

Nursing Attitudes and Practices in Code Documentation Employing a New Electronic Health Record

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Abstract

Objective Based on feedback from nurses regarding the challenges of code documentation following the implementation of a new electronic health record (EHR), we sought to better understand inpatient nurse attitudes and practices in code documentation and to identify opportunities for improvement.

Methods An anonymous electronic survey was distributed to all inpatient nurses working at a single, 999-bed, university-based, and quaternary care hospital. Participation in the study was voluntary and consent was implied by survey completion.

Results Overall, 432 (14%) of 3,121 inpatient nurses completed the survey. While nearly 80% of respondents indicated feeling very comfortable using computers for personal use, only 5% felt very comfortable navigating the EHR to document codes in real time. While 53% had documented codes in the new EHR, most admitted to documenting on paper with retroactive entry into the EHR. About 25% reported having participated in a code that was not accurately documented in the new EHR. All respondents provided specific suggestions for improving the EHR interface, and over 90% expressed interest in having opportunities to practice code documentation using simulated code events.

Conclusion Despite completion of training modules in code documentation in a new EHR, many inpatient nurses in a single institution feel uncomfortable documenting codes directly into the EHR, and some question the accuracy of this documentation. Improving EHR functionality based on specific recommendations from end-users coupled with more practice documenting simulated codes may ease EHR navigation, leading to nurses' acceptance of the EHR tool, more accurate and efficient documentation, greater nurse satisfaction and more appropriate quality improvement measures.

Keywords

- ▶ simulation and modeling
- ▶ electronic health records and systems
- ▶ nurse
- ▶ data quality
- ▶ user acceptance and resistance
- ▶ workarounds
- ▶ critical care and emergency

Background and Significance

Cardiopulmonary resuscitation (CPR) is the process of ventilating and circulating blood for a patient in cardiopulmonary arrest.¹ Interventions immediately surrounding and includ-

ing CPR in the hospital setting are referred to as a code, and code documentation captures the minute-to-minute details of such an event in the patient's chart. Prior to electronic health records (EHRs), code documentation was completed

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on paper and placed in the patient's paper chart. Code documentation is now commonly documented directly in the EHR.

Complete, timely, and accurate code documentation helps to inform the future care plan of an individual patient and enables later review with an eye toward improving the quality and safety of care.^{2,3} Code documentation can also be a determining factor when establishing whether a breach in the standard of care has occurred, and it can help reduce liability and costs related to medicolegal actions.^{4,5} The Joint Commission supports the use of a code documentation tool in which all important data elements are clearly defined.^{6,7}

Sittig and Singh have identified three considerations when using an EHR to achieve national safety goals, including (1) analysis of safety concerns unique to the EHR; (2) appreciation of safety concerns from failure to use the EHR appropriately; and (3) the value of the EHR to help identify opportunities to improve patient safety.⁸

Massachusetts General Hospital (MGH) is a 999-bed medical/surgical hospital that is part of a network of 12 medical centers, collectively referred to as Mass General Brigham (MGB). Prior to 2016, the EHR across the enterprise varied with limited ability to share records across centers. In 2009, the Health Information Technology for Economic and Clinical Health Act (HITECH) was signed into law to promote the adoption and meaningful use of health information technology.^{9,10} To comply with the HITECH act, MGB transitioned the enterprise to a commercial EHR (Epic, Verona, Wisconsin, United States). Prior to the transition, code documentation was completed on paper. With implementation of the new EHR, it was determined that all codes would be documented in the code narrator, an Epic module designed with input from frontline nurse providers for real-time code documentation.

The new EHR went live across all inpatient units at MGH in April 2016. Informal feedback from nurses indicated that many feel uncomfortable documenting in the code narrator because it is not user-friendly. The stressful nature of codes and their infrequent occurrence make it particularly difficult to navigate the module. Few studies have examined nurses' knowledge, confidence, or actual practices documenting codes in the EHR.^{11–13}

Objectives

Based on concerns that the new EHR tool designed for real-time code documentation was not being used as intended with possible downstream negative impact, we developed a survey to assess nurse attitudes and practices in code documentation and identify opportunities for improvement.

Methods

The investigators designed a 20-question electronic survey for inpatient nurses who use the code narrator. Survey questions were designed based on the Model of Human-Computer Interaction, which stresses the importance of

assessing several important dimensions that contribute to the building of acceptance by end users of a new computer information system (CIS).¹⁴ These include (1) user characteristics; (2) CIS characteristics; (3) context of use and environment characteristics; (4) development process characteristics; and (5) real and perceived impacts of the new CIS.¹⁴ The survey included multiple choice questions focused on (1) user demographics; (2) code charting experience and training; (3) user comfort level with computers in general and with the code narrator in particular; (4) experience charting codes before and after implementation of the code narrator; (5) perceived impact of the code narrator on user workflow; and (6) user suggestions to improve the code narrator functionality. To address the sixth dimension, the survey included a list of six categories of possible enhancements to the EHR, and respondents were asked to check off those they believed would be most helpful. Respondents were also provided space to free text other recommendations to improve functionality of the code narrator. Lastly, nurses were asked about their interest in obtaining simulation-based practice documenting codes in real time.

A link to the survey was distributed via email to all inpatient staff nurses. The survey was designed to take no more than 5 to 8 minutes and could be accessed on any desktop computer or smartphone. In addition, flyers were posted in staff break rooms and included in a monthly hospital nurse publication that described the study and included a QR code that could easily be used to access the survey. The survey was available for 8 weeks, and recipients received two reminder emails 1 week and again 72 hours prior to survey closure. The survey platform used does not collect IP addresses, email addresses, or other identifiable data which would allow for tracing survey responses back to individual responders. The platform assures respondents that no identifiable information will be captured. A qualitative analysis was performed on the open-ended questions by two separate study staff who independently identified themes and resolved any discrepancies through discussion. This study was approved by the institutional review board.

Results

Demographics

The survey was distributed to 3,121 nurses who work on the inpatient wards and intensive care units (ICUs) and was completed by 432 (14%). **Fig. 1** displays demographic data from all respondents. However, 72% were inpatient nurses and 28% were ICU nurses, closely matching the hospital-wide breakdown (78% inpatient and 22% ICU). Of all respondents, 95% had a bachelor of science in nursing or higher degree. The average percent at our institution with a bachelor of science in nursing or higher is 91.4%. The median age range of respondents was 30 to 40 years, compared with a median age of 38 years for all nurses at our institution. The median number of years of nursing experience of respondents was 11 to 15 years compared with a median of 10.4 years for all nurses at our institution.

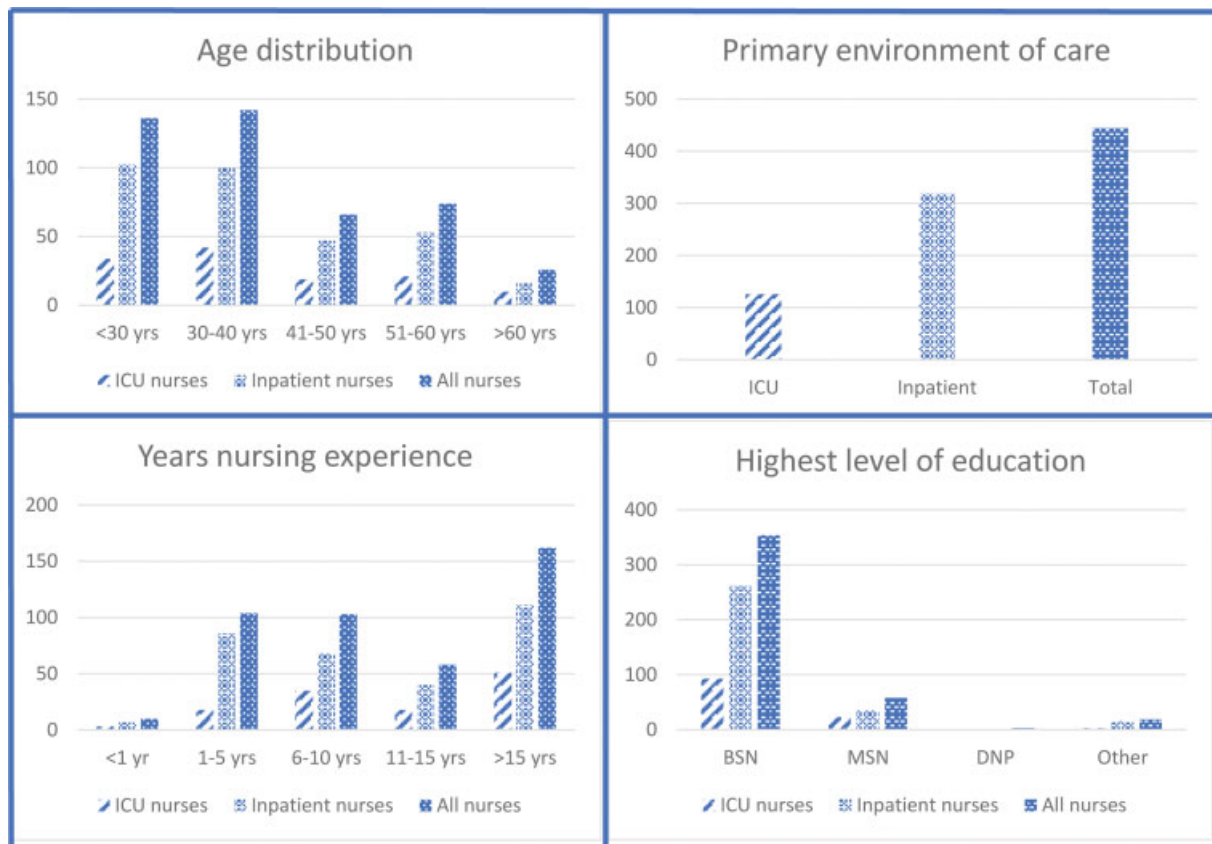


Fig. 1 Demographics.

Comfort Level with Technology and Code Documentation

►Fig. 2 reflects the level of comfort using computers versus the Epic code narrator, broken down by nurse age and primary work environment. However, 91% of ICU nurses under 40 years old and 88% of inpatient nurses under 40 years old indicated feeling comfortable using computers for personal use. These percentages were only slightly lower for nurses over the age of 40. In contrast, only 8% of ICU nurses under 40 years old and 4% of inpatient nurses under 40 years old felt the same level of comfort using the code narrator. These percentages drop further for nurses over 40 years old. Comparison of nurses with fewer than 10 years of nursing experience versus those with over 10 years of experience revealed only a slight increase in level of comfort using the code narrator, 4.8 versus 5.6%. We examined nurses' prior training in use of the EHR and past experiences documenting codes at other facilities and prior to the EHR. Furthermore, 78% reported no prior Epic training at another hospital of employment. The training at MGH was live, instructor-led for 62% and online, and self-directed for 47%. Some nurses completed both. Moreover, 20% reported hands-on practice documenting a recorded simulated code. There was little difference in the training received between nurses who indicated feeling very comfortable documenting in real time in the code narrator and those who indicated not feeling comfortable.

Preferred Method of Code Documentation

When asked about code role preferences, 88% of respondents indicated that they would prefer to provide bedside patient care over code documentation in the EHR. If given different options for documenting a code, 19% indicated that they would prefer documenting on paper only, 52% would prefer documenting on paper with retrospective data entry into the EHR, and only 29% would prefer live documentation in the EHR. ►Table 1 summarizes the reasons for these choices. Eighty-three percent indicated that they "worry that live documentation in Epic will be less accurate because I am not practiced enough to navigate it quickly." Of the 53% of respondents who indicated they had documented a real code since Epic went live in April 2016, 60% reported that they had documented at least one of these on paper and later transcribed the data into the EHR. Sixteen nurses indicated that they had documented at least one code on paper without later transcribing the event into the code narrator, and thirteen nurses indicated that they had participated in a code that was never documented in the code narrator. Nearly 25% responded that they had participated in a code where they believe the details of the code event were not accurately recorded. Twenty-eight percent of nurses with greater than 10 years' experience responded that they felt the code narrator was more accurate than paper documentation with retrospective documentation into the code narrator compared with 19% of nurses with less than 10 years.

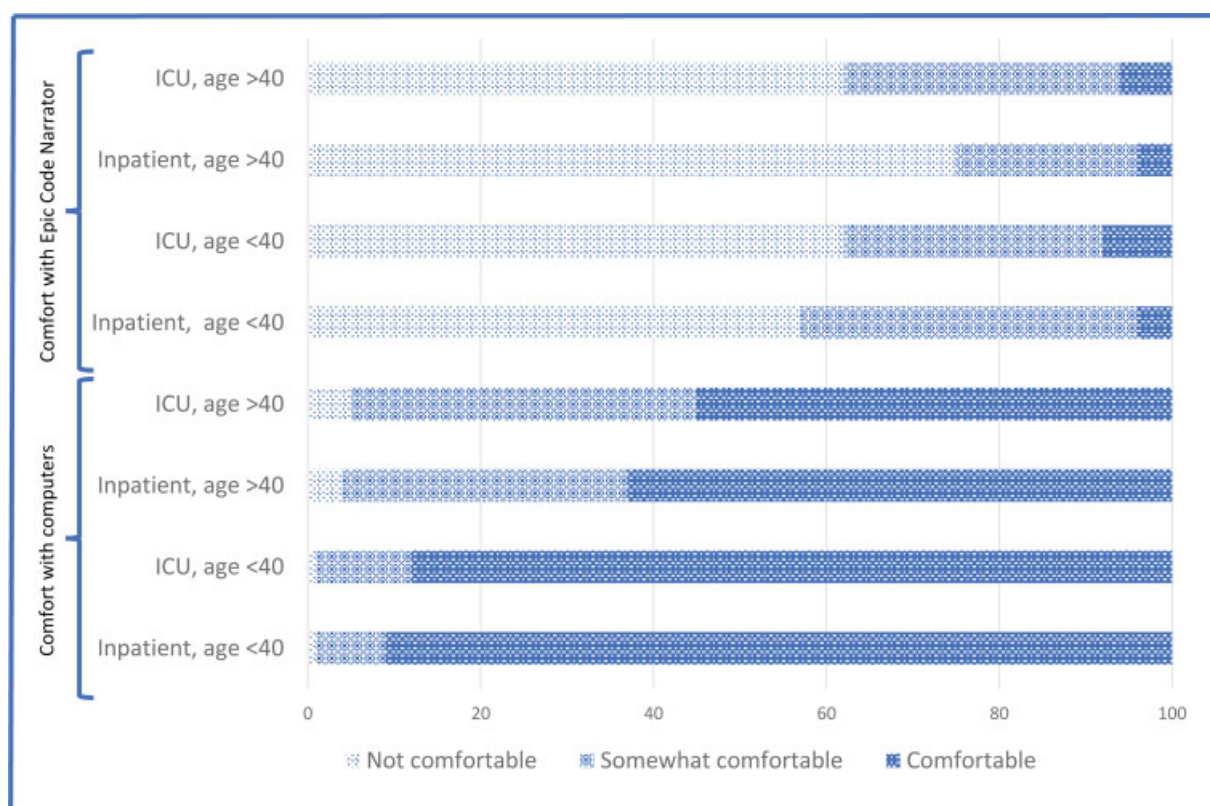


Fig. 2 Level of comfort with computers versus Epic code narrator based on work environment and age.

Fourteen percent of nurses who responded that they did not feel comfortable documenting in real time in the code narrator felt this method of documenting was actually more accurate than paper documentation with retrospective data entry into the EHR. In comparison, 42.5% of those nurses who felt comfortable documenting a code directly into the EHR indicated this form of documentation was more accurate than paper documentation with retrospective data entry into the EHR.

Table 1 Reasons indicated for paper preference of code documentation

Worry that live documentation in Epic will be less accurate because I am not practiced enough to navigate it quickly.
Worry that live documentation in Epic will be less accurate because the code narrator functionality limits what I can document
Do not have to find the right place in code narrator to enter information
Takes too long to log onto the computer on which to document
Unit culture has never emphasized the importance of using code narrator over paper documentation followed by retrospective Epic chart completion
Enables me to ask other members of the code team to help me fill in gaps in what happened during the event so that what goes in Epic is more thorough

Recommendation to Improve Code Narrator Functionality and Training

Nearly all respondents (95%) indicated that it would be helpful to have continuing education opportunities to practice documenting live, simulated codes in the code narrator. In addition to more practice, nurses had many specific ideas to improve the functionality of the code narrator. (► **Table 2**). Nearly every respondent was interested in enhancements that make it easier to find key items in the code narrator. Most took advantage of open-ended questions to (1) share their frustrations; (2) identify specific barriers to using the code narrator as intended; and (3) suggest changes that would enable nurses to use the narrator as intended. Most comments echoed one another and spoke to several themes, including (1) difficulty navigating a crowded screen with many superfluous data cells; (2) significant delay between code start time and cumbersome computer log in; and (3) difficulty attaining and maintaining competency due to the rare nature of codes, inadequate training, and lack of opportunities to practice.

Discussion

Several small studies have examined nursing attitudes toward and perceptions of code documentation in the EHR.^{15,16} To our knowledge, ours is the largest (432 respondents) to examine nurse attitudes toward code documentation in a new EHR and the first to report on actual nurse practices in code documentation following implementation of a new

Table 2 Proposed enhancements for code narrator

Category	n (%)	Enhancements executed (yes/no)
Remove unnecessary items that can be documented outside of code narrator (i.e., lines, drains, airways, wounds/burns)	n = 274 (68)	Yes
Make “code documentation” one of the default work space tabs that never disappears from any nurse’s side bar	n = 282 (70)	Yes
Make it easier to find key items in code narrator	n = 329 (82)	Yes
Automatically close drop-down menu for rapid response documentation once nurse chooses “code”	n = 176 (43)	No
Add one-step laboratory orders that automatically print	n = 299 (74)	No
Add one-step continuous medication infusions	n = 250 (62)	No

EHR. This survey-based study employed the Model of Human Computer Interaction to successfully characterize the interaction between nurses and the code narrator from the nurses’ perspective and inform interventions that promote acceptance.¹⁴ The model highlights the importance of assessing several different dimensions to achieve a successful evaluation, including (1) user characteristics; (2) CIS characteristics; (3) development process; (4) context of use; and (5) impacts.¹⁴

User Characteristics

User characteristics are one of the most important influences when assessing the acceptance of a new tool.¹⁴ In our study, we examined the end users’ demographics and their comfort level with computers versus the code narrator. While most nurses indicated a high level of comfort using computers for personal use, the majority did not feel comfortable navigating the code narrator. This was particularly true for nurses over the age of 40, where 67.5% indicated they did not feel comfortable using the code narrator compared with 58.5% of respondents under 40. Several studies have found that older nurses tend to be more resistant, less comfortable, and less likely to use health information technology in their practice.^{17,18} In our study, ICU nurses were slightly more comfortable using the code narrator than inpatient nurses. This may highlight the frequency with which ICU nurses use the code narrator compared with inpatient nurses. Studies have shown that increased exposure to information systems increases nurses’ familiarity and acceptance of the tool.^{11,19} Furthermore, critical care nurses may have a higher level of comfort functioning during clinical emergencies that occur more frequently in an ICU than on an inpatient ward.

Computer Information System Characteristics

Assessment of the nurses’ acceptance and attitudes regarding the functionality of the code narrator revealed a lack of trust in the accuracy of direct data entry into the code narrator. In fact, 60% of respondents reported documenting a code on paper and later transcribing that data into the EHR, raising significant concerns that a system meant to improve efficiency and accuracy may actually be contributing to inefficient workarounds and inaccurate data collection.

Our ability to reliably review and reconstruct events based on code documentation helps to highlight performance gaps, inform quality improvement initiatives, and design educational interventions.²⁰ However, if code documentation is incomplete and/or inaccurate, this hinders our ability to do this and may actually steer educators and quality improvement leaders toward inappropriate interventions. An unintended consequence of EHRs is incomplete information.²¹ In this study, 23% of nurses had participated in a code they felt was not accurately documented. Only 5% felt very comfortable documenting in real time in the code narrator, and of these 42.5% felt the data were more reliable when documented on paper and retroactively entered into the code narrator. The Joint Commission has considered regulations to require measures of specific time intervals during resuscitation based on studies showing that real-time documentation with automated timestamps is more accurate than paper documentation.^{16,22–24} By documenting on paper with retroactive EHR data entry, the power of automated time stamping is lost and documentation becomes less reliable.

After sharing the results of this survey with hospital Informatics leadership and Patient Care Services Quality and Safety leadership, enhancements to the code narrator module were made in many domains highlighted by respondents. Technical constraints prevented implementation of some improvements suggested by end users, though we remain hopeful these will be made in the future.

Development Process

Prior studies have shown that nurse attitudes improve when they feel their voices are heard, their opinions are valued, and there is a pathway for providing feedback that leads to action.²¹ While nurses were involved in the original design of the code narrator, no system was established to solicit feedback on functionality of the tool once nurses had actually used the tool to document on real patients. In our survey, nurses were given the opportunity to provide recommendations to improve functionality of the code narrator with the understanding that their input would be used to improve the tool. In fact, detailed feedback from our survey was presented to our hospital’s leadership, leading to multiple concrete changes to the code narrator module.

Understanding nurses' perceptions of an EHR tool and its implementation can help with ongoing efforts to improve the design, implementation, and functionality.¹¹ A similar process of soliciting feedback from end users of newly released CIS at other institutions could lead to improved functionality, positive provider attitudes, greater acceptance of the CIS, and more reliable data capture.

Context of Use

According to Despont-Gros et al, "a computer system cannot be abstracted from the setting in which it is being deployed. It belongs to a social and an organizational context in which users have to perform tasks"¹⁴. This concept is important when considering training using the code narrator. All respondents reported learning how to use the code narrator in a classroom setting (62%) and/or through an online module (47%). The results of our survey indicate little difference in level of comfort using the code narrator based on the type of initial training received (classroom vs. online). Practicing code documentation in a quiet, controlled classroom environment or through an online tutorial is very different from documenting a real code in a noisy, stress-filled patient room. Given that codes are relatively rare, it is not surprising that nurses may revert back to what they know best, in this case paper documentation. Kolb describes learning as an iterative process and argues strongly for experiential learning where the learner has the opportunity to undertake deliberate, repetitive practice in an activated state such as that afforded by in situ, simulation-based training.^{15,25–28} In our hospital's pediatric intensive care unit (PICU), nurses embrace weekly opportunities to practice charting in the code narrator during live, in situ, simulation-based team training exercises. Given that 95% of survey, respondents indicated an interest in having opportunities to practice code documentation in this way. Further research is warranted to weigh the presumed benefit of these opportunities to help nurses attain and maintain competency in real-time code documentation in the EHR versus the time and resource-intensive nature of this type of experiential learning.

Impacts

The results of this survey highlight the importance of querying end-users of newly implemented EHR to understand whether they are using the CIS appropriately to minimize the risk of using bad data to inform quality improvement measures.^{14,29} Prior studies have suggested that a lack of general computer literacy may contribute to negative nurse attitudes toward new CIS, yet we found that 80% of nurses who responded to our survey feel very comfortable using computers, but only 5% feel the same way about charting codes in real time in the EHR.^{30,31} A study done by Carrington and Effken determined that the EHR created barriers to documentation.³² By examining the characteristics of the Model of Human-Computer Interaction, our survey results suggest that a combination of (1) inadequate training; (2) cumbersome EHR functionality; and (3) infrequent use of the code narrator all contribute to nurses' lack of comfort and

acceptance of the information technology leading to inefficient, inappropriate workarounds.

Our study was limited by a low response rate of 14%. However, comparison of respondents' demographics to those of all inpatient and ICU nurses employed at our institution suggests respondents were generally representative of the nurses as a whole. It is possible that nurses with less computer literacy were less apt to take the survey. If this were the case, it is likely that even less than 5% of inpatient nurses at our hospital feel comfortable navigating the code narrator, and more than 60% are using the module inappropriately. In addition, our study did not examine accuracy of code documentation when nurses document directly into the EHR versus on paper documentation. Rather, our study focused on nurse perceptions of reliability of the new CIS and was not designed to compare accuracy of different forms of code documentation. However, Grigg et al did conduct such a study that indicated a lower rate of errors along with a 24% increase in critical data capture in the EHR when compared with paper.¹⁶ Lastly, while our survey proved to be a reliable method to assess nurses' attitudes and practices in code documentation in our institution based on consistent responses among nurses from different ICUs and nurses from different inpatient settings, it is possible these results are not valid as our survey was not previously tested for validity. That said, we believe that the results of our survey are valid, as they are consistent with our own observations of code documentation practices in our ICU and align with previous reports in the literature suggesting that inadequate training, cumbersome EHR functionality, and infrequent use of new EHR contribute to lack of acceptance and workarounds as reported by participants in our study.

Conclusion

To our knowledge, this is the largest (432 respondents) survey-based study to examine nurse attitudes toward code documentation in a new EHR, and the first to report on actual nurse practices regarding code documentation following implementation of a new EHR. The results of this study highlight the potential pitfalls of implementing CIS meant to improve accuracy and efficiency of data collection without circling back to ensure that the tool is achieving its stated goal. According to Kutney-Lee et al, improving EHR usability is imperative to improve quality and safety and patient outcomes.³³ Employing the Model of Human-Computer Interaction enables one to successfully capture users' attitudes toward and acceptance of a new EHR tool.¹⁴ Without this, one runs the risk of implementing quality improvement measures driven by incomplete or inaccurate data. Furthermore, there must be a clear pathway for end-users to provide feedback to improve functionality of the tool and to practice using this important but rarely used CIS. Feedback from frontline nurse users is crucial to the refinement of a tool they will accept, resulting in high-quality data that can be used to improve patient care, guide quality improvement initiatives, identify educational opportunities, and minimize medicolegal action.²⁹

Clinical Relevance Statement

This survey-based study highlights the potential pitfalls of implementing CIS meant to improve accuracy and efficiency of data collection without evaluating end users' acceptance to ensure the tool is achieving its stated goal. Future research is required to understand and address barriers to acceptance and functionality of new CIS. This research can lead to more accurate data collection that can better inform efforts to improve patient safety.

Multiple Choice Questions

1. The model of Human-Computer Interaction to evaluate end user acceptance of CIS requires evaluation of all of the following dimensions except:
 - a. CIS characteristics
 - b. Developmental process
 - c. User's characteristics
 - d. Impacts
 - e. All the above

Correct Answer: The correct answer is option e (all the above). Based on the model of Human-Computer Interaction, we designed a survey to evaluate nurse acceptance of new CIS that examined all of these dimensions—CIS characteristics (how the end user interacts with the CIS); developmental process (role of end users in development of the CIS; user's characteristics (age, education, level of comfort using computers, environment of care, training in the new CIS, and years of nursing experience); and impacts (how the end users use the tool, workarounds, level of comfort using the code narrator).¹⁴ Exploration of all of these dimensions is crucial to understanding users' attitudes toward new CIS and identifying measures to improve acceptance.

2. What documentation of codes is considered by the Joint Commission to be the most accurate?
 - a. Paper documentation with retroactive data entry into EHR
 - b. Live documentation in EHR
 - c. Paper documentation
 - d. Not documenting the code
 - e. Documentation in a progress note in EHR

Correct Answer: The correct answer is option b (live documentation in EHR). The Joint Commission has considered regulations to require measures of specific time intervals during resuscitation based on studies showing that real-time documentation with automated time-stamps is more accurate than paper documentation.^{16,22–24} By documenting on paper with retroactive EHR data entry, the power of automated time stamping is lost and documentation becomes less reliable. The results of this study highlight the potential pitfalls of implementing IS meant to improve accuracy and efficiency of data collection without circling back to ensure

that the tool is achieving its stated goal. It is important to query end-users of newly implemented EHR to understand whether they are using the IS appropriately to minimize the risk of using bad data to inform quality improvement measures. Without this, one runs the risk of implementing quality improvement measures driven by incomplete or inaccurate data. Furthermore, there must be a clear pathway for end-users to provide feedback to improve functionality of the tool and to practice using this important but rarely used IS.

Protection of Human and Animal Subjects

Institutional review board approval was obtained.

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None.

Conflict of Interest

None declared.

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References

- 1 Taber's Cyclopedic Medical Dictionary. 18th edition. Copyright 1997 Philadelphia, PA: FA Davis Company;312
- 2 Kittinger BJ, Matejicka A II, Mahabir RC. Surgical precision in clinical documentation connects patient safety, quality of care, and reimbursement. *Perspect Health Inf Manag* 2016;13:1f
- 3 Chan PS, Nichol G, Krumholz HM, Spertus JA, Nallamothu BKAmerican Heart Association National Registry of Cardiopulmonary Resuscitation (NRCPR) Investigators. Hospital variation in time to defibrillation after in-hospital cardiac arrest. *Arch Intern Med* 2009;169(14):1265–1273
- 4 Painter LM, Dudjak LA, Kidwell KM, Simmons RL, Kidwell RP. The nurse's role in the causation of compensable injury. *J Nurs Care Qual* 2011;26(04):311–319
- 5 Lyons JM III, Martinez JA, O'Leary JP. Medical malpractice matters: medical record M & Ms. *J Surg Educ* 2009;66(02):113–117
- 6 JCAHO hospital accreditation standards. Accessed November 9, 2020 at: https://www.jointcommission.org/facts_about_joint_commission_accreditation_standard
- 7 Resuscitation Central Hospital Code Documentation Accessed November 9, 2020 at: <https://www.resuscitationcentral.com/documentation/joint-commission-and-resuscitation>
- 8 Sittig DF, Singh H. Electronic health records and national patient-safety goals. *N Engl J Med* 2012;367(19):1854–1860
- 9 Blumenthal D. Stimulating the adoption of health information technology. *N Engl J Med* 2009;360(15):1477–1479
- 10 Blumenthal D. Launching HIT. *N Engl J Med* 2010;362(05):382–385
- 11 Carayon P, Cartmill R, Blosky MA, et al. ICU nurses' acceptance of electronic health records. *J Am Med Inform Assoc* 2011;18(06):812–819
- 12 Laramie AS, Bosek M, Shaner-McRae H, Powers-Phaneuf T. A comparison of nurse attitudes before implementation and 6 and 18 months after implementation of an electronic health record. *Comput Inform Nurs* 2012;30(10):521–530
- 13 Yen PY, McAlearney AS, Sieck CJ, Hefner JL, Huerta TR. Health information technology (HIT) adaptation: refocusing on the

- journey to successful HIT implementation. *JMIR Med Inform* 2017;5(03):e28
- 14 Despont-Gros C, Mueller H, Lovis C. Evaluating user interactions with clinical information systems: a model based on human-computer interaction models. *J Biomed Inform* 2005;38(03):244–255
 - 15 Sapyta YY, Eiger C. Improving pediatric nurses' knowledge, accuracy, and confidence through code documentation simulation. *Clin Simul Nurs* 2017;13(06):278–283
 - 16 Grigg E, Palmer A, Grigg J, et al. Randomised trial comparing the recording ability of a novel, electronic emergency documentation system with the AHA paper cardiac arrest record. *Emerg Med J* 2014;31(10):833–839
 - 17 Ibrahim S, Donelle L, Regan S, Sidani S. Predicting registered nurses' behavioural intention to use electronic documentation system in home care: application of an adapted unified theory of acceptance and use of technology model. *Nurs Leadersh (Tor Ont)* 2019;32(02):48–70
 - 18 Song L, Park B, Oh KM. Analysis of the technology acceptance model in examining hospital nurses' behavioral intentions toward the use of bar code medication administration. *Comput Inform Nurs* 2015;33(04):157–165
 - 19 Tubaishat A. Perceived usefulness and perceived ease of use of electronic health records among nurses: application of technology acceptance model. *Inform Health Soc Care* 2018;43(04):379–389
 - 20 Su L, Waller M, Kaplan S, Watson A, Jones M, Wessel DL. Cardiac resuscitation events: one eyewitness is not enough. *Pediatr Crit Care Med* 2015;16(04):335–342
 - 21 Zadvinskis IM, Garvey Smith J, Yen PY. Nurses' experience with health information technology: longitudinal qualitative study. *JMIR Med Inform* 2018;6(02):e38
 - 22 Peace JM, Yuen TC, Borak MH, Edelson DP. Tablet-based cardiac arrest documentation: a pilot study. *Resuscitation* 2014;85(02):266–269
 - 23 The Joint Commission Technical Advisory Panel to Identify or Maintain Performance Measures for Sudden Cardiac Arrest (US) Accessed 2013 at: http://www.jointcommission.org/sudden-cardiac-arrest_initiatives/
 - 24 Grundgeiger T, Albert M, Reinhardt D, Happel O, Steinisch A, Wurmb T. Real-time tablet-based resuscitation documentation by the team leader: evaluating documentation quality and clinical performance. *Scand J Trauma Resusc Emerg Med* 2016; 24:51
 - 25 Kolb DA. *Experiential Learning: Experience as the Source of Learning and Development*. 2nd edition 2015 Saddle River, NJ: Pearson Education Inc
 - 26 Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach* 2005; 27(01):10–28
 - 27 Yager PH, Lok J, Klig JE. Advances in simulation for pediatric critical care and emergency medicine. *Curr Opin Pediatr* 2011; 23(03):293–297
 - 28 Weinstock PH, Kappus LJ, Garden A, Burns JP. Simulation at the point of care: reduced-cost, in situ training via a mobile cart. *Pediatr Crit Care Med* 2009;10(02):176–181
 - 29 Hackl WO, Rauchegger F, Ammenwerth E. A nursing intelligence system to support secondary use of nursing routine data. *Appl Clin Inform* 2015;6(02):418–428
 - 30 Verma M, Gupta S. Problems faced by nurses in use of electronic health records during clinical practice. *Stud Health Technol Inform* 2016;225:985–986
 - 31 Takian A, Sheikh A, Barber N. We are bitter, but we are better off: case study of the implementation of an electronic health record system into a mental health hospital in England. *BMC Health Serv Res* 2012;12:484
 - 32 Carrington JM, Effken JA. Strengths and limitations of the electronic health record for documenting clinical events. *Comput Inform Nurs* 2011;29(06):360–367
 - 33 Kutney-Lee A, Brooks Carthon M, Sloane DM, Bowles KH, McHugh MD, Aiken LH. Electronic health record usability: associations with nurse and patient outcomes in hospitals. *Med Care* 2021. Doi: 10.1097/MLR.0000000000001536