CE 2.5 ANCC CONTACT HOURS

Use of Electronic Medication Administration Records to Reduce Perceived Stress and Risk of Medication Errors in Nursing Homes

Malin Alenius, PhD, Peter Graf, MD, PhD

Concerns have been raised about the effects of current medication administration processes on the safety of many of the aspects of medication administration. Keeping electronic medication administration records could decrease many of these problems. Unfortunately, there has not been much research on this topic, especially in nursing homes. A prospective case-control survey was consequently performed at two nursing homes; the electronic record system was introduced in one, whereas the other continued to use paper records. The personnel were asked to fill in a questionnaire of their perceptions of stress and risk of medication errors at baseline (n = 66) and 20 weeks after the intervention group had started recording medication administration electronically (n = 59). There were statistically significant decreases in the perceived risk of omitting a medication, of medication errors occurring because of communication problems, and of medication errors occurring because of inaccurate medication administration records in the intervention group (all $P < .01$ vs the control group). The perceived overall daily stress levels were also reduced in the intervention group ($P < .05$). These results indicate that the utilization of electronic medication administration records will reduce many of the concerns regarding the medication administration process.

KEY WORDS: Electronic medication administration record, Medication errors, Medication management, Nursing home, Stress

Pharmacotherapy is one of the main treatment strategies for healthcare problems in residents of nursing homes despite geriatric patients often being more sensitive to the effects of drugs; adverse drug reactions appear two to three times more often in this group than in younger adults.[1–3] A correctly used drug can enhance the quality of life and prolong the life span of the recipient but can also, if wrongly used, be fatal; drugs are one of the most common sources of injury during a healthcare stay.[1,4–6] In a cohort study of 18 nursing homes in the US over 12 months, there were 1.89 adverse drug events per 100 resident-months. Forty-two percent of these events were found to be fatal, life threatening, or serious. Almost three-quarters of these injuries were thought to be preventable.[6] Studies have shown that errors can occur in 10% to 20% of medication administrations.[7–9] It is acknowledged that humans can, and do, make mistakes; systematic factors and barriers that undermine safe medication management must be identified, and defenses and safeguards built into the system to help prevent these errors.[8,10–12] Many potential causes of error have been identified. Heavy nursing workloads, competing demands, lack of communication, and system processes such as keeping paper-based medication administration records all contribute to errors.[10,12,13] In the south of Sweden, approximately 10% of the reports sent to the Swedish National Board of Health and Welfare regarding injuries or the risk of severe injury (Lex Maria cases) in primary healthcare, municipal healthcare, and home services that were caused by medication errors were due to problems associated with paper medication administration records (D. Jensen, T. Hultqvist. *Risks in Drug Management in Primary Healthcare, Municipal Healthcare and Home Care Services. A Study of Lex Maria cases between 2006 and 2012*. Sweden: Malmö University, Institution for health and Society; 2012 [unpublished data]). The Swedish National Board of Health and Welfare has also stated (2009) that the development of new routines and processes is strengthened when they are combined with user-friendly technology and technological safeguards.[14] In the US, electronic medical administration records (eMARs) are widely used and have been associated with good results; the US government has allocated US $20 billion to the development of health information technology, including the use of eMARs.[12,13,15–20] However, data on the use of eMARs in nursing homes are scarce, despite the high use of pharmacotherapy in these establishments and the increased sensitivity of the patients to medication errors.[1,3,12,18,20]

The aim of this study was to investigate the impact of a Swedish eMAR system (the Medication and Care Support

Author affiliations: TioHundra AB, Norrtälje, Sweden.

The study did not receive funding from outside sources.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

Corresponding author: Malin Alenius, PhD, TioHundra AB, Box 905, S-761 29 Norrtälje, Sweden (malin.alenius@live.se).

System [MCSS]) on perceived stress among health personnel and the risk of medication errors in a long-term nursing home setting.

METHODS

This prospective, case-control survey was carried out at two long-term nursing homes in Norrtälje, Sweden. The participants filled in questionnaires on their perceptions of stress and the risk of medication errors over the previous 3 months. This was done both at baseline and 20 weeks after the MCSS was introduced into one of the nursing homes. The heads of the departments collected the paper questionnaires and sent them to the corresponding author for analysis. The MCSS was introduced on October 7, 2014, and the alerting system for late-dosage administration was put in place on January 15, 2015, 1 week before the follow-up assessment.

Participants

The participants were assistant nurses (with a high school diploma) and nurses' aides (with in-service training) who had worked for the 3 months prior to each assessment in either the control (Eneberg Nursing Home) or the intervention (Grind Nursing Home) nursing homes. The two nursing homes were chosen because of similarities in their demographics: both had approximately 60 residents, both were run by the same healthcare company (TioHundra AB), and both were located in the same city (Norrtälje, Sweden).

The RNs (with a university degree) working at these nursing homes (four in each nursing home) were excluded from the study because the role of RNs in the medication administration process in Sweden is different from that of the assistant nurses and nurses' aides. The RNs primarily prepare drug doses and carry out follow-ups for each resident, while the actual administration of the drugs is delegated to the assistant nurses and nurses' aides. Therefore, because the scope of the study involved only the administration of drugs in nursing homes, nurses were excluded.

Medication and Care Support System

The eMAR system used in this study was the MCSS version 1.5.0 (Appva, Gothenburg, Sweden). The MCSS is an electronic medication administration record system comprising three levels. The top management level has tools for organizational follow-up of medication administration (mainly for strategic and business management use). The management level has tools for instructing personnel, planning, and evaluating the administration of the residents' medication (on a daily basis). The operational level has tools for actually administering the medication including, for example, a real-time sign-off function, reminders, instruction details, traceability functions, and a secure log-in limited to those qualified to administer the medication. The top-management-level and management-level tools are computer based, whereas the operational-level tools have an application for use on smartphones or iPads so that they can be used when visiting residents.

The MCSS keeps a register of all medication administrations and all deviations from the agreed process; for example, the number of times that medication is not administered on time or is not signed off is recorded. These data were recorded for the intervention nursing home during the intervention period but were not available either for the baseline assessment in nursing home or at any other time in the control nursing home.

Assessment

A self-assessment questionnaire was filled out by participants to assess their perceived stress and their perception of the risk of medication errors occurring. The participants were asked to state their occupation (assistant nurse or nurses' aide) and whether they had a permanent or substitute position at the nursing home. The first four of the 14 questions dealt with how often they felt worried/anxious about the possibility of medication errors during a day (q1), how often they felt worried/anxious about this in their spare time (q2), how often they felt a need to double check the administration of medication (q3), and how often they were themselves involved in any medication errors (q4). For these questions, the available choices were *never*, *less than every month*, *every month*, *every week*, or *every day*. Questions 5 to 11 dealt with the extent of the participant's perceived risk of completely missing the administration of a medication dose (q5), administering a dose at the wrong time (q6), medication errors occurring because of inaccurate medication records (q7), not administering one of the prescribed drugs on any one occasion (q8), errors related to signing off the medication administration record (q9), errors related to communication problems between personnel (q10), and any other errors related to medication administration (q11). Questions 12 and 13 dealt with the extent to which "the participant felt stress and/or anxiety regarding their work at the nursing home as a whole (q12) and regarding the medication administration process per se (q13). Questions 5 to 13 were answered on a visual analog scale (VAS), where 0 mm represented "none," and 7.8 mm represented "considerable." Question 14 dealt with how the participant perceived the medication management process in general, where 0 mm on the VAS scale represented "very good," and 7.8 mm represented "bad." During analysis of the results, the VAS scales were transformed to a 0- to 100-mm scale for easier interpretation.

Statistical Analysis

The data were coded and entered into the Excel 2013 (Microsoft, Kista, Sweden) program, which was used for

statistical analyses. The χ^2 test was used for categorical variables, and Student *t* test, with two samples with similar variance (homoscedastic), was used for continuous variables. Analyses were 2-tailed, and $P < .05$ was considered indicative of a statistically significant difference between the compared groups.

RESULTS

During the 20 weeks of the MCSS intervention, there were 38 302 individual administrations of medication, approximately 8000 per month, at the intervention nursing home. Of these, 89% were given at the correct time, and 98% were signed off, as recorded by the MCSS.

Participant Characteristics

At baseline, the intervention nursing home had a total of 66 care personnel, of whom 18 (27%) were permanent assistant nurses, three (5%) were substitute assistant nurses, 21 (32%) were permanent nurses' aides, and 24 (36%) were substitute nurses' aides. The control nursing home had 53 care personnel, including 29 permanent assistant nurses (55%), four substitute assistant nurses (8%), 18 permanent nurses' aides (34%), and two substitute nurses' aides (4%) ($P < .001$ vs the intervention group). The difference between the groups was mainly due to more substitute nurses' aides in the intervention nursing home and more permanent assistant nurses in the control nursing home. At the intervention nursing home, 37 (56% of the available staff) responded to the questionnaire at baseline, and 36 (55%) responded at follow-up, and at the control nursing home, 29 (55%) responded at baseline, and 23 (43%) responded at follow-up ($P = .151$).

Questions 1 to 4: Occurrence of Worries/Anxiety and Known Medication Errors

At follow-up, the intervention nursing home had fewer personnel who were worried or anxious about medication administration errors during the working day (q1) than the control nursing home ($P < .001$). This difference was not seen between the two nursing homes at baseline ($P = .605$) or between baseline and follow-up for either of the two nursing homes (Table 1). There was a difference between the intervention nursing home and control nursing home at baseline regarding personnel with no worries/anxiety that lingered into their spare time (q2) ($P < .001$). This difference, however, did not remain at follow-up ($P = .310$).

The participants at the control nursing home were less likely to feel a need for double checking (q3) than those at the intervention nursing home at baseline ($P = .009$). However, this difference had disappeared at follow-up ($P = .617$). Similarly, the personnel at the control nursing home felt responsible for medication errors (q4) more frequently compared with those at the intervention nursing home at baseline ($P = .007$) but not at follow-up ($P = .954$).

Table 1. Participants' Views on Frequency of Worries/Anxiety and Known Medication Errors

Question	Nursing Home[a]	Assessment	Never, %	Less Than Every Month, %	Every Month, %	Every Week, %	Every Day, %	P[b]
1. Do you ever have worries/anxiety regarding a possibly forgotten dose or other errors during the medication administration process during your working day?	Intervention	Baseline	31	47	8	8	6	.104
		Follow-up	44	50	0	6	0	
	Control	Baseline	41	38	14	7	0	.552
		Follow-up	27	32	18	14	9	
2. Do you ever have worries/anxiety regarding a possibly forgotten dose or other errors during the medication administration process outside your working day (in your spare time)?	Intervention	Baseline	43	49	5	3	0	.036
		Follow-up	67	25	3	6	0	
	Control	Baseline	62	21	7	3	7	.436
		Follow-up	52	26	13	9	0	
3. Do you ever go back and double check a performed medication administration because of insecurity about its correctness?	Intervention	Baseline	24	41	16	14	5	.250
		Follow-up	25	25	22	17	11	
	Control	Baseline	14	66	7	7	7	.009
		Follow-up	17	35	22	13	13	
4. To your knowledge, how often would you have attributed to a medication administration error to your own work?	Intervention	Baseline	51	49	0	0	0	.937
		Follow-up	56	39	3	3	0	
	Control	Baseline	24	72	3	0	0	.052
		Follow-up	52	48	0	0	0	

[a]There were 37 and 29 participants in the intervention and control nursing homes at baseline and 36 and 23 at follow-up.

[b]*P* values for statistical significance between baseline and follow-up for each nursing home (for *P* values regarding statistical significance between intervention and control nursing home at baseline and at follow-up, see section "Questions 1 to 4: Occurrence of Worries/Anxiety and Known Medication Errors").

Questions 5 to 11: Perceived Risk

At the intervention nursing home, the perceived risk of making errors during drug administration was statistically significantly reduced from baseline to follow-up for all questions in this category except Question 6 (Table 2). The perceived risk was also significantly lower at the intervention nursing home than at the control nursing home for Questions 5 and 7 to 11 at follow-up (q5, $P = .005$; q6, $P = .574$; q7, $P < .001$; q8, $P = .007$; q9, $P = .001$; q10, $P = .012$; q11, $P = .007$). There were no statistically significant differences between the two nursing homes at baseline for Questions 5 to 8 and 11 (q5, $P = .708$; q6, $P = .555$; q7, $P = .057$; q8, $P = .484$; q11, $P = .405$). For Questions 9 and 10, regarding the signing off of medication administration (q9) and the perceived risk of errors occurring because of communication problems (q10), the perceived risk was greater in the intervention nursing home than in the control nursing home at baseline (q9, $P = .015$; q10, $P = .026$). However, the perceived risk decreased from baseline to follow-up in the intervention nursing home and increased from baseline to follow-up in the control nursing home for both questions, leaving the intervention nursing home with a lesser perceived risk at follow-up than the control (q9, $P = .001$; q10, $P = .012$; Table 2).

Questions 12 and 13: Perceived Stress

The participants at the intervention nursing home rated their perceived stress in their general daily work (q12) as 27.7 (SD, 16.9) mm on the VAS at baseline and as 16.6 (SD, 12.0) mm at follow-up, where 0 mm was "none," and 100 mm was "considerable" stress ($P = .014$). There were no significant differences at the control nursing home between baseline (42.0 [SD, 22.1] mm) and follow-up (38.0 [SD, 21.9] mm; $P = .600$). Perceived stress was significantly lower, however, at the intervention nursing home than at the control nursing home both at baseline ($P = .020$) and at follow-up ($P < .001$).

There were no statistically significant differences between baseline and follow-up in perceived stress with regard to the medication administration process per se (q13) in either nursing home. The VAS scores were 17.8 (SD, 14.7) mm at baseline and 10.7 (SD, 10.1) mm at follow-up for the intervention nursing home ($P = .065$) and 25.3 (SD, 19.3) mm and 24.7 (SD, 14.3) mm for the control nursing home ($P = .931$). Neither did the nursing homes differ at baseline for this question ($P = .156$), but they did differ at follow-up: perceived stress was lower in the intervention nursing home than in the control nursing home ($P = .001$).

Question 14: Perception of the Medication Administration Process in General

The intervention nursing home participants' perception of the medication administration process in general was significantly improved from baseline (mean VAS score, 17.8 [SD, 10.5] mm) to follow-up (8.4 [SD, 8.4] mm; $P = .002$). The VAS scores for this question did not differ significantly at the control nursing home, with scores of 11.8 (SD, 6.6) mm at baseline and 16.3 (SD, 9.3) mm at follow-up ($P = .121$). The VAS scores for Question 14 differed significantly between the nursing homes both at baseline and at follow-up, but in opposite directions. At baseline, the impression of the medication administration process was worse at the intervention nursing home than at the control nursing home ($P = .036$). However, after using the MCSS for 20 weeks, the perception of the process improved to the extent that the VAS scores

Table 2. Participants' Perceived Risk of Medication Errors Occurring During the Medication Administration Process, Given on a VAS Where 0 mm = No Risk and 100 mm = Considerable Risk

Question	Intervention Nursing Home			Control Nursing Home		
How Great Would You Perceive the Risk to Be	Baseline (n = 37) (SD), mm	Follow-up (n = 36) (SD), mm	P[a]	Baseline (n = 29) (SD), mm	Follow-up (n = 23) (SD), mm	P[a]
5. ...of completely missing administering a dose?	18.2 (15.0)	8.4 (7.2)	.007	19.8 (14.1)	17.7 (12.0)	.663
6. ...of a drug being given at the wrong time (at least 2 h off)?	19.5 (14.1)	15.8 (14.9)	.399	16.8 (13.5)	13.3 (9.8)	.414
7. ...of errors occurring during the medication administration process due to inaccurate medication administration records?	28.6 (17.0)	17.0 (10.0)	.008	38.7 (15.7)	37.3 (13.6)	.794
8. ...of completely missing the administration of at least one of the drugs on the medication chart?	20.2 (16.2)	9.0 (7.6)	.005	23.4 (14.2)	21.9 (19.3)	.800
9. ...of not signing off on the medication administration record or of not giving a signed-off dose?	29.3 (16.8)	10.8 (9.1)	<.001	16.8 (13.2)	28.7 (16.3)	.027
10. ...of errors occurring in the medication administration process because of lack of communication between peers?	26.9 (17.2)	12.3 (9.1)	<.001	15.3 (12.2)	22.6 (14.8)	.134
11. ...of errors occurring for any other reason in the medication administration process?	21.6 (17.2)	8.6 (8.9)	.014	15.9 (13.4)	26.5 (20.8)	.213

[a] *P* values for statistical significance between baseline and follow-up.

were more positive in the intervention nursing home than in the control nursing home ($P = .012$).

DISCUSSION

There are few studies that have investigated the effects of eMARs and even fewer that have been conducted at a nursing home facility.[12,13,17,18] In our study, the use of the MCSS eMAR resulted overall in a more positive perception of the medication administration process. This is in line with another survey that showed an improvement in perceived overall nurse satisfaction after the introduction of an eMAR system at an inpatient setting.[13] The same study also indicated that the eMAR could increase the perceived safety of the medication administration process for patients.[13] In another study, which investigated 156 medication administration activities in an acute care setting, medication errors were more than halved from 11.0 events per month to 5.3 events per month after using an eMAR.[17] Our study showed a reduction in the perceived risk of many types of medication error. For example, the perceived risk of missing a dose decreased by more than 50%, and the perceived risk of omitting administration of at least one of the drugs on one occasion decreased to almost a third of baseline with the eMAR. These results are not surprising, because missing medications are thought to be the errors most likely to be improved by eMARs and quality improvement efforts.[18] Timeliness of medication administration is one of the main concerns regarding the medication administration process and also appears to be one of the areas most receptive to change.[12,18] The fact that our study did not show a statistically significant decrease in the perceived risk of doses being late was surprising, because one of the main MCSS support functions is to signal when a dose is overdue. The lack of significance here might have been the result of the relatively generous time allowed before defining the dose as late (2 hours). It is possible that some doses did not quite reach the "late dose" definition in our study or the dose was forgotten altogether and then classified as omitted. In addition, the alerting system for late doses had been in use for approximately only a week when the study ended. This might have been too short a time for the assessed personnel to perceive a decrease in the risk of late administration.

Communication is another area of concern regarding the medication administration process, and eMARs have also been shown to have beneficial effects in this respect, with perceived improvements in teamwork and enhanced communication and integrated complex processes.[12,13,18] Communication was also perceived to be improved in our study, with the perceived risk of medication errors due to lack of communication among peers more than halved.

Concerns have previously been raised about the common use of paper-based medication administration records.[12] The eMAR system used in this study proved to be beneficial in this respect, as the perceived risk of medication errors occurring during the medication administration process due to inaccurate medication administration records decreased during the study period.

Concerns have also been raised regarding competing demands on personnel during the medication administration process.[12] A study by Moreland and colleagues[13] showed that use of an eMAR improved the perceived workload, which is in line with our study results showing that the perceived stress associated with their daily work decreased in the group using the eMAR. Nonetheless, the perceived stress associated with the medication administration process per se did not differ between baseline and follow-up in the intervention group in our study, although there was a trend toward a reduction ($P = .065$). The perceived stress, however, was statistically significantly lower in the intervention group than in the control group at follow-up but not at baseline. This indicates that the perceived stress in both general daily work and the medication administration process could be decreased with an eMAR. There were also fewer personnel who had worries regarding a possibly forgotten dose or other errors during the medication administration process among those who had had the help of the eMAR system.

Limitations

There were some limitations associated with this study. First, the intervention nursing home and the control nursing home differed to some extent at baseline. The higher number of substitute nurses' aides in the intervention nursing home and permanent assistant nurses in the control nursing home might have influenced the responses to the survey. The two nursing homes also differed at baseline regarding a few questions in the survey, indicating that the personnel at the intervention nursing home may have had a higher awareness of the risks associated with the medication administration process than those at the control nursing home. This risk awareness may have resulted in a keener focus on the potential risks as they were going to start an intervention, with subsequent reductions in errors. However, the inclusion of a control group and the prospective nature of the study would probably have prevented the results being overly affected. Second, the response rate was quite low at both the baseline and follow-up assessments, suggesting the possibility of bias. However, the response rates were similar between the two nursing homes and between baseline and follow-up, which minimizes the risk of false differences between baseline and follow-up, although the results might not be representative of all the personnel at the nursing homes. Third, the alerting system in the eMAR for late doses had been in use for only 1 week at the follow-up assessment, suggesting that the full potential of this support system might not have been experienced at

follow-up and that the effects of the eMAR system may have been falsely low. Finally, the validity and reliability of the questionnaire used in this study had not been scientifically proven. However, questionnaires with proven validity and reliability are not available in this area, and the questionnaire was tested on nonparticipating personnel before the study to explore the comprehensiveness of the questions, the assessment method, and the relevance of the questions. The questionnaire was then modified as a result of the feedback received before being used in the study. It was assumed that the questionnaire was capable of assessing perceived stress and perceived risk of the occurrence of medication errors in the relevant personnel.

CONCLUSIONS

The utilization of an electronic, instead of paper-based, medication administration record can result in a more positive overall perception of the medication administration process by the relevant personnel. The eMAR reduced the perceived risk of omitting a dose, medication errors occurring as a result of communication problems, and medication errors occurring as a result of inaccurate medication administration records. The stress levels among the personnel working with the medication administration process were also reduced by the eMAR. These results indicate that an eMAR would be preferable to a paper-based record for the medication administration process in a nursing home setting.

Acknowledgments

The authors thank the personnel at Grind and Eneberg Nursing Homes, Norrtälje, Sweden, who contributed to this study. They also thank Susanne Karlsson, head of nurses, TioHundra AB Nursing Homes, Norrtälje, Sweden, for her generous support. Ann-Sophie Holgersson, head of unit, Grind Nursing Home and vice head of department, TioHundra AB Nursing Homes, Norrtälje, Sweden, and Sara Söderling, head of unit Eneberg Nursing Home, Norrtälje, Sweden, are also acknowledged for their assistance and overall support. The authors also acknowledge TioHundra AB (via Jan Blomqvist, head of department, TioHundra AB Nursing Homes, Norrtälje, Sweden) for funding the study.

References

1. Handler SM, Wright RM, Ruby CM, Hanlon JT. Epidemiology of medication-related adverse events in nursing homes. *Am J Geriatr Pharmacother.* 2006;4(3): 264–272.
2. Turnheim K. Drug dosage in the elderly. Is it rational? *Drugs Aging*. 1998;13: 357–379.
3. Turnheim K. When drug therapy gets old: pharmacokinetics and pharmacodynamics in the elderly. *Exp Gerontol*. 2003;38(8): 843–853.
4. The Swedish National Board of Health and Welfare (Socialstyrelsen). *Good can become better. Summary of the 2009 Swedish Health Care Report*. Stockholm, Sweden: Socialstyrelsen; 2009.
5. Crespin DJ, Modi AV, Wei D, et al. Repeat medication errors in nursing homes: contributing factors and their association with patient harm. *Am J Geriatr Pharmacother.* 2010;8(3): 258–270.
6. Gurwitz JH, Field TS, Avorn J, et al. Incidence and preventability of adverse drug events in nursing homes. *Am J Med*. 2000;109(2): 87–94.
7. Gunningberg L, Pöder U, Donaldson N, Leo Swenne C. Medication administration accuracy: using clinical observation and review of patient records to assess safety and guide performance improvement. *J Eval Clin Pract*. 2014;20(4): 411–416.
8. McBride-Henry K, Foureur M. Medication administration errors: understanding the issues. *Aust J Adv Nurs*. 2006;23(3): 33–41.
9. Keers RN, Williams SD, Cooke J, Ashcroft DM. Prevalence and nature of medication administration errors in health care settings: a systematic review of direct observational evidence. *Ann Pharmacother.* 2013;47(2): 237–256 doi: 10.1345/aph.1R147.
10. McLeod M, Barber N, Franklin BD. Facilitators and barriers to safe medication administration to hospital inpatients: a mixed methods study of nurses' Medication Administration Processes and Systems (the MAPS Study). *PLoS One*. 2015;10(6): e0128958.
11. Reason J. Human error: models and management. *BMJ*. 2000;320(7237): 768–770.
12. Vogelsmeier A, Scott-Cawiezell J, Zellmar D. Barriers to safe medication administration in the nursing home—exploring staff perceptions and concerns about the medication use process. *J Gerontol Nurs*. 2007;33(4): 5–12.
13. Moreland PJ, Gallagher S, Bena JF, Morrison S, Albert NM. Nursing satisfaction with implementation of electronic medication administration record. *Comput Inform Nurs*. 2012;30(2): 97–103.
14. The Swedish National Board of Health and Welfare (Socialstyrelsen). *Riskanalys och händelseanalys: Handbok för patientsäkerhetsarbete*. 2nd ed. Stockholm, Sweden: Socialstyrelsen; 2009.
15. Caesar BR, Hutchinson B. Reducing medication errors by using applied technology. *Nursing*. 2006;36(8): 24–25.
16. Guo J, Iribarren S, Kapsandoy S, Perri S, Staggers N. Usability evaluation of an electronic medication administration record (eMAR) application. *Appl Clin Inform*. 2011 15;2(2): 202–224.
17. McComas J, Riingen M, Chae Kim S. Impact of an electronic medication administration record on medication administration efficiency and errors. *Comput Inform Nurs*. 2014;32(12): 589–595.
18. Scott-Cawiezell J, Madsen RW, Pepper GA, Vogelsemeier A, Petroski G, Zellmer D. Medication safety teams' guided implementation of electronic medication administration records in five nursing homes. *Jt Comm J Qual Patient Saf*. 2009;35(1): 9–35.
19. Terry N. The government pushes for electronic medical records. *Medscape Fam Med*. 2009. http://www.medscape.com/viewarticle/588354. Accessed August 20, 2015.
20. Vogelsmeier AA, Halbesleben JR, Scott-Cawiezell JR. Technology implementation and workarounds in the nursing home. *J Am Med Inform Assoc*. 2008;15(1): 114–119.
21. Department of Health. *Governance Arrangements for Research Ethics Committees*. Leeds, UK: Department of Health; 2011.

For more than 49 additional continuing education articles related to Nursing Informatics, go to NursingCenter.com/CE

Instructions for Taking the CE Test Online
Use of Electronic Medication Administration Records to Reduce Perceived Stress and Risk of Medication Errors in Nursing Homes

- Read the article. The test for this CE activity can be taken online at www.nursingcenter.com/ce/CIN. Tests can no longer be mailed or faxed.
- You will need to create a free login to your personal CE Planner account before taking online tests. Your planner will keep track of all your Lippincott Williams & Wilkins online CE activities for you.
- There is only one correct answer for each question. A passing score for this test is 13 correct answers. If you pass, you can print your certificate of earned contact hours and the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Williams & Wilkins: 1-800-787-8985.

Registration Deadline: July 31, 2018

Disclosure Statement:

The authors and planners have disclosed that they have no financial relationships related to this article.

Provider Accreditation:

Lippincott Williams & Wilkins, publisher of *CIN, Computers Informatics Nursing*, will award 2.5 contact hours for this continuing nursing education activity.

Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.5 contact hours. Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia and

in all states.

Payment:

- The registration fee for this test is $24.95.