the task had to be inferred from the text in some cases. The final comprehensive list with all of the possible

competencies physicians could be expected to perform contained a total 138 items (See Appendix 1). Appendix 2, Competencies' Source Documents, illustrates the questions and its source documents.

This large number of items exceeded the number of items that an expert rater could realistically be expected to review. In order to reduce the number of questions, the first option was to arbitrarily eliminate all the items that appeared irrelevant to the safe use of an EHR system. This method could have introduced personal bias to the list, and might have eliminated competencies that an expert might have considered important. Phase II of the study was developed to refine the competency list to a manageable number of items.

Phase II: Competency List Refinement



Aims

Refine the list of competencies to create a more manageable list of competencies that could be ranked by experts in a reasonable amount of time.

Process

For this phase of the study, a group of mid-career informatics trainees was selected. This group was selected as it would have to have the knowledge to rank the complete list and the time to do it. The subjects selected were current and former students of the Clinical Information Systems class at the Department of Biomedical Informatics and Clinical Epidemiology at Oregon Health & Science University, as well as other clinical users, implementers, teachers and decision makers of EHR systems that could be reached through Dean Sitting, PhD, who were willing to participate.

This group was contacted by email directly from Dr. Sittig, instructor for this class, with an introductory letter and an invitation to participate. Candidates were explicitly advised they were free to decline without consequences for their grade in the

class. Candidates who agreed to participate received a second email with instructions and the attached survey. The raters were asked to return the survey by email, fax or printed copy after completion. Raters were made aware that the goal of this phase of the study was to eliminate the competencies that were not related to clinicians' safe use of EHR systems. Their ranking included the removal of any competencies that were not related to clinicians' use of EHR systems or related to the safe use of the systems

A six item scale was used to rank each competency:

- 0 - **Not relevant** for physician use
- 1 - **Optional** – useful for advanced users
- 2 -
- 3 - **Important** for effective use
- 4 -
- 5 - **Critical** for patient safety

Participants were asked to rank each of items using this scale and were also invited to suggest any additional items or comments at the end of the survey. This approach was designed to ensure that the competencies that were system related would receive a 0 ranking and be removed entirely, that those competencies that were clinician relevant would receive a higher score and remain on the list, and that any important competencies not present on the list could be added.

A set of demographic questions were included in the survey to identify the raters' ' roles and knowledge though self perceived responses to the following questions:

Are you involved in EHR education as a (please check all that apply):

- EHR learner (currently receiving instruction)
- EHR teacher (formal or designated instructor as part of your job)
- EHR clinical user (currently use EHR systems for clinical work) EHR implementer (primarily an implementer of EHRs)
- EHR high level decision maker (on purchasing, installing, changing systems)

The goal of these questions was to allow analysis of the rankings according to rater experience

Survey items were grouped according to section headings adapted from the CCHIT document, with one section (security) added to accommodate competencies from the other documents.

The survey (See Appendix 3: Survey) was created using Adobe Designer 7.0 which allowed the survey to have interactive fields that allowed the rater the option to complete the rating form on the computer, or they could choose to print out the survey and complete it by hand. This gave raters more freedom to fill out the survey in their preferred way. After the surveys were completed, the raters had the option to email the data file to the investigator as an email attachment (xml) or they could choose to print, fax or mail the survey.

The initial email invitation (See Appendix 4) was sent to 22 potential rater candidates and of these 11 (50%) agreed to participate. An email was sent to the 11 volunteer rates with the survey and instructions (See Appendix 5) attached as a pdf file. A total of 11 surveys were received and used in the refinement of the comprehensive competency list.

The top ranked competencies would be identified used in the third phase of the study. The number of top ranked competencies that would be selected for expert review had to be small enough for the experts to rank the questions in a short period of time, yet large enough for a good representation of the original 138 items.

The selection of the highest ranked items in ranked data is typically handled by averaging the rank assigned to each item over the set of raters. The median rank may also be used, but can lead to a different ordering. There were several potential drawbacks to consider when selected which method to ultimately use.

If one or more experts failed to rank all of the items, then the mean (or median) rank would be based on differing numbers of raters. In the case of this survey, there were 138 competencies and 6 possible rankings (from 0 to 5). There are several scenarios where the behavior of the rater might introduce problems when selecting a data analysis method. Consider that a rater might just “skip” a skill and might not select a rank for a particular competency. Measures such as the mean or median rank often result in ties so that the final ordering will still be ambiguous. When selecting the top ranked competencies, it is imperative to select an analysis method that removes this ambiguity where appropriate and that is not affected by missing data.

In statistics, the area of paired comparisons deals with ranking preferences and establishing a subset of “most preferred/dominant” objects. The field has been sufficiently developed to overcome the problems described above when using simple summary measures (mean/median). T. H. Wei [14] and later M. G. Kendall [15] developed a foundation for the problems encountered in paired comparisons. In particular, the approach described by Kendall does not require that preferences be assigned to every element or object of interest. That is, experts may elect to rank any subset of competencies as “most important” and leave others unranked. Tied ranks are allowed in case some experts see one or more competencies as being equally important, and the rankings can be weighted to account for differing levels of expertise of each rater or panelist, such as when experts with more experience are included with others with fewer years of experience. A side benefit of this more elaborate method is that the final ordering is usually unambiguous and can be used to compute both a summary measure of agreement among the experts or panelists and a measure of how far the final order departs from a "perfect" ranking situation where all the experts are in agreement.

The Kendall-Wei method was used to analyze the data and create a ranked list that allowed the top competencies to be selected. In an effort to reduce the influence of the first group of raters in the second group of experts ranking, the questions selected for the second phase of the study’s survey were rearranged back to their original order. The question and sections were renumbered in sequential order, and a tally was kept of the original numbers of the questions and sections.

Statistical Analysis

The data was entered in Microsoft Excel file and analyzed by Mr. Michael Lasarev using a statistical analysis program named “Dominant-Matrix” compiled by Mr. Lasarev).

The “Dominant-Matrix” program takes as input a $q \times r$ matrix of rankings, where the q rows of the matrix correspond to questionnaire items and the r columns of the matrix correspond to individual raters. Missing values (coded as -999) are allowed since the procedure does not require complete information from all raters to produce a final ranking. As output, the program computes a $q \times q$ dominance matrix, where the entry in the i th row and j th column counts the number of times questionnaire item i was ranked higher than (i.e., dominated) questionnaire item j . The user can manipulate the matrix to produce an ordering of the questionnaire items (from most to least important). In particular, the row means of the dominance matrix give an average ranking for each of the k items, while the spectral decomposition of the matrix (eigenvalue-eigenvector decomposition) produces the Kendall-Wei ordering for the k items. The user sorts the rows and columns of the dominance matrix according to the order suggested by the chosen ranking method. If raters express unanimous agreement with respect to ranking individual items, then the sorted dominance matrix will have all counts appearing above the main diagonal (i.e., in the upper-triangular portion of the matrix), with counts of zero appearing below the main diagonal (the lower-triangular portion of the matrix). The degree of asymmetry between the upper- and lower-triangular portions of the (row- and column-sorted) dominance matrix provides a measure of how far the raters are from perfect agreement, with lower numbers of the coefficient indicating closer agreement. Variation associated with this estimate of agreement is assessed by jackknifing (“leave-

one-rater-out”) the entire procedure. At the same time, the jackknifed estimates can provide insight into how much influence each rater exerts on the final overall ranking.

Results

The data from the surveys was collected using an Excel spreadsheet where the columns indicated the raters and the rows indicated the 138 competencies. Under each rater the rank from 0 to 5 was entered for each skill, if the rater did not answer a question, the ranking for that competency was left blank.

Using Laserev's Dominant-Matrix (see statistical analysis) program to analyze the results of the survey, the questions were ranked using Kendall-Wei values (K-W values) from the highest to the lowest values or the most important to less important competencies. This method gave clear ranking with minimum ties.

After the competencies were ranked, using the K-W values (See Appendix 7), the 50 top ranked items were chosen. The 50 items correspond to the first 50 items, not to the 50th rank and up, as there were some ties. The coefficient of agreement for this group of raters was 0.431. Table 4 illustrates the level of agreement between raters in each question with the use of conditional formatting, as each rank is shown in a different color and the agreement can be seen as the uniformity of color across each question. The K-W values in blue denote the questions that have the top 50 values.

Standard deviations were also calculated; however, missing values (denoted by blank cells), and the fact that the rankings are not normally distributed, make this measurement less reliable. The distribution of the ranks is indicated in appendix 8 which shows the count of ranks for each question and the total number of records for that count. The darker green denotes a higher count for that rank in that particular question.

When the items were returned back to the survey format, it became clear that whole sections had been completely eliminated in the ranking process. Some sections

retained only one or two ranked competencies, but interestingly, some large sections were eliminated completely as seen in table 4

Table 4: Eliminated Sections

Section	Name	# of Questions
2	Manage patient demographics	2
8	Manage clinical documents and notes	17
9	Review external data	2
10	Generate and record patient specific instructions	5
13	Manage order set	3
14	Manage results	8
15	Manage consents and authorization	3
16	Manage patient advance directives	2
17	Standard care plans, guidelines, protocols	1
18	Capture variances from standard care plans, guidelines, and protocols	1
21	Support for non-medication ordering (referrals, care management)	2
22	Present alerts for disease management, preventive services and wellness	5
23	Notifications and reminders for disease management, preventive services and wellness	5
26	Report generation	6
27	health record output	2
28	Encounter management	2
29	Rules-driven financial and administrative coding assistance	1

In the case of the sections that were retained, the number of questions retained varied from 40 to 100 percent. Table 5 shows the sections selected for the new survey,

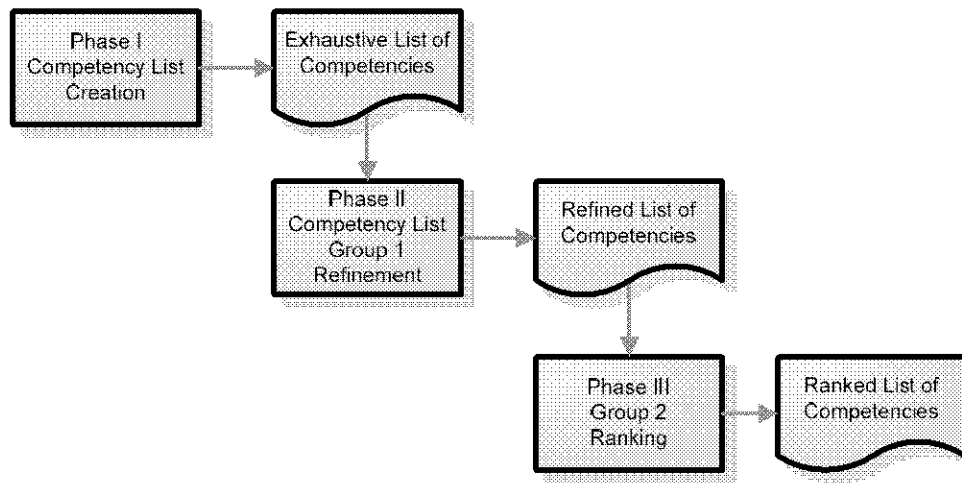
with the number of questions originally existing compared to the number of questions remaining after reducing the survey from 138 items to 50 items.

Table 5: Remaining sections

Sections	Name	Number of Questions on 138 Items Survey	Number of Questions on 50 Items Survey
1	Identify and maintain a patient record	2	1
3	Manage problem list	7	6
4	Manage medication list	9	8
5	Manage allergy and adverse reaction list	5	5
6	Manage patient history	3	2
7	Summarize health record	1	1
11	Order medications	18	11
12	Order diagnostic tests	6	3
19	Drug interaction	9	8
20	Medication or immunization administration or supply	5	2
24	Inter-provider communication	2	1
25	Pharmacy communication	2	1
30	Security	2	1

The sections were also ranked using the Kendal-Wei average for the questions contained in the section. This revealed some interesting results, since the sections in the bottom of the list were included in the 50 question survey. Each of the section rankings are illustrated in appendix 9. The resulting top 50 (See Appendix 10) questions were rearranged to their original order and used to create a new survey to be ranked by the second group of raters.

Phase III: Ranking



Aims

To identify the top 25 competencies for safe use of the EHR by physicians, according to EHR experts.

Process

National experts in EHR development and implementation were identified with the help of faculty advisors and using a snowball sampling technique. Those suggested by faculty advisors were high level executives of U.S. health care organization and universities or clinicians with extensive experience in EHR systems, and were in decision making positions. This group was contacted via email and invited to complete a “survey of educational needs.” The expert raters were informed that they were not required to complete the survey, and that by returning the survey their consent was implied.

Experts who agreed to participate received the electronic version of the refined competency list and an instruction file. After completion, the second group of experts was able to return the list by email, fax or printed copy. A total of 58 suggested experts

were invited to participate; of these 22 agreed; and of these 12 returned completed surveys.

Data analysis of the 12 surveys was again conducted using Laserev's Dominant-matrix program to calculate the Kendall-Wei method as the basis for ordering the ranked list of competencies. As there is no clear cut-off value or bimodal distribution in the rankings, the list was arbitrarily truncated to 25 to provide a list of reasonable size.

Results

The process and analysis of the data from the second group of surveys was very similar to the process and analysis of the first group of surveys. The data was organized using an Excel spreadsheet where the columns were occupied by the raters and the rows contained the 50 competencies. Under each rater, the rank from 0 to 5, was entered for each skill, if the rater did not answer a question, the ranking for that competency was left blank.

The Dominant-matrix program analysis, coupled with the Kendall-Wei values (K-W values) from the highest to the lowest values or the most important to less important competencies resulted in a clear ranking with a minimum of ties. The coefficient of agreement for this group of raters was 0.55.

Appendix 11 illustrates, with the use of conditional formatting, the level of agreement between raters for each question, as each rank is shown in a different color and again, the degree of agreement is indicated by the degree of uniformity of color across each question. Standard deviations were also calculated; however missing values (denoted by white cells), and the fact that the rankings are not normally distributed, again make this measurement less reliable.

The distribution of the ranks is visually depicted in appendix 12 which shows the count of ranks for each question and the total number of record for that count.

The darker green denotes a higher count for that rank in that particular question.

After the competencies were ranked, using the K-W values (Appendix 11), the top 25 questions were chosen. The 25 questions correspond to the first 25 question (Table 6), not to the 25th rank, and up, due to the fact that some question resulted in tied values.

Table 6: Top 25 competencies

1	The physician should know how to use key identifying information to look up a unique patient record.
2	The physician should know how to review the lists of medications and other agents to which the patient has had an allergic or other adverse reactions
3	The physician should know how to prescribe a medication despite alerts for interactions and/or allergies being present.
4	The physician should know how to create prescription or other medication orders with sufficient information for correct filling and administration by a pharmacy.
5	The physician should know how to check for dose ranges based on patient age and weight.
6	The physician should know how to check for potential interactions between a current medication and a newly entered allergy.
7	The physician should know how to review the medication list
8	The physician should know how to proceed when an alert that potential interactions exist is displayed, at the time of medication ordering.
9	The physician should know how to create and maintain medication lists.
10	The physician should know how to associate orders, medications, and notes with one or more problems.
11	The physician should know how to document at least one reason for overriding any drug-drug or drug allergy interaction warning triggered at the time of medication ordering.
12	The physician should know how to cancel an order electronically.
13	The physician should know how to exclude a medication from the current medication list (e.g., marked inactive, erroneous, completed, discontinued) and document reason for such action.
14	The physician should know how to fill common content for prescription details including strength, sig, quantity, and refills/
15	The physician should know how to proceed when the system display alerts based on the results of a laboratory test, the patient may be at increased risk for adverse effects of the medication.
16	The physician should know how to review medication ordering dates.
17	The physician should know how to view active orders for an individual patient
18	The physician should know how to use a dose calculator for patient-specific dosing based on weight and age.
19	The physician should know how to proceed when the system display an alert at the time of ordering that the patient had a prior adverse reaction to that immunization.
20	The physician should know how to explicitly indicate that a patient has no known drug allergies.
21	The physician should know how to discern if an alert at the time a new medication is prescribed is valid or not (The patient is not taking the medication anymore)
22	The physician should know how to find patient specific dosing recommendations based on age and weight.
23	The physician should know how to proceed when the system display a drug-disease interaction alerts at the time of medication ordering or at the time of entering a problem
24	The physician should know how to specify the type of allergic or adverse reactions
25	The physician should know how to display medication history for the patient.

Group I and Group II Combined Results

A third analysis of the data combined the rankings of the 50 competencies from Group I with those of Group II, as shown in appendix 13. Only the 50 competencies analyzed by Group II were selected from Group I list. Using the Kendall-Wei method the competencies rankings were recalculated for Group I using the top 50 competencies only, and Group I and Group II combined. The coefficient of agreement for this Group I was 0.70 and for Group II 0.55. The resulting top 25 competencies for Group I, Group II and the two groups combined are shown in Table 7. The groups agree on 72% of the competencies ranked in the top 25: the shaded cells show the competencies that are common to the three groups. Non shaded cells indicated competencies that were highly ranked by one group but not the other.

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Table 7: Group II ranking compared to Group I and II combined (listed by competency number in the ranking instrument)

Group I (Competencies #)	Group II (Competencies #)
15	1
38	15
14	39
8	24
24	29
46	45
1	9
16	38
45	8
20	7
4	40
47	49
42	12
5	27
9	42
31	10
39	37
7	31
27	47
33	20
41	14
35	32
11	44
44	16
26	11

Discussion

This study sought to identify the key competencies needed by physicians to use the EHR safely. A comprehensive list of 138 EHR-related competencies was compiled from the EHR training materials used by three healthcare organizations, and from items adapted from CCHIT criteria for safe EHR systems. This list was reduced based on rankings by human experts in two stages, first by mid-career biomedical informatics trainees and system users to the 50 most important items, then by nationally recognized experts in the field to the 25 most important items. The result is a list of 25 key competencies (Table 6) that can serve as a starting point for ensuring, through training and evaluation, that physicians and other users have the skills required to use EHR and CPOE systems safely.

These 25 key competencies are grouped in Table 8 according to the general area of EHR use. Two observations stand out in this table: 1) the number one competency identified is the correct identification of the patient; and 2) the majority of the key competencies are related to ordering and managing medications. The remaining competencies identified also concern physician tasks such as managing problem lists and ordering diagnostic tests.

Table 8: Main top 25 competencies topic

Topic	# of top 25 competencies	Ranking of competencies
Manage medication list	7	2, 7, 9, 13, 16, 21, 25
Drug interaction	6	3, 6, 8, 11, 15, 23
Order medications	5	4, 5, 14, 18, 22
Manage allergy and adverse reaction list	2	20, 24
Identify and maintain a patient record	1	1
Manage Problem list	1	10
Pharmacy communication	1	12
Order diagnostic test	1	17
Medication or immunization administration	1	19

Implications

Implications for Research and Development

This study identified an initial list of competencies that physicians should possess in order to use an EHR system safely. Future research is needed to validate and extend or expand this list, for example by identifying current users who demonstrate a high degree of safety and assessing whether they possess these competencies. Additional work to address the limitations of the current effort might include repeating the study using more specific instructions to raters about the system limitations and workflow restrictions, and possibly specifying different medical specialties or clinical roles to determine if different competencies are believed to be necessary for different disciplines of medical practice and different clinical roles, such as nursing, pharmacy, and others. Finally, the list of competencies developed in this and similar studies could be used as a complement to expand or improve the CCHIT process for certifying EHR systems.

Implications for Education and Training

The initial list of competencies identified in this study can be used to restructure EHR training programs to ensure that they cover each one of these competencies, and to ensure that physicians possess them before providing access to EHR and CPOE systems. This may involve a change in focus away from efficiency, which remains important, to greater emphasis on safety, which is the highest priority. A checklist of these competencies could be used in EHR training and refresher sessions, as well as a certification or recertification process.

Implications for Patient Care

As was discussed in the introduction of this study an important aspect of EHR systems is the safety of the patients. Retraining physicians or changing the training's focus for new physicians emphasizing the 25 top competencies, in the opinion of our group of experts would mean fewer errors and grater safety for the patients.

This study does not only have implication for the training of users it also can be use to improve the EHR systems design. Designing or modifying systems so they can offer features that will allow a physician to find or check information, like dose or interaction information more easily would allow trainers to focus in other competencies.

Limitations

Any time physician competencies are being discussed we need to consider that physicians work settings, workflows, and professional practices varied considerably. When talking about EHR systems the size of the systems and features available are also very diverse. Added variation arises from different raters (students vs. experts) used in this study. These factors are potential threats to the validity of the findings.

When creating the initial list, the goal was to create an exhaustive list from which relevant competencies could be drawn to create a more concise and relevant list. The first option was to arbitrarily eliminate all the competencies that could be considered more related to the system itself, or tasks that a physician would not be likely to perform, such as entry of demographic information or vital sign data in the system. These would be more related to workflow of the others in a clinic than to the EHR itself.

When students were asked to rank the 138 competencies it was expected that all the competencies that were directly related to system, and not available in all the systems in the market, or were more workflow related, would be given a rank of 0 and eliminated. This did not occur, and several competencies that were system or workflow related were actually ranked 3 or higher. In the case of these system-related competencies (Table 9) it is not clear what was the interpretation of the competency in question that each subject had in mind when ranking the questions. It could be that raters were thinking beyond the physicians' competencies and considering the system features when rating these items. This lead me to believe that for ratings may in part be influenced by the raters prior experience with or knowledge of that feature of EHR use. A way to fix this problem

would be to specify in the question that it be assumed that the system has the feature in question, and the question ranking refers to the physician's competency

Table 9: System related competencies

#	Competencies
6	The physician should know how to record the chronicity (chronic, acute/self-limiting, etc.) of a problem.
18	The physician should know how to enter uncoded or free text medications when medications are not on the vendor-provided medication database or information is insufficient to completely identify the medication.
37	The physician should know how to enter free text progress notes.
41	The physician should know how to use templates for entering data in a structured format as part of clinical documentation.
42	The physician should know how to customize clinical templates.
47	The physician should know how to access to clinical images from within the patient's chart
58	The physician should know how to check for daily dose outside of recommended range for patient age (e.g., off-label dosing).
67	The physician should know how to prescribe uncoded medications.
68	The physician should know how to proceed when an alert is displayed because the drug interaction information is outdated
71	The physician should know how to proceed when a reminder for necessary follow up tests based on medication prescribed is displayed.
75	The physician should know how to relay orders for a diagnostic test to the correct destination for completion
78	The physician should know how to create an order set on the fly
79	The physician should know how to modify order sets
83	The physician should know how to filter or sort results by patient
85	The physician should know how to link the results to the original order.
87	The physician should know how to associate one or more images with a result
89	The physician should know how to display and print patient consents forms
92	The physician should know how to indicate that a patient has completed advanced directive(s).
101	The physician should know how to proceed when the system display an alert at the time of medication ordering if noted ineffectiveness exists.
102	The physician should know how to review, potential interactions on a patient's medication list, even if a medication is not being prescribed at the time.
104	The physician should know how to check for potential interactions between a current medication and a newly entered allergy.
115	The physician should know how to override guidelines
116	The physician should know how to document reasons why disease management or preventive services/wellness prompts were overridden
124	The physician should know how to communicate electronically with the pharmacy about a initial medication order as well as renewals of an existing order
125	The physician should know how to cancel an order electronically.
127	The physician should know how to display reports regarding multiple patients (e.g. diabetes roster).
137	The physician should know how to secure work station

Some items refer to competencies that a physicians would be very unlikely to require because they are not part of their typical workflow or because did not apply to their specialty (Table 10). Again, it is unknown how the raters might have interpreted these items and if possessing or not possessing these competencies as part of their own workflow would influence their ranking.

Table 10: Competencies that may not be relevant to some physician

#	Question
3	The physician should know how to enter demographic information about the patient
4	The physician should know how to modify demographic information about the patient
34	The physician should know how to cosign a note
38	The physician should know how to filter, search or order progress notes by associated diagnosis within a patient record.
44	The physician should know how to use the system to record comments by the patient or the patient's representative regarding the accuracy or veracity of information in the patient record (henceforth 'patient annotations')
45	The physician should know how to identify and maintain patient or patient proxy completed clinical information.
46	The physician should know how to display a graphic of height and weight over time
51	The physician should know how to access test and procedure instructions
52	The physician should know how to record that patient specific instructions or educational material were provided to the patient.
53	The physician should know how to create patient specific instructions.
55	The physician should know how to cosign medication orders
66	The physician should know how to enter identification information for medication samples dispensed, including lot number and expiration date.
74	The physician should know how to co-sign for all test orders.
105	The physician should know how to document medication administration.
108	The physician should know how to record an adverse reaction to a specific immunization
110	The physician should know how to create referral orders with correct routing
111	The physician should know how to compose a referring provider letter
121	The physician should know how to generate letters to remind the patient or the patient's guardian of services that are due.

The top ranked sections were:

1. “Drug interaction”
2. “Manage medication list”
3. “Manage allergy and adverse reaction list”
4. “Identify and maintain a patient record”
5. “Order medications”

A high percent of the competencies ranked as critical for patient safety by students and experts are related to medication management. This may be influenced by recent reports in both professional literature and public media regarding medication safety and EHR systems. Future work about the use of EHR systems will be necessary to rule out any other hidden issues that could potentially be harmful to patients.

Several problems in this study arose from the selection of a portable document format (pdf). The form had several limitations. Some found the form to be difficult to use. In some cases the form would open with pages missing, the form required some users to download specialized fonts, and in some instances when printed it would not print all the pages, making it impossible to fax or mail the form. The “Submit by Email” button also proved unusable to some users, when their pop-up screen with instructions failed to open. To solve this problem surveys were sent in different pdf formats to accommodate to the rankers needs. Even so, 2 raters' answers were lost due to the problems with the survey tool.

If the instrument was to be use again, several steps must be taking in order to make the instrument usable:

1. The questions need to be reviewed for clarity.
2. A clear separation between physicians' competencies and systems functionality need to be done. Indicate in the text that the competency has to be rated considering that the systems have that particular feature. This way if the question ranks high it would mean that the feature should be part of an EHR system.
3. Questions that are work flow related need to be rewritten to clarified (it only applied if the competency is part of the physician's work flow), or eliminated.

Conclusions

There was strong agreement among experts that medication related competencies are the most important for physicians to possess for safe use of the EHR. These competencies are mainly related to the CPOE functionality, and therefore training and certification should emphasize this aspect of EHR systems, while still covering other features included in this list like identifying patients, managing problem lists, and ordering diagnostic tests.

Efforts to improve and certify EHR systems should be accompanied by greater emphasis on providing training that ensures that physicians and other users possess the essential competencies for safe use of the EHR

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Appendices

Appendix 1: List of Competencies

#	Competency
1	The physician should know how to use key identifying information to look up a unique patient record.
2	The physician should know how to use more than one means of looking up a patient record.
3	The physician should know how to enter demographic information about the patient
4	The physician should know how to modify demographic information about the patient
5	The physician should know how to record onset date of the problem.
6	The physician should know how to record the chronicity (chronic, acute/self-limiting, etc.) of a problem.
7	The physician should know how to enter a new problem in the patient problem list
8	The physician should know how to update the problem list.
9	The physician should know how to move diagnosis to the patient problem list
10	The physician should know how to associate orders, medications, and notes with one or more problems.
11	The physician should know how to display active problems
12	The physician should know how to create and maintain medication lists.
13	The physician should know how to review the medication list
14	The physician should know how to review medication ordering dates.
15	The physician should know how to display medication history for the patient.
16	The physician should know how to exclude a medication from the current medication list (e.g., marked inactive, erroneous, completed, discontinued) and document reason for such action.
17	The physician should know how to print a current medication list.
18	The physician should know how to enter uncoded or free text medications when medications are not on the vendor-provided medication database or information is insufficient to completely identify the medication.
19	The physician should know how to discern if an alert at the time a new medication is prescribed is valid or not (The patient is not taking the medication anymore)
20	The physician should know how to review the lists of medications and other agents to which the patient has had an allergic or other adverse reactions
21	The physician should know how to specify the type of allergic or adverse reactions
22	The physician should know how to deactivate an item from the allergy and adverse reaction list.
23	The physician should know how to specify the reason for deactivating an allergy /allergen from the allergy list
24	The physician should know how to document that the allergy list was reviewed.
25	The physician should know how to explicitly indicate that a patient has no known drug allergies.
26	The physician should know how to enter, display, and manage patient history.
27	The physician should know how to update a patient history by modifying, adding, removing, or inactivating items from the patient history as appropriate.
28	The physician should know how to enter patient history as both a presence and absence of conditions, i.e., the specification of the absence of a personal or family history of a specific

Competency

diagnosis, procedure or health risk behavior.

- 29 The physician should know how to create and display a summary list for each patient that includes, at a minimum, the active problem list, current medication list, medication allergies and adverse reactions
- 30 The physician should know how to create clinical documentation or progress notes.
- 31 The physician should know how to display progress notes.
- 32 The physician should know how to save a progress notes "in progress" prior to finalizing the note.
- 33 The physician should know how to finalize a progress notes, i.e., change the status of the progress notes from "in progress" to "complete" so that any subsequent changes are recorded as such.
- 34 The physician should know how to cosign a note
- 35 The physician should know how to add and/or correct notes that have been finalized
- 36 The physician should know how to add and/or correct progress notes that have been finalized.
- 37 The physician should know how to enter free text progress notes.
- 38 The physician should know how to filter, search or order progress notes by associated diagnosis within a patient record.
- 39 The physician should know how to enter patient vital signs, including blood pressure, heart rate, respiratory rate, height, and weight, as discrete data.
- 40 The physician should know how to enter and display other clinical data elements, such as peak expiratory flow rate, size of lesions, severity of pain, as discrete data.
- 41 The physician should know how to use templates for entering data in a structured format as part of clinical documentation.
- 42 The physician should know how to customize clinical templates.
- 43 The physician should know how to find/display medical summary data
- 44 The physician should know how to use the system to record comments by the patient or the patient's representative regarding the accuracy or veracity of information in the patient record (henceforth 'patient annotations').
- 45 The physician should know how to identify and maintain patient or patient proxy completed clinical information.
- 46 The physician should know how to display a graphic of height and weight over time.
- 47 The physician should know how to access to clinical images from within the patient's chart
- 48 The physician should know how to display medication details from an external source.
- 49 The physician should know how to access to patient instructions and patient educational materials, which may reside within the system or be provided through links to external sources.
- 50 The physician should know how to access medication instructions, which may reside within the system or be provided through links to external sources.
- 51 The physician should know how to access test and procedure instructions
- 52 The physician should know how to record that patient specific instructions or educational material were provided to the patient.
- 53 The physician should know how to create patient specific instructions.
- 54 The physician should know how to create prescription or other medication orders with sufficient information for correct filling and administration by a pharmacy.
- 55 The physician should know how to cosign medication orders
- 56 The physician should know how to search medications, including both generic and brand name.
- 57 The physician should know how to fill common content for prescription details including strength, sig, quantity, and refills/

Competency

58	The physician should know how to check for daily dose outside of recommended range for patient age (e.g., off-label dosing).
59	The physician should know how to check for dose ranges based on patient age and weight.
60	The physician should know how to display a drug by therapeutic class.
61	The physician should know how to print and electronically fax prescriptions.
62	The physician should know how to submit prescriptions electronically.
63	The physician should know how to use a dose calculator for patient-specific dosing based on weight and age.
64	The physician should know how to find patient specific dosing recommendations based on age and weight.
65	The physician should know how to find patient specific dosing recommendations based on renal function.
66	The physician should know how to enter identification information for medication samples dispensed, including lot number and expiration date.
67	The physician should know how to prescribe uncoded medications.
68	The physician should know how to proceed when an alert is displayed because the drug interaction information is outdated.
69	The physician should know how to associate a diagnosis with a prescription.
70	The physician should know how to access links to general prescribing information at the point of prescribing.
71	The physician should know how to proceed when a reminder for necessary follow up tests based on medication prescribed is displayed.
72	The physician should know how to order diagnostic tests, including labs and imaging studies.
73	The physician should know how to use the system to associate a problem or diagnosis with the order.
74	The physician should know how to co-sign for all test orders.
75	The physician should know how to relay orders for a diagnostic test to the correct destination for completion.
76	The physician should know how to view active orders for an individual patient.
77	The physician should know how to view orders by like or comparable type, e.g., all radiology or all lab orders.
78	The physician should know how to create an order set on the fly.
79	The physician should know how to modify order sets.
80	The physician should know how to display orders placed through an order set either individually or as a group.
81	The physician should know how to display numerical results in flow sheets and graphical form in order to compare results, and know how to use the system to review values graphed over time.
82	The physician should know how to filter or sort results by type of test and test date.
83	The physician should know how to filter or sort results by patient.
84	The physician should know how to forward a result to other users.
85	The physician should know how to link the results to the original order.
86	The physician should know how to attach a free text comment to a result that can be seen by another user who might subsequently view that result.
87	The physician should know how to associate one or more images with a result.
88	The physician should be able use the system to acknowledge the result presented to her/him.
89	The physician should know how to display and print patient consents forms.
90	The physician should know how to find and display patient consents associated with a specific clinical activity and know how to use the system to go to that event in the patient's electronic chart.
91	The physician should know how to chronologically display consents and authorizations.

Competency

- 92 The physician should know how to indicate that a patient has completed advanced directive(s).
- 93 The physician should know how to review when advanced directives were last reviewed.
- 94 The physician should know how to access to standard care plan, protocol and guideline documents at the time of the clinical encounter. These documents may reside within the system or be provided through links to external sources
- 95 The physician should be able to use the system to record the reason for variation from care plans, guidelines, and protocols as discrete data.
- 96 The physician should know how to proceed when an alert that potential interactions exist is displayed, at the time of medication ordering.
- 97 The physician should know how to prescribe a medication despite alerts for interactions and/or allergies being present.
- 98 The physician should know how to document at least one reason for overriding any drug-drug or drug allergy interaction warning triggered at the time of medication ordering.
- 99 The physician should know how to proceed when the system display a proactive alerts, for patients on a given medication when they are due for required laboratory or other diagnostic studies, to monitor for therapeutic or adverse effects of the medication.
- 100 The physician should know how to proceed when the system display alerts based on the results of a laboratory test, the patient may be at increased risk for adverse effects of the medication.
- 101 The physician should know how to proceed when the system display an alert at the time of medication ordering if noted ineffectiveness exists.
- 102 The physician should know how to review, potential interactions on a patient's medication list, even if a medication is not being prescribed at the time.
- 103 The physician should know how to proceed when the system display a drug-disease interaction alerts at the time of medication ordering or at the time of entering a problem
- 104 The physician should know how to check for potential interactions between a current medication and a newly entered allergy.
- 105 The physician should know how to document medication administration.
- 106 The physician should know how to document immunization administration.
- 107 The physician should know how to record an adverse reaction to a specific immunization.
- 108 The physician should know how to record an adverse reaction to a specific immunization
- 109 The physician should know how to proceed when the system display an alert at the time of ordering that the patient had a prior adverse reaction to that immunization.
- 110 The physician should know how to create referral orders with correct routing
- 111 The physician should know how to compose a referring provider letter
- 112 The physician should know how to review establish criteria for disease management, wellness, and preventive services based on patient demographic data (minimally age and gender).
- 113 The physician should know how to review establish criteria for disease management, wellness, and preventive services based on clinical data (problem list, current medications).
- 114 The physician should know how to review preventive services/wellness guidelines and associated reference material.
- 115 The physician should know how to override guidelines
- 116 The physician should know how to document reasons why disease management or preventive services/wellness prompts were overridden
- 117 The physician should know how to view preventive services, tests, or counseling that are due on an individual patient.
- 118 The physician should know how to proceed to reminders for disease management, preventive, and wellness services in the patient record.

Competency

- 119** The physician should know how to review, disease management, preventive, and wellness services based on patient demographic data (age, gender).
- 120** The physician should know how to identify criteria for disease management, preventive, and wellness services based on clinical data (problem list, current medications, and lab values).
- 121** The physician should know how to generate letters to remind the patient or the patient's guardian of services that are due.
- 122** The physician should know how to document verbal/telephone communication into the patient record.
- 123** The physician should know how to send messages to other users.
- 124** The physician should know how to communicate electronically with the pharmacy about a initial medication order as well as renewals of an existing order
- 125** The physician should know how to cancel an order electronically.
- 126** The physician should know how to display reports consisting of all or part of an individual patient's medical record (e.g. patient summary).
- 127** The physician should know how to display reports regarding multiple patients (e.g. diabetes roster).
- 128** The physician should know how to display reports base in specific report parameters (sort and filter criteria) based on patient demographic and clinical data (e.g., all male patients over 50 that are diabetic and have a HbA1c value of over 7.0 or that are on a certain medication).
- 129** The physician should know how to display reports based on the absence of a clinical data element (e.g., a lab test has not been performed or a blood pressure has not been measured in the last year).
- 130** The physician should know how to save report parameters for generating subsequent reports.
- 131** The physician should know how to modify one or more parameters of a saved report specification when displaying a report using that specification.
- 132** The physician should know how to generate hardcopy or electronic output of part or all of the individual patient's medical record.
- 133** The physician should know how to create hardcopy and electronic report summary information (procedures, medications, labs, immunizations, allergies, and vital signs).
- 134** The physician should know how to document a patient encounter.
- 135** The physician should know how to document encounters by one or more of the following means: direct keyboard entry of text; structured data entry utilizing templates, forms, pick lists or macro substitution; dictation with subsequent transcription of voice to text, either manually or via voice recognition system.
- 136** The physician should know how to select an appropriate CPT Evaluation and Management code based on data found in a clinical encounter.
- 137** The physician should know how to secure work station
- 138** The physician should know how to change provider assigned

Appendix 2: Competencies' Source Documents.

Section	Question	CCHIT	OHSU	Kaiser	Providence
I. Identify and maintain a patient record		X			
	1. The physician should know how to use key identifying information to identify (look up) the unique patient record.	X			
	2. The physician should know how to use more than one means of identifying (looking up) a patient.	X			
II. Manage patient demographics		X	X		
	3. The physician should know how to enter demographic information about the patient	X			
	4. The physician should know how to modify demographic information about the patient	X			
III. Manage Problem list		X	X	X	X
	5. The physician should know how to record onset date of the problem.	X	X		
	6. The physician should know how to record the chronicity (chronic, acute/self-limiting, etc.) of a problem.	X			
	7. The physician should know how to enter a new problem in the patient problem list	X	X	X	
	8. The physician should know how to updates to the problem list.	X		X	
	9. The physician should know how to move diagnosis to the patient problem list	X	X		
	10. The physician should know how to associate orders, medications, and notes with one or more problems.	X		X	
	11. The physician should know how to display active problems	X			
IV. Manage Medication List		X	X	X	X
	12. The physician should know how to create and maintain medication lists.	X	X	X	X
	13. The physician should know how to review the medication list	X			
	14. The physician should know how to review medication ordering dates.	X			
	15. The physician should know how to display medication history for the patient.	X			

Section	Question	CCHIT	OHSU	Kaiser	Providence
	16. The physician should know how to exclude a medication from the current medication list (e.g., marked inactive, erroneous, completed, discontinued) and document reason for such action.	X	X	X	
	17. The physician should know how to print a current medication list.	X			X
	18. The physician should know how to enter uncoded or free text medications when medications are not on the vendor-provided medication database or information is insufficient to completely identify the medication.	X			
	19. The physician should know how to discern if an alert at the time a new medication is prescribed is valid or not (the patient is not taking the medication anymore)				
	20. The physician should know how to review the lists of medications and other agents to which the patient has had an allergic or other adverse reactions				
V. Manage allergy and adverse reaction list		X	X	X	X
	21. The physician should know how to specify the type of allergic or adverse reactions	X	X	X	X
	22. The physician should know how to deactivate an item from the allergy and adverse reaction list.	X			
	23. The physician should know how to specify the reason for deactivating an allergy /allergen from the allergy list	X			
	24. The physician should know how to document that the allergy list was reviewed.	X	X		
	25. The physician should know how to explicitly indicate that a patient has no known drug allergies.	X	X		
VI. Manage Patient History		X	X	X	
	26. The physician should know how to capture, display, and manage patient history.	X	X	X	X
	27. The physician should know how to update a patient history by modifying, adding, removing, or inactivating items from the patient history as appropriate.	X	X	X	

Section	Question	CCHIT	OHSU	Kaiser	Providence
	28. The physician should know how to capture patient history as both a presence and absence of conditions, i.e., the specification of the absence of a personal or family history of a specific diagnosis, procedure or health risk behavior.	X	X	X	
VII. Summarize Health Record		X	X		
	29. The physician should know how to create and display a summary list for each patient that includes, at a minimum, the active problem list, current medication list, medication allergies and adverse reactions	X	X	X	X
VIII. Manage clinical documents and notes		X	X	X	X
	30. The physician should know how to create clinical documentation or notes (henceforth "documentation").	X	X	X	X
	31. The physician should know how to display documentation.	X	X	X	X
	32. The physician should know how to save a note in progress prior to finalizing the note.	X			
	33. The physician should know how to finalize a note, i.e., change the status of the note from in progress to complete so that any subsequent changes are recorded as such.	X			
	34. The physician should know how to cosign a note	X	X		
	35. The physician should know how to addend and/or correct notes that have been finalized.				
	36. The physician should know how to enter free text notes.	X			
	37. The physician should know how to filter, search or order notes by associated diagnosis within a patient record.	X	X	X	
	38. The physician should know how to capture patient vital signs, including blood pressure, heart rate, respiratory rate, height, and weight, as discrete data.	X	X		
	39. The physician should know what procedures to follow when the system indicates that a vital sign measurement falls outside a preset normal range	X			

Section	Question	CCHIT	OHSU	Kaiser	Providence
	40. The physician should know how to capture and display other clinical data elements, such as peak expiratory flow rate, size of lesions, severity of pain, as discrete data.	X			
	41. The physician should know how to use templates for inputting data in a structured format as part of clinical documentation.	X	X	X	
	42. The physician should know how to customize clinical templates.	X	X		X
	43. The physician should know how to find/display medical summary data	X	X	X	X
	44. The physician should know how to record comments by the patient or the patient's representative regarding the accuracy or veracity of information in the patient record (henceforth 'patient annotations').	X			
	45. The physician should know how to identify and maintain patient or patient proxy completed clinical information.	X			
	46. The physician should know how to graph height and weight over time.	X	X		
IX. Review External Data		X			
	47. The physician should know how to access to clinical images from within the patient's chart	X			
	48. The physician should know how to display medication details from an external source.	X			
X. Generate and record patient specific instructions		X	X	X	X
	49. The physician should know how to access to patient instructions and patient educational materials, which may reside within the system or be provided through links to external sources.	X	X	X	
	50. The physician should know how to access to medication instructions, which may reside within the system or be provided through links to external sources.	X			X
	51. The physician should know how to access test and procedure instructions	X	X	X	
	52. The physician should know how to record that patient specific instructions or educational material were provided to the patient.	X		X	

Section	Question	CCHIT	OHSU	Kaiser	Providence
	53. The physician should know how to create patient specific instructions.	X			
XI. Order medication		X	X	X	X
	54. The physician should know how to create prescription or other medication orders with sufficient information for correct filling and administration by a pharmacy.	X	X	X	X
	55. The physician should know how to cosign medication orders	X	X		
	56. The physician should know how to search medications, including both generic and brand name.	X			
	57. The physician should know how to fill common content for prescription details including strength, sig, quantity, and refills	X			
	58. The physician should know how to check for daily dose outside of recommended range for patient age (e.g., off-label dosing).	X			
	59. The physician should know how to check for dose ranges based on patient age and weight.	X			X
	60. The physician should know how to display a drug by therapeutic class.	X			
	61. The physician should know how to print and electronically fax prescriptions.	X			
	62. The physician should know how to submit prescriptions electronically.	X	X	X	X
	63. The physician should know how to use a dose calculator for patient- specific dosing based on weight and age.	X			
	64. The physician should know how to find patient specific dosing recommendations based on age and weight.	X			
	65. The physician should know how to find patient specific dosing recommendations based on renal function.	X			
	66. The physician should know how to enter identification information for medication samples dispensed, including lot number and expiration date.	X			
	67. The physician should know how to prescribe uncoded medications.	X			
	68. The physician should know how to proceed when an alert is displayed because the drug interaction information is outdated.				

Section	Question	CCHIT	OHSU	Kaiser	Providence
	69. The physician should know how to associate a diagnosis with a prescription.	X	X	X	
	70. The physician should know how to access links to general prescribing information at the point of prescribing.	X			
	71. The physician should know how to proceed when reminders for necessary follow up tests based on medication prescribed is displayed.	X	X	X	
XII. Order diagnostic tests		X	X	X	X
	72. The physician should know how to order diagnostic tests, including labs and imaging studies.	X	X	X	X
	73. The physician should know how to associate a problem or diagnosis with the order.	X		X	
	74. The physician should know how to co-signatures for all test orders.	X			
	75. The physician should know how to relay orders for a diagnostic test to the correct destination for completion	X	X	X	
	76. The physician should know how to view active orders for an individual patient	X		X	X
	77. The physician should know how to view of orders by like or comparable type, e.g., all radiology or all lab orders	X			
XIII. Manage order sets		X	X	X	X
	78. The physician should know how to create an order set on the fly	X			
	79. The physician should know how to modify order sets	X	X		
	80. The physician should know how to display orders placed through an order set either individually or as a group.	X	X		
XIV. Manage results		X			
	81. The physician should know how to display numerical results in flow sheets and graphical form in order to compare results, and know how to review values graphed over time.	X	X		
	82. The physician should know how to filter or sort results by type of test and test date.	X	X		
	83. The physician should know how to filter or sort results by patient	X	X		
	84. The physician should know how to forward a result to other users.	X			

Section	Question	CCHIT	OHSU	Kaiser	Providence
	85. The physician should know how to link the results to the original order.	X			
	86. The physician should know how to attach a free text comment to a result that can be seen by another user who might subsequently view that result.	X			
	87. The physician should know how to associate one or more images with a result	X			
	88. The physician should be able to acknowledge the result presented to her/him	X			
XV. Manage consents and authorizations		X			
	89. The physician should know how to display and print patient consents forms	X			
	90. The physician should know how to find and display patient consents associated with a specific clinical activity and know how to go to that event in the patient's electronic chart.	X			
	91. The physician should know how to chronologically display consents and authorizations.	X			
XVI. Manage patient advance directives		X	X		
	92. The physician should know how to indicate that a patient has completed advanced directive(s).	X			
	93. The physician should know how to review when advanced directives were last reviewed.	X			
XVII. Standard care plans, guidelines, protocols		X		X	
	94. The physician should know how to access to standard care plan, protocol and guideline documents at the time of the clinical encounter. These documents may reside within the system or be provided through links to external sources	X		X	
XVIII. Capture variances from standard care plans, guidelines, protocols		X			
	95. The physician should be able to record the reason for variation from care plans, guidelines, and protocols as discrete data.	X			
XIX. Drug interaction		X			X
	96. The physician should know how to proceed when an alert is displayed at the time of medication ordering if potential interactions exist.	X			X

Section	Question	CCHIT	OHSU	Kaiser	Providence
	97. The physician should know how to prescribe a medication despite alerts for interactions and/or allergies being present.	X			
	98. The physician should know how to document at least one reason for overriding any drug-drug or drug allergy interaction warning triggered at the time of the medication ordering	X			
	99. The physician should know how to proceed when the system display provided proactive alerts, for patients on a given medication when they are due for required laboratory or other diagnostic studies, to monitor for therapeutic or adverse effects of the medication.	X			
	100. The physician should know how to proceed when the system display alerts based on the results of a laboratory test, the patient may be at increased risk for adverse effects of the medication.	X			
	101. The physician should know how to proceed when the system display an alert at the time of medication ordering if noted ineffectiveness exists.	X			
	102. The physician should know how to display, potential interactions on a patient's medication list, even if a medication is not being prescribed at the time.	X			
	103. The physician should know how to proceed when the system display a drug-disease interaction alerts at the time of medication ordering or at the time of entering a problem	X			
	104. The physician should know how to check for potential interactions between a current medication and a newly entered allergy.	X			
XX. Medication or immunization administration or supply		X			
	105. The physician should know how to document medication administration.	X			
	106. The physician should know how to document, for any medication, the medication type, doses, time of administration, route, site, lot number, expiration date, and manufacturer as structured documentation.	X			
	107. The physician should know how to document immunization administration.	X			

Section	Question	CCHIT	OHSU	Kaiser	Providence
	108. The physician should know how to record an adverse reaction to a specific immunization.				
	109. The physician should know how to proceed when the system display an alert at the time of ordering that the patient had a prior adverse reaction to that immunization.	X			
XXI. Support for non-medication ordering (referrals, care management)		X			
	110. The physician should know how to create referral orders with correct routing	X	X		
	111. The physician should know how to compose a referring provider letter	X	X		
XXII. Present alerts for disease management, preventive services and wellness		X		X	
	112. The physician should know how to establish criteria for disease management, wellness, and preventive services based on patient demographic data (minimally age and gender).	X		X	
	113. The physician should know how to establish criteria for disease management, wellness, and preventive services based on clinical data (problem list, current medications).	X			
	114. The physician should know how to update preventive services/wellness guidelines and associated reference material.	X			
	115. The physician should know how to override guidelines	X		X	
	116. The physician should know how to document reasons why disease management or preventive services/wellness prompts were overridden	X			
XXIII. Notifications and reminders for disease management, preventive services and wellness		X			X
	117. The physician should know how to identify preventive services, tests, or counseling that are due on an individual patient.	X			
	118. The physician should know how to find reminders for disease management, preventive, and wellness services in the	X			X

Section	Question	CCHIT	OHSU	Kaiser	Providence
	patient record.				
	119. The physician should know how to identify criteria for disease management, preventive, and wellness services based on patient demographic data (age, gender).	X			
	120. The physician should know how to identify criteria for disease management, preventive, and wellness services based on clinical data (problem list, current medications, lab values).	X			
	121. The physician should know how to generate letters to remind the patient or the patient's guardian of services that are due.	X			
XXIV. Inter-provider communication		X	X	X	
	122. The physician should know how to document verbal/telephone communication into the patient record.	X	X	X	
	123. The physician should know how to send messages to other users.	X	X		
XXV. Pharmacy communication		X			X
	124. The physician should know how to communicate electronically with the pharmacy about a initial medication order as well as renewals of an existing order	X	X		X
	125. The physician should know how to cancel an order electronically.	X			
XXVI. Report Generation		X	X		X
	126. The physician should know how to generate reports consisting of all or part of an individual patient's medical record (e.g. patient summary).	X	X		X
	127. The physician should know how to generate reports regarding multiple patients (e.g. diabetes roster).	X			
	128. The physician should know how to use specific report parameters (sort and filter criteria) based on patient demographic and clinical data (e.g., all male patients over 50 that are diabetic and have a HbA1c value of over 7.0 or that are on a certain medication).	X	X		

Section	Question	CCHIT	OHSU	Kaiser	Providence
	129. The physician should know how to produce reports based on the absence of a clinical data element (e.g., a lab test has not been performed or a blood pressure has not been measured in the last year).	X			
	130. The physician should know how to save report parameters for generating subsequent reports.	X			
	131. The physician should know how to modify one or more parameters of a saved report specification when generating a report using that specification.	X			
XXVII. Health record output		X	X		X
	132. The physician should know how to generate hardcopy or electronic output of part or all of the individual patient's medical record.	X			
	133. The physician should know how to create hardcopy and electronic report summary information (procedures, medications, labs, immunizations, allergies, and vital signs).	X	X	X	X
XXVIII. Encounter management		X	X	X	X
	134. The physician should know how to document a patient encounter.	X	X	X	X
	135. The physician should know how to document encounters by one or more of the following means: direct keyboard entry of text; structured data entry utilizing templates, forms, pick lists or macro substitution; dictation with subsequent transcription of voice to text, either manually or via voice recognition system.	X	X	X	X
XXIX. Rules-driven financial and administrative coding assistance		X			
	136. The physician should know how to select an appropriate CPT Evaluation and Management code based on data found in a clinical encounter.	X	X		
XXX. Security					
	137. The physician should know how to secure work station		X		
	138. The physician should know how to change provider assigned		X		

Appendix 3: Survey

Print Form

Submit by Email

Physicians' Task List Delphi Round One

Are you involved in EHR education as a (please check all that apply):

- EHR learner (currently receiving instruction) ☐
- EHR teacher (formal or designated instructor as part of your job) ☐
- EHR clinical user (currently use EHR systems for clinical work) ☐
- EHR implementer (primarily an implementer of EHRs) ☐
- EHR high level decision maker (on purchasing, installing, changing systems) ☐

The next section contains a list of tasks that physicians may perform with an Electronic Health Record (EHR). Please read each item and mark the check box corresponding to its relative importance for safe use of the EHR. Please also answer the open ended questions at the end of the form with any comments or additions.

	0 Not Relevant for Physician Use	1 Optional - Useful for Advanced Users	2	3 Important for effective use	4	5 Critical for Patient Safety
I. Identify and maintain a patient record						
1. The physician should know how to use key identifying information to identify (look up) the unique patient record.	☐	☐	☐	☐	☐	☐
2. The physician should know how to use more than one means of identifying (looking up) a patient.	☐	☐	☐	☐	☐	☐
II. Manage patient demographics						
3. The physician should know how to enter demographic information about the patient	☐	☐	☐	☐	☐	☐
4. The physician should know how to modify demographic information about the patient	☐	☐	☐	☐	☐	☐
III. Manage Problem list						
5. The physician should know how to record onset date of the problem.	☐	☐	☐	☐	☐	☐
6. The physician should know how to record the chronicity (chronic, acute/self-limiting, etc.) of a problem.	☐	☐	☐	☐	☐	☐
7. The physician should know how to enter a new problem in the patient problem list	☐	☐	☐	☐	☐	☐
8. The physician should know how to updates to the problem list.	☐	☐	☐	☐	☐	☐
9. The physician should know how to move diagnosis to the patient problem list	☐	☐	☐	☐	☐	☐
10. The physician should know how to associate orders, medications, and notes with one or more problems.	☐	☐	☐	☐	☐	☐
11. The physician should know how to display active problems	☐	☐	☐	☐	☐	☐

	0 Not Relevant for Physician Use	1 Optional - Useful for Advanced Users	2	3 Important for effective use	4	5 Critical for Patient Safety
IV. Manage Medication List						
12. The physician should know how to create and maintain medication lists.	☐	☐	☐	☐	☐	☐
13. The physician should know how to review the medication list.	☐	☐	☐	☐	☐	☐
14. The physician should know how to review medication ordering dates.	☐	☐	☐	☐	☐	☐
15. The physician should know how to display medication history for the patient.	☐	☐	☐	☐	☐	☐
16. The physician should know how to exclude a medication from the current medication list (e.g., marked inactive, erroneous, completed, discontinued) and document reason for such action.	☐	☐	☐	☐	☐	☐
17. The physician should know how to print a current medication list.	☐	☐	☐	☐	☐	☐
18. The physician should know how to enter uncoded or free text medications when medications are not on the vendor-provided medication database or information is insufficient to completely identify the medication.	☐	☐	☐	☐	☐	☐
19. The physician should know how to discern if an alert at the time a new medication is prescribed is valid or not (the patient is not taking the medication anymore).	☐	☐	☐	☐	☐	☐
20. The physician should know how to review the lists of medications and other agents to which the patient has had an allergic or other adverse reactions.	☐	☐	☐	☐	☐	☐
V. Manage allergy and adverse reaction list						
21. The physician should know how to specify the type of allergic or adverse reactions.	☐	☐	☐	☐	☐	☐
22. The physician should know how to deactivate an item from the allergy and adverse reaction list.	☐	☐	☐	☐	☐	☐
23. The physician should know how to specify the reason for deactivating an allergy/allergen from the allergy list.	☐	☐	☐	☐	☐	☐
24. The physician should know how to document that the allergy list was reviewed.	☐	☐	☐	☐	☐	☐
25. The physician should know how to explicitly indicate that a patient has no known drug allergies.	☐	☐	☐	☐	☐	☐
VI. Manage Patient History						
26. The physician should know how to capture, display, and manage patient history.	☐	☐	☐	☐	☐	☐
27. The physician should know how to update a patient history by modifying, adding, removing, or inactivating items from the patient history as appropriate.	☐	☐	☐	☐	☐	☐
28. The physician should know how to capture patient history as both a presence and absence of conditions, i.e., the specification of the absence of a personal or family history of a specific diagnosis, procedure or health risk behavior.	☐	☐	☐	☐	☐	☐

VII. Summarize Health Record

29. The physician should know how to create and display a summary list for each patient that includes, at a minimum, the active problem list, current medication list, medication allergies and adverse reactions

Not Relevant for Physician Use	Optional - Useful for Advanced Users		Important for effective use		Critical for Patient Safety
0	1	2	3	4	5

☐	☐	☐	☐	☐	☐
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VIII. Manage clinical documents and notes

30. The physician should know how to create clinical documentation or notes (henceforth "documentation").

☐	☐	☐	☐	☐	☐
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31. The physician should know how to display documentation.

☐	☐	☐	☐	☐	☐
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32. The physician should know how to save a note in progress prior to finalizing the note.

☐	☐	☐	☐	☐	☐
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33. The physician should know how to finalize a note, i.e., change the status of the note from in progress to complete so that any subsequent changes are recorded as such.

☐	☐	☐	☐	☐	☐
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34. The physician should know how to cosign a note

☐	☐	☐	☐	☐	☐
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35. The physician should know how to addend and/or correct notes that have been finalized.

☐	☐	☐	☐	☐	☐
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36. The physician should know how to enter free text notes.

☐	☐	☐	☐	☐	☐
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37. The physician should know how to filter, search or order notes by associated diagnosis within a patient record.

☐	☐	☐	☐	☐	☐
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38. The physician should know how to capture patient vital signs, including blood pressure, heart rate, respiratory rate, height, and weight, as discrete data.

☐	☐	☐	☐	☐	☐
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39. The physician should know what procedures to follow when the system indicates that a vital sign measurement falls outside a preset normal range.

☐	☐	☐	☐	☐	☐
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40. The physician should know how to capture and display other clinical data elements, such as peak expiratory flow rate, size of lesions, severity of pain, as discrete data.

☐	☐	☐	☐	☐	☐
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41. The physician should know how to use templates for inputting data in a structured format as part of clinical documentation.

☐	☐	☐	☐	☐	☐
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42. The physician should know how to customize clinical templates.

☐	☐	☐	☐	☐	☐
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43. The physician should know how to find/display medical summary data.

☐	☐	☐	☐	☐	☐
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44. The physician should know how to record comments by the patient or the patient's representative regarding the accuracy or veracity of information in the patient record (henceforth "patient annotations").

☐	☐	☐	☐	☐	☐
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45. The physician should know how to identify and maintain patient or patient proxy completed clinical information.

☐	☐	☐	☐	☐	☐
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46. The physician should know how to graph height and weight over time.

☐	☐	☐	☐	☐	☐
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IX. Review External Data

47. The physician should know how to access to clinical images from within the patient's chart.

48. The physician should know how to display medication details from an external source.

X. Generate and record patient specific instructions

49. The physician should know how to access to patient instructions and patient educational materials, which may reside within the system or be provided through links to external sources.

50. The physician should know how to access to medication instructions, which may reside within the system or be provided through links to external sources.

51. The physician should know how to access test and procedure instructions.

52. The physician should know how to record that patient specific instructions or educational material were provided to the patient.

53. The physician should know how to create patient specific instructions.

XI. Order medication

54. The physician should know how to create prescription or other medication orders with sufficient information for correct filling and administration by a pharmacy.

55. The physician should know how to design medication orders.

56. The physician should know how to search medications, including both generic and brand name.

57. The physician should know how to fill common content for prescription details including strength, sig, quantity, and refills.

58. The physician should know how to check for daily dose outside of recommended range for patient age (e.g., off-label dosing).

59. The physician should know how to check for dose ranges based on patient age and weight.

60. The physician should know how to display a drug by therapeutic class.

61. The physician should know how to print and electronically fax prescriptions.

62. The physician should know how to submit prescriptions electronically.

63. The physician should know how to use a dose calculator for patient specific dosing based on weight and age.

Not Relevant for Physician Use	Optional - Useful for Advanced Users		Important for effective use		Critical for Patient Safety
0	1	2	3	4	5
☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐
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☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐

	Not Relevant for Physician Use 0	Optional - Useful for Advanced Users 1	2	Important for effective use 3	4	Critical for Patient Safety 5
64. The physician should know how to find patient specific dosing recommendations based on age and weight.	☐	☐	☐	☐	☐	☐
65. The physician should know how to find patient specific dosing recommendations based on renal function.	☐	☐	☐	☐	☐	☐
66. The physician should know how to enter identification information for medication samples dispensed, including lot number and expiration date.	☐	☐	☐	☐	☐	☐
67. The physician should know how to prescribe uncoded medications.	☐	☐	☐	☐	☐	☐
68. The physician should know how to proceed when an alert is displayed because the drug interaction information is outdated.	☐	☐	☐	☐	☐	☐
69. The physician should know how to associate a diagnosis with a prescription.	☐	☐	☐	☐	☐	☐
70. The physician should know how to access links to general prescribing information at the point of prescribing.	☐	☐	☐	☐	☐	☐
71. The physician should know how to proceed when reminders for necessary follow up tests based on medication prescribed is displayed.	☐	☐	☐	☐	☐	☐
XII. Order diagnostic tests						
72. The physician should know how to order diagnostic tests, including labs and imaging studies.	☐	☐	☐	☐	☐	☐
73. The physician should know how to associate a problem or diagnosis with the order.	☐	☐	☐	☐	☐	☐
74. The physician should know how to co - signatures for all test orders.	☐	☐	☐	☐	☐	☐
75. The physician should know how to relay orders for a diagnostic test to the correct destination for completion.	☐	☐	☐	☐	☐	☐
76. The physician should know how to view active orders for an individual patient.	☐	☐	☐	☐	☐	☐
77. The physician should know how to view of orders by like or comparable - type, e.g., all radiology or all lab orders.	☐	☐	☐	☐	☐	☐
XIII. Manage order sets						
78. The physician should know how to create an order set on the fly.	☐	☐	☐	☐	☐	☐
79. The physician should know how to modify order sets.	☐	☐	☐	☐	☐	☐
80. The physician should know how to display orders placed through an order set either individually or as a group.	☐	☐	☐	☐	☐	☐

	Not Relevant for Physician Use 0	Optional - Useful for Advanced Users 1	2	Important for effective use 3	4	Critical for Patient Safety 5
XIV. Manage results						
81. The physician should know how to display numerical results in flow sheets and graphical form in order to compare results, and know how to review values graphed over time.	☐	☐	☐	☐	☐	☐
82. The physician should know how to filter or sort results by type of test and test date.	☐	☐	☐	☐	☐	☐
83. The physician should know how to filter or sort results by patient	☐	☐	☐	☐	☐	☐
84. The physician should know how to forward a result to other users.	☐	☐	☐	☐	☐	☐
85. The physician should know how to link the results to the original order.	☐	☐	☐	☐	☐	☐
86. The physician should know how to attach a free text comment to a result that can be seen by another user who might subsequently view that result.	☐	☐	☐	☐	☐	☐
87. The physician should know how to associate one or more images with a result	☐	☐	☐	☐	☐	☐
88. The physician should be able to acknowledge the result presented to her/him	☐	☐	☐	☐	☐	☐
XV. Manage consents and authorizations						
89. The physician should know how to display and print patient consents forms	☐	☐	☐	☐	☐	☐
90. The physician should know how to find and display patient consents associated with a specific clinical activity and know how to go to that event in the patient's electronic chart.	☐	☐	☐	☐	☐	☐
91. The physician should know how to chronologically display consents and authorizations	☐	☐	☐	☐	☐	☐
XVI. Manage patient advance directives						
92. The physician should know how to indicate that a patient has completed advanced directive(s).	☐	☐	☐	☐	☐	☐
93. The physician should know how to review when advanced directives were last reviewed.	☐	☐	☐	☐	☐	☐
XVII. Standard care plans, guidelines, protocols						
94. The physician should know how to access to standard care plan, protocol and guideline documents at the time of the clinical encounter. These documents may reside within the system or be provided through links to external sources	☐	☐	☐	☐	☐	☐
XVIII. Capture variances from standard care plans, guidelines, protocols						
95. The physician should be able to record the reason for variation from care plans, guidelines, and protocols as discrete data.	☐	☐	☐	☐	☐	☐

	Not Relevant for Physician Use 0	Optional - Useful for Advanced Users 1	2	Important for effective use 3	4	Critical for Patient Safety 5
XIX. Drug interaction						
96. The physician should know how to proceed when an alert is displayed at the time of medication ordering if potential interactions exist.	☐	☐	☐	☐	☐	☐
97. The physician should know how to prescribe a medication despite alerts for interactions and/or allergies being present.	☐	☐	☐	☐	☐	☐
98. The physician should know how to document at least one reason for overriding any drug - drug or drug allergy interaction warning triggered at the time of the medication ordering	☐	☐	☐	☐	☐	☐
99. The physician should know how to proceed when the system display provided proactive alerts, for patients on a given medication when they are due for required laboratory or other diagnostic studies, to monitor for therapeutic or adverse effects of the medication.	☐	☐	☐	☐	☐	☐
100. The physician should know how to proceed when the system display alerts based on the results of a laboratory test, the patient may be at increased risk for adverse effects of the medication.	☐	☐	☐	☐	☐	☐
101. The physician should know how to proceed when the system display an alert at the time of medication ordering if noted ineffectiveness exists.	☐	☐	☐	☐	☐	☐
102. The physician should know how to display, potential interactions on a patient's medication list, even if a medication is not being prescribed at the time.	☐	☐	☐	☐	☐	☐
103. The physician should know how to proceed when the system display a drug-disease interaction alerts at the time of medication ordering or at the time of entering a problem	☐	☐	☐	☐	☐	☐
104. The physician should know how to check for potential interactions between a current medication and a newly entered allergy.	☐	☐	☐	☐	☐	☐
XX. Medication or immunization administration or supply						
105. The physician should know how to document medication administration.	☐	☐	☐	☐	☐	☐
106. The physician should know how to document, for any medication, the medication type, doses, time of administration, route, site, lot number, expiration date, and manufacturer as structured documentation.	☐	☐	☐	☐	☐	☐
107. The physician should know how to document immunization administration.	☐	☐	☐	☐	☐	☐
108. The physician should know how to record an adverse reaction to a specific immunization.	☐	☐	☐	☐	☐	☐
109. The physician should know how to proceed when the system display an alert at the time of ordering that the patient had a prior adverse reaction to that immunization.	☐	☐	☐	☐	☐	☐

	Not Relevant for Physician Use 0	Optional - Useful for Advanced Users 1	2	Important for effective use 3	4	Critical for Patient Safety 5
XXI. Support for non - medication ordering (referrals, care management)						
110. The physician should know how to create referral orders with correct routing	☐	☐	☐	☐	☐	☐
111. The physician should know how to compose a referring provider letter	☐	☐	☐	☐	☐	☐
XXII. Present alerts for disease management, preventive services and wellness						
112. The physician should know how to establish criteria for disease management, wellness, and preventive services based on patient demographic data (minimally age and gender).	☐	☐	☐	☐	☐	☐
113. The physician should know how to establish criteria for disease management, wellness, and preventive services based on clinical data (problem list, current medications).	☐	☐	☐	☐	☐	☐
114. The physician should know how to update preventive services/wellness guidelines and associated reference material.	☐	☐	☐	☐	☐	☐
115. The physician should know how to override guidelines	☐	☐	☐	☐	☐	☐
116. The physician should know how to document reasons why disease management or preventive services/wellness prompts were overridden	☐	☐	☐	☐	☐	☐
XXIII. Notifications and reminders for disease management, preventive services and wellness						
117. The physician should know how to identify preventive services, tests, or counseling that are due on an individual patient.	☐	☐	☐	☐	☐	☐
118. The physician should know how to find reminders for disease management, preventive, and wellness services in the patient record.	☐	☐	☐	☐	☐	☐
119. The physician should know how to identify criteria for disease management, preventive, and wellness services based on patient demographic data (age, gender).	☐	☐	☐	☐	☐	☐
120. The physician should know how to identify criteria for disease management, preventive, and wellness services based on clinical data (problem list, current medications, lab values).	☐	☐	☐	☐	☐	☐
121. The physician should know how to generate letters to remind the patient or the patient's guardian of services that are due.	☐	☐	☐	☐	☐	☐

	Not Relevant for Physician Use 0	Optional – Useful for Advanced Users 1	2	Important for effective use 3	4	Critical for Patient Safety 5
XXIV. Inter-provider communication						
122. The physician should know how to document verbal/telephone communication into the patient record.	☐	☐	☐	☐	☐	☐
123. The physician should know how to send messages to other users.	☐	☐	☐	☐	☐	☐
XXV. Pharmacy communication						
124. The physician should know how to communicate electronically with the pharmacy about a initial medication order as well as renewals of an existing order	☐	☐	☐	☐	☐	☐
125. The physician should know how to cancel an order electronically.	☐	☐	☐	☐	☐	☐
XXVI. Report Generation						
126. The physician should know how to generate reports consisting of all or part of an individual patient's medical record (e.g., patient summary).	☐	☐	☐	☐	☐	☐
127. The physician should know how to generate reports regarding multiple patients (e.g., diabetes roster).	☐	☐	☐	☐	☐	☐
128. The physician should know how to use specific report parameters (sort and filter criteria) based on patient demographic and clinical data (e.g., all male patients over 50 that are diabetic and have a HbA1c value of over 7.0 or that are on a certain medication).	☐	☐	☐	☐	☐	☐
129. The physician should know how to produce reports based on the absence of a clinical data element (e.g., a lab test has not been performed or a blood pressure has not been measured in the last year).	☐	☐	☐	☐	☐	☐
130. The physician should know how to save report parameters for generating subsequent reports.	☐	☐	☐	☐	☐	☐
131. The physician should know how to modify one or more parameters of a saved report specification when generating a report using that specification.	☐	☐	☐	☐	☐	☐
XXVII. Health record output						
132. The physician should know how to generate hardcopy or electronic output of part or all of the individual patient's medical record.	☐	☐	☐	☐	☐	☐
133. The physician should know how to create hardcopy and electronic report summary information (procedures, medications, labs, immunizations, allergies, and vital signs).	☐	☐	☐	☐	☐	☐

	0 Not Relevant for Physician Use	1 Optional - Useful for Advanced Users	2	3 Important for effective use	4	5 Critical for Patient Safety
XXVIII. Encounter management						
134. The physician should know how to document a patient encounter.	☐	☐	☐	☐	☐	☐
135. The physician should know how to document encounters by one or more of the following means: direct keyboard entry of text; structured data entry utilizing templates, forms, pick lists or macro substitution; dictation with subsequent transcription of voice to text; either manually or via voice recognition system.	☐	☐	☐	☐	☐	☐
XXIX. Rules-driven financial and administrative coding assistance						
136. The physician should know how to select an appropriate CPT Evaluation and Management code based on data found in a clinical encounter.	☐	☐	☐	☐	☐	☐
XXX. Security						
137. The physician should know how to secure work station	☐	☐	☐	☐	☐	☐
138. The physician should know how to change provider assigned	☐	☐	☐	☐	☐	☐

Please, write here any comments or additions to this list:

You may complete the form electronically and email it to me at youngda@ohsu.edu, or print the form and return it by fax (503-494-4551) or conventional mail to:

Daniela Young
c/o Medical Informatics
Oregon Health & Science University
3181 SW Sam Jackson Park Road
Portland, OR 97239

Appendix 4: Introductory e-mail

Dear XXXX,

My name is Daniela Young and I am a student in the Master in Biomedical Informatics program at Oregon Health and Science University. My thesis concern is the best way to train physicians, resident and medical students on the safe use of EHR system. For this reason the topic of my thesis is “What Competencies a Physician Must Possess in Order to Use an EHR System Safely.

To answer this question I need your help. I have put together a preliminary list of task and ask you to grade them in a scale of 0 to 5, where 5 is “Critical for Patient use” and 0 is “Not Relevant for Physician Use”. Depending in the degree of agreement I may have to ask you to do the ranking more than once.

If you accept to participate in this study, I will send you an email with further instructions and the survey attached as an interactive pdf file.

Thank you for your help

Appendix 5: Survey Instruction

Thank you for agreeing to participate in this study. This form contains a list of tasks that physicians may perform with an Electronic Health Record (EHR). The aim of this study is to identify the tasks which a physician must be able to perform in order to use the EHR safely.

For the purpose of this study safety is defined as “freedom from accidental injury due to medical care,”¹ including use of the EHR for medical care.

Patient Safety: “Freedom from accidental injury due to medical care and medication errors” (Institute of Medicine - 2000).

Adverse Event: Any occurrence which is not consistent with the routine operation regardless of whether an actual injury results or not.

The task list is derived from the several sources:

- Certification Commission for Healthcare Information technology (CCHIT)
Ambulatory EHR 2007 Functionality Criteria²
- Kaiser Permanente HealtConnect Ambulatory Training, *Check your competencies*
– *Clinician*
- Oregon Health & Science University EPIC *Competency Checklist*
- Providence Health System ProvExpert *Competency Checklist*

Please read each item and mark the check box corresponding to its relative importance on the following scale

0 - **Not relevant** for physician use

1 -**Optional** – useful for advanced users

2-

3- **Important** for effective use

4-

5- **Critical** for patient safety

Please also answer the open ended questions at the end of the form with any comments or additions. You may complete the form electronically and email it to me at youngda@ohsu.edu, or print the form and return it by fax (503-494-4551) or conventional mail to:

Daniela Young

c/o Medical Informatics

Oregon Health & Science University

3181 SW Sam Jackson Park Road

Portland, OR 97239

If you have any question, please contact me at youngda@ohsu.edu .

Thank you again for your contribution to this study.

Appendix 6: Raters Comments

Group I

Rater 3

Part of my reasoning for high priority of items related to medication ordering, allergies, drug interactions, drug calculations may be due in part to the high (or perhaps) higher priority these play in Pediatrics. Most medications dosages need to be calculated and medication errors are a common problem in paper record systems.

Additional items to consider:

Ordering diets (again perhaps more an issue in pediatrics)

Ordering precautions/safety issues (e.g., seizure precautions, side rails up while patient in bed, seat belt in wheel chairs)

Ordering isolation (e.g., respiratory, wound)

Rater 4

A basic understanding of order-entry concepts is essential for achieving clinician adoption of any CPOE system. A lot of the more advanced features and functions can wait until the physician is more familiar with the workflows, how to enter information and how to override and proceed in response to one or more clinical decision support

alerts. Frustration over basic CPOE functions can quickly lead to a collapse of clinician involvement and willingness to continue using a newly implemented electronic health record.

Rater 6

These are all pretty important physician capacity and should be put into the system. If you are triaging, as to what to put and not to put in, that is not a good idea.

Rater 7

3 and 4 on entering and managing demographics may or may not be essential depending upon the type of physician practice/office. In our hospital system, the demographic information is entered by registration clerks and any changes (due to erroneous information) have to be done centrally. They specifically do not want the physicians or other direct care professionals to mess up the data. In other settings, however, entry of such information by physicians could be crucial.

9. I'm not sure what you mean by move diagnosis to the problem list.

10. Do most systems offer the functionality to associate orders, medications and/or notes with a particular problem? This sounds like it would be extremely time consuming to do and that the time/benefit trade off wouldn't be worth it (for the most part). Also I think it would be very confusing since there are sometimes several problems that can be treated

by a particular order/medication. I think you'd be lucky to get the physicians to keep their problem list updated and accurate!

18. This is crucial for patient safety for someone to be able to do this, so I marked it as crucial for the physician to do. But our system does not let anyone but the pharmacy staff makes these changes. So at our hospital it wouldn't be relevant for physician use.

19. I left this blank – I couldn't understand the question.

The clinical documents and notes section depends to some extent on the hospital/clinic workflow. If people can still dictate notes and then have them entered into the system by someone else, many of these features would not be as crucial. Similarly at an academic center an ability to co-sign notes would be very important whereas a non-teaching hospital it wouldn't matter.

37. It's not clear to me that most EHR systems have the ability to search/filter by diagnosis – ours certainly does not.

38. I personally think this is crucial but the fact of the matter is that most physicians let the nurses take and record the vitals or have them populate automatically through interfaces.

39. I left this blank – I wasn't sure what it meant or how it related to the EHR per se.

Obviously the MD should know what to do for abnormal vitals but it can be quite variable; repeat measurement; order more frequent vitals; hold medications; institute hypertensive meds.; call the resuscitation team.

44. The answer to this would depend on workflow. I don't think our health information management staff would let the MDs do this after the fact.

45. This would also be workflow dependent.

46. This would be more essential for pediatrics in order to see height/weight positioning relative to normative data. Adult physicians can get a reasonable sense of weight change from the numbers and relative weight from BMI calculations.

47. This wouldn't be crucial if you could independently access it through the external application. This functionality may not be available for all record systems.

48. Crucial to be able to use if available but you can't use it if you don't have it. (Our system does not have it.)

Generating instructions is also dependent on workflow and system capability.

Medications often need more discussion than other pre-procedure checklists. The latter can often be explained by nursing staff, especially in specialties that do a particular

procedure routinely. Knowing how to create patient specific modifications is less crucial as the MD can just write the modifications on the other sheet. Most systems don't seem to allow such modifications anyway.

55. Only relevant to teaching hospitals or, rarely, with non-independent practitioners (state dependent in terms of Physician Assistants, Nurse Practitioners). It would be essential for some physician to be able to do it at a teaching hospital but I could always get the resident to co-sign it (rather than me having to do it as the attending).

56/57. I'm not totally sure what these are asking but they sound important. If you could pick from a variety of common order sentences, it may be less crucial to know how to complete individual fields for medication orders.

58. This is also a little confusing as most systems have popup alerts that do this automatically without needing any direct MD intervention. Consequently, I left this blank.

61 and 62. These depend on workflow. If the office nursing staff can do the printing (or the resident in a teaching hospital) the MD may not need to print or transmit the scripts electronically. Not all systems have the ability to do e-prescribing and not all states permit e-prescribing for controlled substance prescriptions.

63. I answered this question according to the needs of an MD who cares for adults. We don't need to do weight based calculations that often and a regular calculator works fine. For pediatrics, though, it would be absolutely essential for patient safety.

66. This would depend on work flow. We have a staff person who is in charge of all sample dispensing.

67. I have no idea of what this means.

68. I have no idea of what this means.

74. Again, knowing how to do co-signatures is very much dependent upon the practice setting.

75. This doesn't make sense to me. One of the benefits of an electronic system is that the order gets relayed to the correct location automatically.

83. This question doesn't make sense to me. Most systems require that you open a particular patient's chart to see the results so there is no patient specific filtering that occurs.

85. This also makes no sense. Most if not all systems do this automatically.

87. This seems like it would be specialty dependent. A radiologist may need to be able to do this but it would probably be a function of the PACS system and not the generic EHR system. As a psychiatrist, I can't imagine needing to configure an image/text connection myself.

89. This was a little unclear as to whether it referred to display/print before/after consent was obtained. You definitely have to get consent and know that it was gotten before a procedure and if the record is entirely electronic, all physicians must know how to view that information. But if you get the form from a file drawer or if a nurse can print it so the patient can sign it (and then have it scanned in) then the MD wouldn't need to be able to print him/her self.

92 and 93 were a little confusing. The main thing that I would want to know is whether a person has an advance directive or not. But this doesn't seem to be one of the choices. I'm less concerned with when it was last reviewed and I'm less concerned with being able to indicate the presence of advance directives based on interactions with the patient myself. For an internist this may be crucial but as an inpatient psychiatrist, many of my patients lack capacity to give an advance directive. In addition, whenever we ask about advance directives, a significant number of my patients get suspicious and think that the hospital is plotting to kill them.

101 and 102 were confusing. I'm not sure what these are asking.

104. Don't most if not all systems do this automatically?

105 - 108. I put essential but this really depends on workflow. Virtually all meds/shots at our hospital are given and documented by nursing staff and not MDs. It would only be essential for MDs if the nurses don't do it.

110-111. The importance of this depends on workflow. If the EHR is the only way to produce a referral then it's essential. If you can pick up the phone or write out a script to make the referral, then it's not.

112-113. Not sure what these are asking.

115-116. These are essential if the system prevents you from delivering guideline discordant care. Otherwise they would be for advanced users.

117 and 118 seem about the same. I'm not sure what the differences between them would be.

119-120. Not sure what these are asking.

121. This seems like a secretarial task unless it's a solo practitioner office in which it would be very important to be able to do. (e.g. a 4).

124 and 125 would be crucial if they had to be done electronically. If you could achieve the same thing by calling the pharmacy then a 3 (which is what I marked) would be appropriate.

All of the report generation features (126 – 133) are highly dependent on work flow. Our hospital won't let MDs access the program components that do all of these tasks even if we wanted to do so.

134 seems as if it would encompass all of the features already described above (e.g, history, etc.) I wasn't sure what the distinction would be so I left it blank. If it's just additional encounter related documentation, it would depend on the availability/usability of transcription services to enter notes into the chart.

Financial coding is also work flow dependent. If the only way to bill is via the system, the physician has to know how to do it though it has no relationship to patient safety per se. (It does, however, relate to physician safety as our administrators would kill us if we saw patients without billing them!)

Protecting privacy is similarly crucial though not specific to safety per se. Indirectly, however, patients will be reluctant to be honest and open about their medical history if their privacy is not assured.

Rater 10

I noticed that I thought things that outpatient EPIC did were critical and the things it did not do were not important.

Even though I think EPIC needs a lot of improvement, I have gotten used to it and have gotten satisfied with workarounds

Things like marking 'Morphine' as an allergy when the patient is suspected of abusing it and things like assuming if a disease or symptom wasn't mentioned, they did not have it.

The questionnaire did not ask a lot about alarms and alerts. The overload of those is a major problem with the EPIC system

Rater 11

The blank pages in the survey make the task seem daunting. It really was not so bad.

I found the grading confusing. What do 2 and 4 correlate to?

The different aspects of possible physician task seem well presented.

(Transcribed from mailed survey)

Group II

Rater 1

It seems that some of the EHR knowledge should be captured by the system, e.g., renal clearance adjustments, weight-based dosing, alerts about drug-allergy, etc., and less rely on the clinician.

Good luck

Rater 5

I am not sure that effectiveness and patient safety should be part of the same scale. They are different outcomes and are not mutually exclusive; while each may be present without the other.

Rater 6

Have a working definition for the functionality that an Electronic Health Record refers to. No everyone has fully functional EHR vendor or implemented this and therefore, responses may reflect dual processes.

Good luck

(Transcribed from faxed survey)

Appendix 7: Ranking of questions and K-W Value Group I

Question	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	K-W Value	SD
1	4	5	3	4	5	5	5	4	5	5	5	0.14862440	0.6876
2	3	3	3	4	3	5	1	4	5	4	3	0.07488470	1.1282
3	3	1	4	1	4	1	0	3	1	2	3	0.02607160	1.3751
4	3	1	4	1	4	1	0	3	1	3	3	0.02706750	1.4013
5	4	3	5	3	4	5	3	3	3	5	5	0.09014550	0.9439
6	4	3	5	4	4	5	3	3	3	4	5	0.09261750	0.8312
7	5	4	5	5	5	5	4	4	3	5	5	0.14427840	0.6876
8	5	4	4	5	5	5	4	4	3	5	5	0.13411880	0.6876
9	4	3	5	4	5	3	1	4	3	5	5	0.10152550	1.2505
10	3	3	4	5	4	5	1	3	3	5	3	0.06412780	1.2136
11	4	5	4	4	5	5	5	4	3	5	5	0.13060350	0.6876
12	5	5	4	5	5	5	5	5	3	5	5	0.15258190	0.6467
13	5	4	5	4	5	5	5	4	3	5	5	0.13804630	0.6876
14	4	3	4	4	4	5	4	4	3	5	5	0.09730920	0.7006
15	5	5	4	4	4	5	5	4	3	3	5	0.12063720	0.7862
16	5	4	4	4	3	5	5	5	3	5	4	0.12011040	0.7862
17	2	3	3	2	4	3	4	4	3	3	3	0.04674770	0.7006
18	5	3	4	2	4	4	5	4	5	0	3	0.08609350	1.5076
19	5	5	5	4	5	5		5	4	5	5	0.15442010	0.4216
20	5	4	5	5	5	5	5	4	4	5	5	0.16481100	0.4671
21	5	5	5	4	4	5	5	5	4	5	4	0.15425430	0.5045
22	3	4	3	4	4	5	5	4	4	5	4	0.11222520	0.7006
23	5	3	3	3	4	5	5	4	4		4	0.09030890	0.8165
24	3	3	3	4	4	5	5	4	4	3	4	0.09162200	0.7508
25	5	5	3	4	5	5	5	5	4	2	4	0.14056280	1.0090
26	5	3	4	4	4	5	5	3	3	5	5	0.09647980	0.8739
27	5	3	4	4	4		5	3	3	5	4	0.08533100	0.8165
28	5	3	4	4	4	5	5	3	3	1	5	0.08591770	1.2505
29	3	5	3	5	4	4	3	4	3	3	4	0.09449790	0.7862
30	3	3	4	4	4	4	4	3	3	5	3	0.06091000	0.6742
31	3	3	4	4	4	4	4	3	3	5	4	0.07152840	0.6467
32	2	3	4	4	2	5	3	2	3	3	3	0.04807640	0.9439
33	3	3	4	4	4	5	4	2	3	0	3	0.04879310	1.3280
34	3	2	5	4	4	5	3	2	3	0	3	0.05077960	1.4460
35	3	2	5	3	4	5	3	2	3	5	3	0.06011950	1.1282
36	3	2	3	3	4	5	3	4	3	5	3	0.05268060	0.9342
37	1	2	3	2	3	4	1	3	2	1	4	0.02890690	1.1201
38	3	3	5	2	5	5	4	4	2	5	3	0.07917150	1.1909
39	5	3	4	2	3	4		4	3	3	3	0.05439650	0.8433
40	3	2	3	1	5	4	4	3	3	1	3	0.03809250	1.2210
41	3	3	4	3	5	4	2	3	4	0	3	0.06045650	1.3003

Question	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	K-W Value	SD
42	1	1	3	1	3	1	1	2	2	1	2	0.00871650	0.8090
43	3	3	3	4	4	5	3	3	4	5	3	0.06804160	0.8090
44	3	2	3	0	3	5	1	5	4	0	2	0.04727260	1.7529
45	3	2	4	3	3	5	1	3	3	5	3	0.04453980	1.1677
46	1	2	4	1	3	1	2	3	1	5	3	0.03050540	1.3618
47	3	3	4	4	4	5	2	3	3	1	2	0.04307600	1.1362
48	3	3	4	3	5	5	5	3	3		3	0.05794200	0.9487
49	3	3	3	1	5	3	3	5	3	2	3	0.05484340	1.1362
50	3	3	3	1	5	5	4	5	3	1	4	0.07019290	1.4334
51	3	3	3	2	5	5	2	5	3	1	3	0.05562270	1.3280
52	3	3	3	2	3	5	3	4	3	2	2	0.03964950	0.8944
53	3	3	4	2	4	3	1	4	3	1	3	0.03777950	1.0787
54	5	4	5	5	5	5	5	5	3	5	5	0.15764870	0.6467
55	5	3	5	5	4		4	3	3	5	3	0.09110430	0.9428
56	5	3	5	5		5	5	5	3	5	3	0.11367060	0.9661
57	5	3	5	5	5	5	5	5	3	5	3	0.12446330	0.9342
58	4	3	5	4	5	5		5	3	3	5	0.11005630	0.9189
59	4	3	5	4	5	5	3	5	3	2	4	0.10673630	1.0445
60	2	2	4	3	3	5	1	4	3	5	3	0.05102230	1.2505
61	2	4	4	4	5	2	3	4	3	5	3	0.08364390	1.0357
62	5	4	4	4	5	5	3	4	3	1	2	0.08750530	1.2863
63	5	5	5	4	5		3	5	3	1	5	0.12700580	1.3703
64	5	3	5	4	5	5	5	5	3	1	4	0.11404670	1.3003
65	5	4	5	4	5	5	5	5	3	1	4	0.13015740	1.2505
66	1	4	5	3	4		2	4	1	1	2	0.06362520	1.4944
67	5	3	4	2	4	5		4	4	5	3	0.08028090	0.9944
68	5	3	5	4	5	5		5	3	0	4	0.09701880	1.5951
69	3	3	4	3	5	5	1	5	3	3	1	0.06570830	1.4206
70	3	2	4	2	5	5	3	4	3	5	4	0.07242990	1.1201
71	3	3	5	3	5	5	4	4	3	1	4	0.08481290	1.2060
72	5	3	4	5	4	5	5	4	4	5	3	0.11361620	0.7862
73	5	3	4	4	4	5	2	3	3	3	2	0.06089940	1.0357
74	5	3	5	4	4	5	5	3	4	5	3	0.10585660	0.8739
75	5	3	4	3	5	5		3	4	1	4	0.08535320	1.2517
76	5	3	4	5	5	5	4	2	3	5	3	0.09231940	1.0954
77	3	3	3	3	4	5	1	2	3	5	2	0.03974750	1.2210
78	0	1	3	1	3	5	1	2	1	5	2	0.02187760	1.6624
79	1	1	3	1	3	5	4	2	1	5	2	0.03204450	1.5725
80	3	1	3	2	4	5	4	2	1	1	2	0.02887620	1.3685
81	3	3	4	2	5	4	2	5	3	5	4	0.08019610	1.1201
82	3	3	3	2	5	5	3	5	3	5	3	0.06745340	1.1201
83	5	3	4	2	5	5		5	3	0	3	0.06751880	1.6499
84	3	3	3	1	5	5	2	5	3	5	3	0.06310070	1.3685
85	3	2	3	1	4	5		4	3	5	2	0.03811540	1.3166

Question	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	K-W Value	SD
86	3	2	3	2	4	5	4	4	3	0	2	0.03764940	1.3751
87	3	2	3	2	4	5		3	3	0	1	0.01927000	1.4298
88	3	3	4	3	5	5	3	4	3	5	2	0.06609320	1.0269
89	2	5	3	1	2	3	3	3	3	1	1	0.03887090	1.2136
90	2	3	3	1	2	3	5	3	3	1	2	0.02870910	1.1282
91	2	2	3	1	2	3	2	3	3	0	1	0.01110540	1.0000
92	5	5	3	1	3	5	4	3	4	0	3	0.07891090	1.6181
93	5	3	3	3	3	5	3	3	4	0	2	0.05689990	1.3751
94	3	2	4	3	5	5	3	4	4	1	3	0.07215360	1.2060
95	3	3	4	2	5	5	1	3	4	3	2	0.06184570	1.2505
96	5	3	5	5	5	5	5	5	4	5	5	0.15782980	0.6467
97	5	3	5	4	4	5	5	5	4	5	4	0.13305070	0.6876
98	5	3	5	4	5	5	5	4	4	1	3	0.11059070	1.2649
99	5	3	5	3	5	5	3	5	4	3	4	0.12229030	0.9439
100	5	3	5	3	5	5	5	5	4	4	5	0.14160950	0.8202
101	5	3	5	4	5	5		4	4	0	3	0.09356280	1.5492
102	3	3	5	3	5	5		5	3	1	3	0.07342450	1.3499
103	5	3	5	2	5	5	4	5	3	5	5	0.11810220	1.1037
104	5	5	5	5	5	5	5	5	3	0	4	0.14283560	1.5551
105	0	3	4	2	5	4	5	5	0	5	1	0.07173970	2.0226
106	0	3	4	2	5	4	5	5	0	0	1	0.05829000	2.1106
107	3	3	4	2	5	4	5	4	0	1	3	0.05793960	1.5783
108	5	5	5	5	5	5	5	5	3	5	4	0.15628530	0.6467
109	5	3	5	5	5	5	5	5	3	5	5	0.14153790	0.8090
110	5	3	3	2	5	5	3	3	4	3	3	0.07443080	1.0357
111	2	3	3	2	4	5	3	3	4	1	3	0.04779380	1.0954
112	3	3	4	2	5	3		3	1	1	1	0.03161410	1.3499
113	3	3	4	2	5	3		3	1	1	3	0.03538420	1.2293
114	3	3	3	2	5	3	1	4	1	3	3	0.04315060	1.1677
115	3	3	4	3	5	5	5	4	1	5	3	0.07618280	1.2721
116	3	3	4	3	5	5	5	4	1	1	2	0.06288420	1.4894
117	3	4	4	1	5	5	4	3	2	4	3	0.07295460	1.2136
118	3	3	4	1	5	3	4	3	2	4	3	0.05280630	1.0787
119	3	3		1	5	5		3	2	4	3	0.04040700	1.3017
120	3	3	4	1	5	4		3	2	4	3	0.04444380	1.1353
121	3	3	3	0	5	5	1	3	2	1	3	0.03191160	1.5667
122	3	4	5	1	5	5	4	3	3	5	3	0.08572470	1.2721
123	3	3	4	0	5	5	3	3	3	5	3	0.05332820	1.4334
124	3	4	5	1	5	5	3	3	3	0	3	0.06650760	1.6011
125	5	3	5	5	5	5	3	3	3	5	3	0.09787940	1.0445
126	3	2	4	2	4	4	1	4	3	1	3	0.03691070	1.1677
127	1	2	3	2	5	4	1	3	3	3	2	0.03304400	1.2060
128	1	2	3	2	5	4	1		0	1	2	0.02193930	1.5239
129	1	2	4	1	5	4	1	3	1	0	2	0.02424110	1.6011

Question	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	K-W Value	SD
130	1	2	4	2	3	5	1	3	1	0	2	0.01937620	1.4709
131	1	2	3	1	3	5	1	3	1	1	2	0.01328620	1.3003
132	5	2	3	2	5	3	1	3	1	4	1	0.04413700	1.4894
133	5	2	3	1	5	3	1	3	1	4	1	0.04105280	1.5667
134	3	4	4	1	5	5		3	4	5	3	0.08195740	1.2517
135	3	3	4	1	4	5	1	3	4	1	3	0.04757850	1.3751
136	3	4	2	2	3	2	3	1	4	5	3	0.06593270	1.1362
137	5	4	2	4	3	5	3	1	5	5	3	0.09847340	1.3618
138	3	4	2	4	3	5	3	1	5	1	2	0.07342100	1.4142

Appendix 8: Ranking count and Standard Deviation Group II

Competencies	0	1	2	3	4	5	Total Raters
Question 1	0	0	0	1	3	7	11
Question 2	0	1	0	5	3	2	11
Question 3	1	4	1	3	2	0	11
Question 4	1	4	0	4	2	0	11
Question 5	0	0	0	5	2	4	11
Question 6	0	0	0	4	4	3	11
Question 7	0	0	0	1	3	7	11
Question 8	0	0	0	1	4	6	11
Question 9	0	1	0	3	3	4	11
Question 10	0	1	0	5	2	3	11
Question 11	0	0	0	1	4	6	11
Question 12	0	0	0	1	1	9	11
Question 13	0	0	0	1	3	7	11
Question 14	0	0	0	2	6	3	11
Question 15	0	0	0	2	4	5	11
Question 16	0	0	0	2	4	5	11
Question 17	0	0	2	6	3	0	11
Question 18	1	0	1	2	4	3	11
Question 19	0	0	0	0	2	8	10
Question 20	0	0	0	0	3	8	11
Question 21	0	0	0	0	4	7	11
Question 22	0	0	0	2	6	3	11
Question 23	0	0	0	3	4	3	10
Question 24	0	0	0	4	5	2	11
Question 25	0	0	1	1	3	6	11
Question 26	0	0	0	3	3	5	11
Question 27	0	0	0	3	4	3	10
Question 28	0	1	0	3	3	4	11
Question 29	0	0	0	5	4	2	11
Question 30	0	0	0	5	5	1	11
Question 31	0	0	0	4	6	1	11
Question 32	0	0	3	5	2	1	11
Question 33	1	0	1	4	4	1	11
Question 34	1	0	2	4	2	2	11
Question 35	0	0	2	5	1	3	11
Question 36	0	0	1	6	2	2	11
Question 37	0	3	3	3	2	0	11
Question 38	0	0	2	3	2	4	11
Question 39	0	0	1	5	3	1	10
Question 40	0	2	1	5	2	1	11
Question 41	1	0	1	5	3	1	11
Question 42	0	6	3	2	0	0	11
Question 43	0	0	0	6	3	2	11
Question 44	2	1	2	3	1	2	11

Competencies	0	1	2	3	4	5	Total Raters
Question 45	0	1	1	6	1	2	11
Question 46	0	4	2	3	1	1	11
Question 47	0	1	2	4	3	1	11
Question 48	0	0	0	6	1	3	10
Question 49	0	1	1	7	0	2	11
Question 50	0	2	0	4	2	3	11
Question 51	0	1	2	5	0	3	11
Question 52	0	0	3	6	1	1	11
Question 53	0	2	1	5	3	0	11
Question 54	0	0	0	1	1	9	11
Question 55	0	0	0	4	2	4	10
Question 56	0	0	0	3	0	7	10
Question 57	0	0	0	3	0	8	11
Question 58	0	0	0	3	2	5	10
Question 59	0	0	1	3	3	4	11
Question 60	0	1	2	4	2	2	11
Question 61	0	0	2	3	4	2	11
Question 62	0	1	1	2	4	3	11
Question 63	0	1	0	2	1	6	10
Question 64	0	1	0	2	2	6	11
Question 65	0	1	0	1	3	6	11
Question 66	0	3	2	1	3	1	10
Question 67	0	0	1	2	4	3	10
Question 68	1	0	0	2	2	5	10
Question 69	0	2	0	5	1	3	11
Question 70	0	0	2	3	3	3	11
Question 71	0	1	0	4	3	3	11
Question 72	0	0	0	2	4	5	11
Question 73	0	0	2	4	3	2	11
Question 74	0	0	0	3	3	5	11
Question 75	0	1	0	3	3	3	10
Question 76	0	0	1	3	2	5	11
Question 77	0	1	2	5	1	2	11
Question 78	1	4	2	2	0	2	11
Question 79	0	4	2	2	1	2	11
Question 80	0	3	3	2	2	1	11
Question 81	0	0	2	3	3	3	11
Question 82	0	0	1	6	0	4	11
Question 83	1	0	1	3	1	4	10
Question 84	0	1	1	5	0	4	11
Question 85	0	1	2	3	2	2	10
Question 86	1	0	3	3	3	1	11
Question 87	1	1	2	4	1	1	10
Question 88	0	0	1	5	2	3	11
Question 89	0	3	2	5	0	1	11
Question 90	0	2	3	5	0	1	11
Question 91	1	2	4	4	0	0	11

Competencies	0	1	2	3	4	5	Total Raters
Question 92	1	1	0	4	2	3	11
Question 93	1	0	1	6	1	2	11
Question 94	0	1	1	4	3	2	11
Question 95	0	1	2	4	2	2	11
Question 96	0	0	0	1	1	9	11
Question 97	0	0	0	1	4	6	11
Question 98	0	1	0	2	3	5	11
Question 99	0	0	0	4	2	5	11
Question 100	0	0	0	2	2	7	11
Question 101	1	0	0	2	3	4	10
Question 102	0	1	0	5	0	4	10
Question 103	0	0	1	2	1	7	11
Question 104	1	0	0	1	1	8	11
Question 105	2	1	1	1	2	4	11
Question 106	3	1	1	1	2	3	11
Question 107	1	1	1	3	3	2	11
Question 108	0	0	0	1	1	9	11
Question 109	0	0	0	2	0	9	11
Question 110	0	0	1	6	1	3	11
Question 111	0	1	2	5	2	1	11
Question 112	0	3	1	4	1	1	10
Question 113	0	2	1	5	1	1	10
Question 114	0	2	1	6	1	1	11
Question 115	0	1	0	4	2	4	11
Question 116	0	2	1	3	2	3	11
Question 117	0	1	1	3	4	2	11
Question 118	0	1	1	5	3	1	11
Question 119	0	1	1	4	1	2	9
Question 120	0	1	1	4	3	1	10
Question 121	1	2	1	5	0	2	11
Question 122	0	1	0	4	2	4	11
Question 123	1	0	0	6	1	3	11
Question 124	1	1	0	5	1	3	11
Question 125	0	0	0	5	0	6	11
Question 126	0	2	2	3	4	0	11
Question 127	0	2	3	4	1	1	11
Question 128	1	3	3	1	1	1	10
Question 129	1	4	2	1	2	1	11
Question 130	1	3	3	2	1	1	11
Question 131	0	5	2	3	0	1	11
Question 132	0	3	2	3	1	2	11
Question 133	0	4	1	3	1	2	11
Question 134	0	1	0	3	3	3	10
Question 135	0	3	0	4	3	1	11
Question 136	0	1	3	4	2	1	11
Question 137	0	1	1	3	2	4	11
Question 138	0	2	2	3	2	2	11

Appendix 9: Section Ranking by K-W Value Average

Section	Average K-W
19	0.121477
4	0.120084
5	0.117795
1	0.111755
11	0.09783
20	0.097159
7	0.094498
6	0.089243
30	0.085947
12	0.082965
25	0.082194
17	0.072154
24	0.069526
16	0.067905
29	0.065933
28	0.064768
18	0.061846
21	0.061112
14	0.054925
10	0.051618
9	0.050509
8	0.050176
22	0.049843
23	0.048505
27	0.042595
13	0.027599
2	0.02657
15	0.026228
26	0.0248
3	0.012878

Appendix 10: Top 50 Competencies (with original numbering)

#	Competencies
1	The physician should know how to use key identifying information to look up a unique patient record.
5	The physician should know how to record onset date of the problem.
6	The physician should know how to record the chronicity (chronic, acute/self-limiting, etc.) of a problem.
7	The physician should know how to enter a new problem in the patient problem list
8	The physician should know how to update the problem list.
9	The physician should know how to move diagnosis to the patient problem list
10	The physician should know how to associate orders, medications, and notes with one or more problems.
12	The physician should know how to create and maintain medication lists.
13	The physician should know how to review the medication list
14	The physician should know how to review medication ordering dates.
15	The physician should know how to display medication history for the patient.
16	The physician should know how to exclude a medication from the current medication list (e.g., marked inactive, erroneous, completed, discontinued) and document reason for such action.
18	The physician should know how to enter uncoded or free text medications when medications are not on the vendor-provided medication database or information is insufficient to completely identify the medication.
19	The physician should know how to discern if an alert at the time a new medication is prescribed is valid or not (The patient is not taking the medication anymore)
20	The physician should know how to review the lists of medications and other agents to which the patient has had an allergic or other adverse reactions
21	The physician should know how to specify the type of allergic or adverse reactions
22	The physician should know how to deactivate an item from the allergy and adverse reaction list.
23	The physician should know how to specify the reason for deactivating an allergy /allergen from the allergy list
24	The physician should know how to document that the allergy list was reviewed.
25	The physician should know how to explicitly indicate that a patient has no known drug allergies.
26	The physician should know how to enter, display, and manage patient history.
27	The physician should know how to update a patient history by modifying, adding, removing, or inactivating items from the patient history as appropriate.
28	The physician should know how to enter patient history as both a presence and absence of conditions, i.e., the specification of the absence of a personal or family history of a specific diagnosis, procedure or health risk behavior.
54	The physician should know how to create prescription or other medication orders with sufficient information for correct filling and administration by a pharmacy.
55	The physician should know how to cosign medication orders
56	The physician should know how to search medications, including both generic and brand name.
57	The physician should know how to fill common content for prescription details including strength, sig, quantity, and refills/
58	The physician should know how to check for daily dose outside of recommended range for patient age (e.g., off-label dosing).
59	The physician should know how to check for dose ranges based on patient age and weight.
62	The physician should know how to submit prescriptions electronically.
63	The physician should know how to use a dose calculator for patient-specific dosing based on weight and age.

#	Competencies
64	The physician should know how to find patient specific dosing recommendations based on age and weight.
65	The physician should know how to find patient specific dosing recommendations based on renal function.
68	The physician should know how to proceed when an alert is displayed because the drug interaction information is outdated
72	The physician should know how to order diagnostic tests, including labs and imaging studies.
74	The physician should know how to co-sign for all test orders.
76	The physician should know how to view active orders for an individual patient
96	The physician should know how to proceed when an alert that potential interactions exist is displayed, at the time of medication ordering.
97	The physician should know how to prescribe a medication despite alerts for interactions and/or allergies being present.
98	The physician should know how to document at least one reason for overriding any drug-drug or drug allergy interaction warning triggered at the time of medication ordering.
99	The physician should know how to proceed when the system display a proactive alerts, for patients on a given medication when they are due for required laboratory or other diagnostic studies, to monitor for therapeutic or adverse effects of the medication.
100	The physician should know how to proceed when the system display alerts based on the results of a laboratory test, the patient may be at increased risk for adverse effects of the medication.
101	The physician should know how to proceed when the system display an alert at the time of medication ordering if noted ineffectiveness exists.
103	The physician should know how to proceed when the system display a drug-disease interaction alerts at the time of medication ordering or at the time of entering a problem
104	The physician should know how to check for potential interactions between a current medication and a newly entered allergy
108	The physician should know how to record an adverse reaction to a specific immunization
109	The physician should know how to proceed when the system display an alert at the time of ordering that the patient had a prior adverse reaction to that immunization.
122	The physician should know how to document verbal/telephone communication into the patient record.
125	The physician should know how to cancel an order electronically.
137	The physician should know how to secure work station

Appendix 11: Ranking of questions and K-W Value, Group II

Questions	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	Rater 12	K-W value	SD
1	5	5	5	5	5	4	5	5	5	5	4	3	0.24690	0.651339
2	4	5	3	1	4	3	4	3	3	3	2	3	0.05727	1.029857
3	4	4	3	1	3	3	4	1	3	3	2	5	0.04794	1.206045
4	5	4	3	2	4	3	5	3	3	4	2	5	0.11094	1.083625
5	5	5	3	2	4	3	5	3	3	4	2	5	0.12119	1.154701
6	5	5	3	3	4	3	5	3	2	4	2	3	0.10709	1.087115
7	5	4	4	5	4	3	5	3	4	5	2	5	0.16977	0.996205
8	5	5	2	5	4	4	5	4	4	5	2	5	0.17615	1.114641
9	4	5	3	5	5	4	5	4	5	5	4	5	0.19252	0.674200
10	4	5	3	5	4	4	5	2	5	5	4	5	0.15418	0.965307
11	5	5	3	4	3	5	4	2	5	5	4	3	0.13367	1.044466
12		5	3	5	4	5	4	4	5	5	4	5	0.16287	0.687552
13	5	5	3	5	4	4	3	1	5	5	3	3	0.12639	1.267304
14	4	3	3	5	3	5	5	3	2	5	5	5	0.14276	1.128152
15	5	5	3	5	5	5	5	4	5	5	4	5	0.22035	0.651339
16	5	4	3	3	5	3	4	4	5	4	4	4	0.14066	0.738549
17	4	4	3	4	3	3	4	4	5	5	4	5	0.12156	0.738549
18	4	5	3	2	3	3	4	3	3	4	4	5	0.08604	0.900337
19	3	2	3	0	3	3	4	2	1	3	4	3	0.01760	1.164500
20	5	4		5	5	3	4	4	1	5	4	5	0.14307	1.221028
21	5		3	1	5	3	3	4		4	4	4	0.09126	1.173788
22	4		3	1	5	3	3	3	1	4	4	3	0.05624	1.221028
23	5		3	5	3	4	5	2	3	3	4	5	0.10764	1.078720
24	4	3	4	5	5	5	5	3	5	5	5	5	0.21487	0.797724
25	4	3	3	1	2	4	4	4	5	5	5	3	0.10106	1.240112
26	3	3	3	2	4	4	4	3	5	5	5	4	0.10773	0.965307
27	4	3	3	5		5	5	3	5	5	5	5	0.15893	0.924416
28	4	4	4	1	4	5	4	3	3	4	5	3	0.12393	1.073087
29	3	4	4	1	5	5	5	4	5	5	5	5	0.21059	1.215431
30	3	1	2	0	3	5	5	4	5	3	5	4	0.12025	1.669694
31	3	4	4	1	5	5	4	3	3	5	5	4	0.15047	1.193416
32	3	4	4	1	5	4	4	3	3	5	5	5	0.14239	1.193416
33	3	4	4	1	4	4	4	3	3	5	5	4	0.11645	1.073087
34	5	4	3	5	3	3	4	3	3	4	5	0	0.09406	1.381699
35	5	1	3	1	3	4	4	4	3	4	5	4	0.09380	1.311372
36	4	2	3	0	2	4	4	3	3	4	5	2	0.05808	1.348400
37	5	3	4	4	3	4	4	3	5	5	5	4	0.15097	0.792961
38	5	3	3	5	4	4	5	4	5	5	5	5	0.18084	0.792961
39	5	5	3	5	5	4	5	4	5	5	5	5	0.21815	0.651339
40		3	3	5	4	5	5	4	5	4	5	5	0.16851	0.809040

Questions	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Rater 7	Rater 8	Rater 9	Rater 10	Rater 11	Rater 12	K-W value	SD
41	3	1	3	1	3	4	4	4	3	5	5	5	0.09228	1.378954
42	5	5	3	1	4	5	4	4	3	5	5	5	0.15867	1.240112
43	5	3	3	1	3	4	4	2	3	4	5	5	0.08388	1.243163
44	5	5	3	1	4	4	4	3	5	5	5	5	0.14067	1.240112
45	3	5	4	1	5	5	4	4	5	5	5	5	0.20027	1.215431
46		5	3	1	4	5	4	2	2	5	5	5	0.11658	1.489356
47	4	5	3	1	4	5	4	3	5	5	5	5	0.14534	1.240112
48	4	3	3	5	4	3	5	4	3	4	4	4	0.11314	0.717741
49	5	5	5	4	4	2	4	4	3	5	4	4	0.16612	0.900337
50	5	5	3	2	3	1	2	3	5	3	1	3	0.08405	1.414214

Appendix 12: Ranking count and Standard Deviation Group II

Competencies	0	1	2	3	4	5	Total Raters
1	0	0	0	1	2	9	12
2	0	1	1	6	3	1	12
3	0	2	1	5	3	1	12
4	0	0	2	4	3	3	12
5	0	0	2	4	2	4	12
6	0	0	2	5	2	3	12
7	0	0	1	2	4	5	12
8	0	0	2	0	4	6	12
9	0	0	0	1	4	7	12
10	0	0	1	1	4	6	12
11	0	0	1	3	3	5	12
12	0	0	0	1	4	6	11
13	0	1	0	4	2	5	12
14	0	0	1	4	1	6	12
15	0	0	0	1	2	9	12
16	0	0	0	3	6	3	12
17	0	0	0	3	6	3	12
18	0	0	1	5	4	2	12
19	1	1	2	6	2	0	12
20	0	1	0	1	4	5	11
21	0	1	0	3	4	2	10
22	0	2	0	5	3	1	11
23	0	0	1	4	2	4	11
24	0	0	0	2	2	8	12
25	0	1	1	3	4	3	12
26	0	0	1	4	4	3	12
27	0	0	0	3	1	7	11
28	0	1	0	3	6	2	12
29	0	1	0	1	3	7	12
30	1	1	1	3	2	4	12
31	0	1	0	3	4	4	12
32	0	1	0	3	4	4	12
33	0	1	0	3	6	2	12
34	1	0	0	5	3	3	12
35	0	2	0	3	5	2	12
36	1	0	3	3	4	1	12
37	0	0	0	3	5	4	12
38	0	0	0	2	3	7	12
39	0	0	0	1	2	9	12
40	0	0	0	2	3	6	11
41	0	2	0	4	3	3	12
42	0	1	0	2	3	6	12
43	0	1	1	4	3	3	12
44	0	1	0	2	3	6	12

Competencies	0	1	2	3	4	5	Total Raters
45	0	1	0	1	3	7	12
46	0	1	2	1	2	5	11
47	0	1	0	2	3	6	12
48	0	0	0	4	6	2	12
49	0	0	1	1	6	4	12
50	0	2	2	5	0	3	12

Appendix 13: Top 50 Competencies from groups I and II

50 Questions #	Group 1 -Rater 1	Group 1 -Rater 2	Group 1 -Rater 3	Group 1 -Rater 4	Group 1 -Rater 5	Group 1 -Rater 6	Group 1 -Rater 7	Group 1 -Rater 8	Group 1 -Rater 9	Group 1 -Rater 10	Group 1 -Rater 11	Group 2 -Rater 1	Group 2 -Rater 2	Group 2 -Rater 3	Group 2 -Rater 4	Group 2 -Rater 5	Group 2 -Rater 6	Group 2 -Rater 7	Group 2 -Rater 8	Group 2 -Rater 9	Group 2 -Rater 10	Group 2 -Rater 11	Group 2 -Rater 12
1	4	5	3	4	5	5	5	4	5	5	5	5	5	5	5	4	5	5	5	5	4	3	
2	4	3	5	3	4	5	3	3	3	5	5	4	5	3	1	4	3	4	3	3	3	2	3
3	4	3	5	4	4	5	3	3	3	4	5	4	4	3	1	3	3	4	1	3	3	2	5
4	5	4	5	5	5	5	4	4	3	5	5	5	4	3	2	4	3	5	3	3	4	2	5
5	5	4	4	5	5	5	4	4	3	5	5	5	5	3	2	4	3	5	3	3	4	2	5
6	4	3	5	4	5	3	1	4	3	5	5	5	5	3	3	4	3	5	3	2	4	2	3
7	4	5	4	4	5	5	5	4	3	5	5	5	4	4	5	4	3	5	3	4	5	2	5
8	5	5	4	5	5	5	5	5	3	5	5	5	5	2	5	4	4	5	4	4	5	2	5
9	5	4	5	4	5	5	5	4	3	5	5	4	5	3	5	5	4	5	4	5	5	4	5
10	4	3	4	4	4	5	4	4	3	5	5	4	5	3	5	4	4	5	2	5	5	4	5
11	5	5	4	4	4	5	5	4	3	3	5	5	5	3	4	3	5	4	2	5	5	4	3
12	5	4	4	4	3	5	5	5	3	5	4		5	3	5	4	5	4	4	5	5	4	5
13	5	3	4	2	4	4	5	4	5	0	3	5	5	3	5	4	4	3	1	5	5	3	3
14	5	5	5	4	5	5		5	4	5	5	4	3	3	5	3	5	5	3	2	5	5	5
15	5	4	5	5	5	5	5	4	4	5	5	5	5	3	5	5	5	5	4	5	5	4	5
16	5	5	5	4	4	5	5	5	4	5	4	5	4	3	3	5	3	4	4	5	4	4	4
17	3	4	3	4	4	5	5	4	4	5	4	4	4	3	4	3	3	4	4	5	5	4	5
18	5	3	3	3	4	5	5	4	4		4	4	5	3	2	3	3	4	3	3	4	4	5
19	3	3	3	4	4	5	5	4	4	3	4	3	2	3	0	3	3	4	2	1	3	4	3
20	5	5	3	4	5	5	5	5	4	2	4	5	4		5	5	3	4	4	1	5	4	5
21	5	3	4	4	4	5	5	3	3	5	5	5		3	1	5	3	3	4		4	4	4
22	5	3	4	4	4	5	5	3	3	1	5	4		3	1	5	3	3	3	1	4	4	3
23	3	5	3	5	4	4	3	4	3	3	4	5		3	5	3	4	5	2	3	3	4	5
24	5	4	5	5	5	5	5	5	3	5	5	4	3	4	5	5	5	5	3	5	5	5	5
25	5	3	5	5	4		4	3	3	5	3	4	3	3	1	2	4	4	4	5	5	5	3
26	5	3	5	5		5	5	5	3	5	3	3	3	3	2	4	4	4	3	5	5	5	4
27	5	3	5	5	5	5	5	5	3	5	3	4	3	3	5		5	5	3	5	5	5	5
28	4	3	5	4	5	5		5	3	3	5	4	4	4	1	4	5	4	3	3	4	5	3
29	4	3	5	4	5	5	3	5	3	2	4	3	4	4	1	5	5	5	4	5	5	5	5
30	5	4	4	4	5	5	3	4	3	1	2	3	1	2	0	3	5	5	4	5	3	5	4
31	5	5	5	4	5		3	5	3	1	5	3	4	4	1	5	5	4	3	3	5	5	4
32	5	3	5	4	5	5	5	5	3	1	4	3	4	4	1	5	4	4	3	3	5	5	5
33	5	4	5	4	5	5	5	5	3	1	4	3	4	4	1	4	4	4	3	3	5	5	4
34	5	3	5	4	5	5		5	3	0	4	5	4	3	5	3	3	4	3	3	4	5	0
35	5	3	4	5	4	5	5	4	4	5	3	5	1	3	1	3	4	4	4	3	4	5	4
36	5	3	5	4	4	5	5	3	4	5	3	4	2	3	0	2	4	4	3	3	4	5	2
37	5	3	4	5	5	5	4	2	3	5	3	5	3	4	4	3	4	4	3	5	5	5	4
38	5	3	5	5	5	5	5	5	4	5	5	5	3	3	5	4	4	5	4	5	5	5	5
39	5	3	5	4	4	5	5	5	4	5	4	5	5	3	5	5	4	5	4	5	5	5	5

50 Questions #	Group 1 -Rater 1	Group 1 -Rater 2	Group 1 -Rater 3	Group 1 -Rater 4	Group 1 -Rater 5	Group 1 -Rater 6	Group 1 -Rater 7	Group 1 -Rater 8	Group 1 -Rater 9	Group 1 -Rater 10	Group 1 -Rater 11	Group 2 -Rater 1	Group 2 -Rater 2	Group 2 -Rater 3	Group 2 -Rater 4	Group 2 -Rater 5	Group 2 -Rater 6	Group 2 -Rater 7	Group 2 -Rater 8	Group 2 -Rater 9	Group 2 -Rater 10	Group 2 -Rater 11	Group 2 -Rater 12
40	5	3	5	4	5	5	5	4	4	1	3		3	3	5	4	5	5	4	5	4	5	5
41	5	3	5	3	5	5	3	5	4	3	4	3	1	3	1	3	4	4	4	3	5	5	5
42	5	3	5	3	5	5	5	5	4	4	5	5	5	3	1	4	5	4	4	3	5	5	5
43	5	3	5	4	5	5		4	4	0	3	5	3	3	1	3	4	4	2	3	4	5	5
44	5	3	5	2	5	5	4	5	3	5	5	5	5	3	1	4	4	4	3	5	5	5	5
45	5	5	5	5	5	5	5	5	3	0	4	3	5	4	1	5	5	4	4	5	5	5	5
46	5	5	5	5	5	5	5	5	3	5	4		5	3	1	4	5	4	2	2	5	5	5
47	5	3	5	5	5	5	5	5	3	5	5	4	5	3	1	4	5	4	3	5	5	5	5
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50	5	4	2	4	3	5	3	1	5	5	3	5	5	3	2	3	1	2	3	5	3	1	3