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Perspective

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The pharmacist and the EHR

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ABSTRACT

The adoption of electronic health records (EHRs) across the United States has impacted the methods by which health care professionals care for their patients. It is not always recognized, however, that pharmacists also actively use advanced functionality within the EHR. As critical members of the health care team, pharmacists utilize many different features of the EHR. The literature focuses on 3 main roles: documentation, medication reconciliation, and patient evaluation and monitoring. As health information technology proliferates, it is imperative that pharmacists' workflow and information needs are met within the EHR to optimize medication therapy quality, team communication, and patient outcomes.

INTRODUCTION

Pharmacists have a history of early information system adoption, such as telephonic health information exchange in 1877,[1] electronic patient profiles and inventory management systems in the 1960s,[2] and automated drug interaction checking in the 1970s.[3] However, pharmacists are frequently left off the list when it comes to informatics research, design, decision making, and leadership.

Pharmacists are in expanded clinical roles of participation in direct patient care in many clinical settings. Clinical pharmacy is defined as providing patient care to optimize medication therapy and promote health, wellness, patient safety, and disease prevention.[4] This has improved patient care, and in the inpatient setting, clinical pharmacists have been shown to improve the quality, safety,[5,6] and efficiency of patient care,[7] and thus they are recognized as critical members of the health care team.[7–12]

The adoption of EHRs across the United States has impacted the ways in which physicians, nurses, *and pharmacists* provide care for patients.[13] While there is a concerted effort going on, pharmacists are not currently considered eligible providers by the Centers for Medicare and Medicaid Services (CMS). They do not receive incentive funds directly based on Meaningful Use through the adoption of EHRs[14]; however, they are active users of EHRs and play a key role in some core measures such as medication reconciliation, computerized physician order entry (CPOE), e-prescribing, clinical decision support, and immunizations.

HOW DO PHARMACISTS USE THE EHR?

While pharmacists use many different advanced functions in the EHR, the literature describes 3 main uses: (1) documentation,[13,15–33] (2) medication reconciliation,[18,34–53] and (3) patient evaluation and monitoring.[25,32,40,54–64]

Documentation in the EHR

In 2007, 90.7% of hospitals with an EHR provided pharmacists with access to view parts of the EHR for medication therapy management, and only about half of those hospitals allowed pharmacists to document in the EHR.[15] However, a recent survey showed that 62.3% of hospitals in 2013 required pharmacists to document recommendations and progress notes in medical records, up from 54.9% in

2011.[16,17] Documentation tasks performed by pharmacists include medication reconciliation notes,[33] allergy documentation,[24] clinical progress notes, notes on medication therapy (such as reasons for discontinuation[20] or proactive recommendations[21]), and "interventions" for financial justification.[25,29,30,32] Some barriers that have been identified in pharmacists' documentation in the EHR include the fear of litigation or criticism from other professionals, time constraints, perceived significance or appropriateness of documentation, acceptance by doctors, and ownership of the health record.[19,23] There are also questions about what pharmacists need to document; how to document; who reads or uses the documentation; how the documentation is used in communication between pharmacists, other health care professionals, and patients; and whether this documentation can be used somehow for financial justification of clinical pharmacists' costs and benefits, similar to "intervention" documentation.[23,65] However, there should also be careful consideration concerning how data is captured from pharmacists and whether structured or unstructured (free-text) fields best suit the specific use case and workflows to meet the needs of the institution.[31,66]

The expanded role of clinical pharmacists has served to emphasize the need for increased documentation by pharmacists in the EHR,[18] and pharmacists now require access to the entire patient record, regardless of where care was received.[13] As pharmacists' documentation in the EHR increases, it is important that they know how to find information in the EHR and document their assessments or recommendations.[26,27]

Medication reconciliation

During the medication reconciliation process, a pharmacist checks the EHR for consistency and correctness of the medication history, and performs systematic interviews with patients to obtain additional information.[34,35] In one study, 74% of patients had medication discrepancies between their patient reports and the EHR.[36] Of those discrepancies, 51.5% were due to medications reported by patients not being listed in the EHR (such as over-the-counter medications), patients forgetting to report use, medications from outside prescribers, etc.[36] Another study found that the patient population had an average of 6 medication discrepancies in the EHR, with inactive medications listed in the EHR being the most common error (41%).[37] Pharmacists use the EHR to compare and contrast medication lists, link medications to patient problems, evaluate effectiveness and adverse drug events (ADEs), and make documentation recommendations to provide a complete history of the patient's medications.[18,35] Medication reconciliation tasks are significantly dependent on information technology,[42] and medication reconciliation could benefit greatly from the sharing of medication lists between organizations, such as through health information exchange (HIE).[67,68] However, HIE can only provide lists of potential medications that patients are taking; therefore, medication reconciliation still requires interviews with patients to evaluate how they are really taking their medications, and this is a role well suited to pharmacists.[46]

Patient evaluation and monitoring

Pharmacists in the inpatient setting spend large amounts of time using the EHR to evaluate or work up their patients.[12] These evaluations typically consist of identifying potential medication problems, reviewing medication regimens, checking drug-drug and drug-disease interactions, monitoring ADEs, evaluating the therapeutic effectiveness and dosing appropriateness of medications based on the context of disease states and lab values, managing medication therapies, performing medication reconciliation, and evaluating patients' medication adherence.[25,32,54,56–64] Additionally, in many institutions, clinical pharmacists attend patient rounds and participate in other aspects of interdisciplinary patient care, which goes beyond medication issues in many cases. Some clinical decision support tools using EHR data have been designed to help support pharmacists, especially for antibiotic stewardship or ADE detection[25,69–72]; however, there are many opportunities for improvement.

Additionally, there is a serious disconnect between hospitals, retail community pharmacies, and other enterprises regarding patient data, which may result in patient harm.[73] There is a need for timely and accurate HIE between EHRs and community pharmacies, especially in transitions of care and medication reconciliation.[74] For example, in some countries, community pharmacists have access to national EHR data so they can monitor patient therapy.[75] While this type of access has the potential to expand the role of pharmacists and improve patient safety, there are still concerns about reimbursement, time constraints, responsibility, patient consent, and liability,[75] along with additional challenges and barriers in the retail/community pharmacy setting.[76]

There are many studies reviewing the information needs and information-seeking behaviors of nurses and physicians, but we have found none for pharmacists. Nurses seem to seek information about protocols and procedures, while physicians seek information related to diagnosis.[77] Other studies show that physicians tend to focus more on the "Assessment and plan" part of clinical notes, and give very little attention to the "Medication profile" part.[78,79] It is understandable, then, why it is important for pharmacists to focus on medication and monitoring related information in the clinical notes and EHR. However, more research is needed to understand pharmacists' information needs as a critical source of medication information.[17,80]

In summary, the evidence suggests a gap between the role of pharmacists and their need for information. It is imperative to design the EHR to support those needs, as missing, incomplete, or inaccurate information can lead to medication errors, ADEs, failure to provide prophylactic treatment, and other potential patient harm.

IMPLICATIONS AND FUTURE OPPORTUNITIES

Interdisciplinary informatics organizations are recognizing the importance of including pharmacists and of designing EHRs to support pharmacists' cognitive needs. There is a critical need for pharmacists in informatics and informatics in clinical pharmacy. While there are pharmacists in the informatics realm and informatics tools have been developed to support pharmacists, they seem to be few and far between. Generally, there appears to be a misunderstanding of what informatics is in the pharmacy world, perhaps due to the casual use of the word "informatics" in various titles and activities associated with computers.[81,82] Additionally, pharmacy informatics education is lagging behind current practice and is inconsistent across the nation.[83,84] To change this, some colleges of pharmacy are now training pharmacists in informatics and offering PharmD and master's dual degrees. This suggests that the shortage of pharmacists in informatics research and development may be due to a lack of awareness and training.

Many health IT applications seem to be designed to automate tasks or business processes, or even to mimic paper-based charts; however, the EHR allows for opportunities to support pharmacists' cognitive tasks and workflows.[85] Few tools currently exist for pharmacists, yet these tools could help increase problem identification, speed and efficiency of workups, and speed and completeness of

medication reconciliation, and improve patient outcomes by reducing ADEs. Clinical decision support (CDS) tools could help pharmacists perform their clinical responsibilities, such as evaluating patients or performing medication reconciliation,[86–88] and working up patients, as they typically go back and forth between sources in the EHR to get the most up-to-date information.[89] However, CDS for clinical pharmacists remains understudied and underutilized,[71] and there are very few studies evaluating the usability of EHRs or HIE from the pharmacist's perspective.

The use of EHRs and CPOE has helped to provide pharmacists with real-time, and legible, patient information and medication orders.[90] The use of CPOE has increased pharmacists' productivity, thus allowing them to focus on more clinical duties beyond order entry or verification.[91] While CPOE and e-prescribing can reduce transcription and legibility errors,[92] there is the potential for different or new types of medication errors, such as selecting the wrong drug or the wrong patient, creating internal prescription discrepancies, or interrupting workflow.[93–97]

Finally, the role and scope of practice for pharmacists will evolve as they work toward recognition as eligible providers, and as meaningful users and contributors to the EHR.[14,54,98–102] Health care leaders have realized or are realizing the importance of having pharmacists on informatics teams, working along with physicians and nurses, to achieve meaningful use goals and to develop and implement health IT systems. Leaving pharmacists out of the informatics team is a recipe for implementation failure.[88,103]

CONCLUSION

Pharmacists provide care to patients across the health care continuum and are active participants in the EHR, seeking and documenting information. EHR use and implementation are driven by funding and policy changes, and pharmacists need to be part of the design and implementation teams. As health information technology proliferates and EHRs are designed and implemented in the health care setting, it is imperative that pharmacists' workflow and information needs are met within EHRs to optimize medication therapy quality and patient outcomes. Since informatics is an interdisciplinary science, pharmacists need to be included on the list as important members of the health care team.

CONTRIBUTORS

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The authors have no competing interests to declare

REFERENCES

1. Land FD. Notes on the development of telephone service II. *Popular Science Monthly*. The Science Press: New York. 1906;69.
2. Hall EJ. Hermes Drug in La Grange: a pioneer Texas store. *Southwest Hist Q*. 1966;70(1):65–70.
3. Hansten PD. Retrieval and utilization of drug interaction information. *Am J Hosp Pharm*. 1970;27(6):468–472.
4. American College of Clinical Pharmacy. The definition of clinical pharmacy. *Pharmacotherapy*. 2008;28(6):816–817.
5. Nebeker JR, Hoffman JM, Weir CR, Bennett CL, Hurdle JF. High rates of adverse drug events in a highly computerized hospital. *Arch Intern Med*. 2005;165(10):1111–1116.
6. Scarsi KK, Fotis MA, Noskin GA. Pharmacist participation in medical rounds reduces medication errors. *Am J Health Syst Pharm*. 2002;59(21):2089–2092.
7. Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical pharmacists and inpatient medical care: a systematic review. *Arch Intern Med*. 2006;166(9):955–964.
8. Bond CA, Raehl CL. Clinical pharmacy services, pharmacy staffing, and hospital mortality rates. *Pharmacotherapy*. 2007;27(4):481–493.
9. Viktil KK, Blix HS. The impact of clinical pharmacists on drug-related problems and clinical outcomes. *Basic Clin Pharmacol Toxicol*. 2008;102(3):275–280.
10. Dasta JF, Jacob J. The critical care pharmacist: what you get is more than what you see. *Crit Care Med*. 1994;22(6):906–909.
11. Montazeri M, Cook DJ. Impact of a clinical pharmacist in a multidisciplinary intensive care unit. *Crit Care Med*. 1994;22(6):1044–1048.
12. Nelson SD, LaFleur J, Del Fiol G, Evans RS, Weir CR. Reading and writing: qualitative analysis of pharmacists' use of the EHR when preparing for team rounds. *AMIA Annu Symp Proc*. 2015;2015:943–952.
13. Fox BI. Health information technology: are we aware and engaged? *Am J Pharm Educ*. *2013*;77(6):113.
14. Spiro R. The impact of electronic health records on pharmacy practice. *Drug Topics*. 2012, 156(4):46.
15. Pedersen CA, Gumpper KF. ASHP national survey on informatics: assessment of the adoption and use of pharmacy informatics in U.S. hospitals—2007. *Am J Health Syst Pharm*. 2008;65(23):2244–2264.
16. Pedersen CA, Schneider PJ, Scheckelhoff DJ. ASHP national survey of pharmacy practice in hospital settings: dispensing and administration—2011. *Am J Health Syst Pharm*. 2012;69(9):768–785.
17. Pedersen CA, Schneider PJ, Scheckelhoff DJ. ASHP national survey of pharmacy practice in hospital settings: Prescribing and transcribing—2013. *Am J Health SystPharm*. 2014;71(11):924–942.
18. Flynn AJ, Haines S. Pharmacists' requirement for continuity of the clinical narrative in the electronic medical record. *Am J Health Syst Pharm*. 2012;69(12):1027–1029.
19. Pullinger W, Franklin BD. Pharmacists' documentation in patients' hospital health records: issues and educational implications. *Int J Pharm Pract*. 2010;18(2):108–115.
20. Abdel-Qader DH, Cantrill JA, Tully MP. Validating reasons for medication discontinuation in electronic patient records at hospital discharge. *J Eval Clin Practice*. 2011;17(6):1160–1166.
21. Bourne RS, Choo CL. Pharmacist proactive medication recommendations using electronic documentation in a UK general critical care unit. *Int J Clin Pharm*. 2012;34(2):351–357.
22. Brown MA, Bloodworth L, Ross LA. Health information technology use in a rural clinic: the pharmacist's perspective. *J Health Care Poor Underserved*. 2013;24(1 Suppl):15–19.
23. Burgin A, O'Rourke R, Tully MP. Learning to work with electronic patient records and prescription charts: experiences and perceptions of hospital pharmacists. *Res Soc Administrative Pharm* 2014;10(5):741–755.
24. Burrell C, Tsourounis C, Quan D, *et al*. Impact of a pharmacist-driven protocol to improve drug allergy documentation at a university hospital. *Hosp Pharm*. 2013;48(4):302–307.
25. Calloway S, Akilo HA, Bierman K. Impact of a clinical decision support system on pharmacy clinical interventions, documentation efforts, and costs. *Hosp Pharm*. 2013;48(9):744–752.
26. Conway JM, Ahmed GF. A pharmacotherapy capstone course to advance pharmacy students' clinical documentation skills. *Am J Pharm Educ*. 2012;76(7):134.

27. Fox BI, Andrus M, Hester EK, Byrd DC. Selecting a clinical intervention documentation system for an academic setting. *Am J Pharm Educ*. 2011;75(2):37
28. Hughes CM, Hawwa AF, Scullin C, *et al*. Provision of pharmaceutical care by community pharmacists: a comparison across Europe. *Pharm World Sci*. 2010;32(4):472–487.
29. Nurgat ZA, Al-Jazairi AS, Abu-Shraie N, Al-Jedai A. Documenting clinical pharmacist intervention before and after the introduction of a web-based tool. *Int J Clin Pharm*. 2011;33(2):200–207.
30. Rector KB, Veverka A, Evans SK. Improving pharmacist documentation of clinical interventions through focused education. *Am J Health Syst Pharm*. 2014;71(15):1303–1310.
31. Skentzos S, Shubina M, Plutzky J, Turchin A. Structured vs. unstructured: factors affecting adverse drug reaction documentation in an EMR repository. *AMIA Annual Symposium proceedings / AMIA Symposium. AMIA Symposium*. 2011;2011:1270–1279.
32. Williams M, Peterson GM, Tenni PC, Bindoff IK, Stafford AC. DOCUMENT: a system for classifying drug-related problems in community pharmacy. *Int J Clin Pharm*. 2012;34(1):43–52.
33. Yusuff KB, Tayo F, Aina BA. Pharmacists' participation in the documentation of medication history in a developing setting: an exploratory assessment with new criteria. *Pharm Practice*. 2010;8(2):139–145.
34. Downard S, Galt KA, Reel AB. Pharmacists' use of electronic health records: silent leaders no more. *J Am Pharm Assoc*. 2007;47(6):680.
35. Vogelsmeier A, Pepper GA, Oderda L, Weir C. Medication reconciliation: A qualitative analysis of clinicians' perceptions. *Res Social Adm Pharm*. 2013;9(4):419–430.
36. Stewart AL, Lynch KJ. Identifying discrepancies in electronic medical records through pharmacist medication reconciliation. *J Am Pharm Assoc*. 2012;52(1):59–66.
37. Johnson CM, Marcy TR, Harrison DL, *et al*. Medication reconciliation in a community pharmacy setting. *J Am Pharm Assoc*. 2010;50(4):523–526.
38. Amann S, Kantelhardt P. [Medication errors and medication reconciliation from a hospital pharmacist's perspective]. *Zeitschrift fur Evidenz, Fortbildung und Qualitat im Gesundheitswesen*. 2012;106(10):717–722.
39. Andrus MR. Student pharmacist initiated medication reconciliation in the outpatient setting. *Pharm Pract*. 2012;10(2):78–82.
40. Armor BL, Bulkley CF, Truong T, Carter SM. Assessing student pharmacists' ability to identify drug-related problems in patients within a patient-centered medical home. *Am J Pharm Educ*. 2014;78(1):6.
41. Armor BL, Wight AJ, Carter SM. Evaluation of adverse drug events and medication discrepancies in transitions of care between hospital discharge and primary care follow-up. *J Pharm Pract*. 2014.
42. Bassi J, Lau F, Bardal S. Use of information technology in medication reconciliation: a scoping review. *Ann Pharmacother*. 2010;44(5):885–897.
43. Bjeldbak-Olesen M, Danielsen AG, Tomsen DV, Jakobsen TJ. Medication reconciliation is a prerequisite for obtaining a valid medication review. *Danish Med J*. 2013;60(4):A4605.
44. Dersch-Mills D, Hugel K, Nystrom M. Completeness of information sources used to prepare best possible medication histories for pediatric patients. *Canadian J Hosp Pharm*. 2011;64(1):10–15.
45. Ekedahl A, Brosius H, Jonsson J, Karlsson H, Yngvesson M. Discrepancies between the electronic medical record, the prescriptions in the Swedish national prescription repository and the current medication reported by patients. *Pharmacoepidemiol Drug Safety*. 2011;20(11):1177–1183.
46. Green CF, Burgul K, Armstrong DJ. A study of the use of medicine lists in medicines reconciliation: please remember this, a list is just a list. *Int J Pharm Pract*. 2010;18(2):116–121.
47. Halapy H, Kertland H. Ascertaining problems with medication histories. *Canadian J Hosp Pharm*. 2012;65(5):360–367.
48. Lee A, Varma A, Boro M, Korman N. Value of pharmacist medication interviews on optimizing the electronic medication reconciliation process. *Hosp Pharm*. 2014;49(6):530–538.
49. Mergenhagen KA, Blum SS, Kugler A, *et al*. Pharmacist- versus physician-initiated admission medication reconciliation: impact on adverse drug events. *Am J Geriatr Pharmacother*. 2012;10(4):242–250.
50. Page D. Medication reconciliation only as good as the IT allows. *Hosp Health Networks/AHA*. 2011;85(3):48, 50.
51. Provine AD, Simmons EM, Bhagat PH. Establishment and evaluation of pharmacist-managed admission medication history and reconciliation process for pediatric patients. *J Pediatr Pharmacol Ther*. 2014;19(2):98–102.
52. Stewart AL, Lynch KJ. Medication discrepancies despite pharmacist led medication reconciliation: the challenges of maintaining an accurate medication list in primary care. *Pharm Pract*. 2014;12(1):360.
53. Vawdrey DK, Chang N, Compton A, Tiase V, Hripcsak G. Impact of electronic medication reconciliation at hospital admission on clinician workflow. *AMIA Annual Symposium Proceedings/AMIA Symposium. AMIA Symposium*. 2010;2010:822–826.
54. The Roadmap for Pharmacy Health Information Technology Integration in U.S. *Health Care*. Alexandria, VA: Pharmacy e- Health Information Technology Collaborative; 2011.
55. Towards better reporting of adverse drug reactions. *Prescrire Int*. 2012;21(127):128–129.
56. Barnes KD, Tayal NH, Lehman AM, Beatty SJ. Pharmacist-driven renal medication dosing intervention in a primary care patient-centered medical home. *Pharmacotherapy*. 2014;34(12):1330–1335.
57. Emmendorfer T, Glassman PA, Moore V, *et al*. Monitoring adverse drug reactions across a nationwide health care system using information technology. *Am J Health Syst Pharm*. 2012;69(4):321–328.
58. Fiss T, Ritter CA, Alte D, van den Berg N, Hoffmann W. Detection of drug related problems in an interdisciplinary health care model for rural areas in Germany. *Pharm World Sci*. 2010;32(5):566–574.
59. Frenzel JE. Using electronic medical records to teach patient-centered care. *Am J Pharmaceutical Educ*. 2010;74(4):71
60. Jackson AN, Kogut S. Use of electronic personal health records to identify patients at risk for aspirin-induced gastrointestinal bleeding. *Consultant Pharmacist*. 2013;28(5):313–318.
61. Roten I, Marty S, Beney J. Electronic screening of medical records to detect inpatients at risk of drug-related problems. *Pharm World Sci*. 2010;32(1):103–107.
62. Salvo M, Nigro SC, Ward D. Pharmacist-generated electronic consults to improve hypertension management in a multisite health centre: pilot study. *Inform Prim Care*. 2012;20(3):181–184.
63. Spyropoulos AC, Viscusi A, Singhal N, *et al*. Features of electronic health records necessary for the delivery of optimized anticoagulant therapy: consensus of the EHR task force of the New York State Anticoagulation Coalition. *Ann Pharmacother*. 2015;49(1):113–124.
64. van der Linden CM, Jansen PA, van Marum RJ, *et al*. An electronic system to document reasons for medication discontinuation and to flag unwanted represcriptions in geriatric patients. *Drugs Aging*. 2012;29(12):957–962.
65. Pawloski P, Cusick D, Amborn L. Development of clinical pharmacy productivity metrics. *Am J Health Syst Pharm*. 2012;69(1):49–54.
66. Hope CJ, Garvin JH, Sauer BC. Information extraction from narrative data. *Am J Health Syst Pharm*. 2012;69(6):455, 60–61.
67. High-tech approach to medication reconciliation saves time, bolsters safety at hospital in northern Virginia. ED management: the monthly update on emergency department management. 2011;23(10):117–119.
68. Tamblyn R, Poissant L, Huang A, *et al*. Estimating the information gap between emergency department records of community medication compared to on-line access to the community-based pharmacy records. *J Am Med Inform Assoc*. 2014;21(3):391–398.
69. Calabretto J-P, Warren J, Bird L. Pharmacy decision support: where is it? A systematic literature review. *Int J Pharm Pract*. 2005;13(3):157–163.
70. Curtain C, Peterson GM. Review of computerized clinical decision support in community pharmacy. *J Clin Pharm Ther*. 2014;39(4):343–348.
71. Robertson J, Walkom E, Pearson SA, *et al*. The impact of pharmacy computerised clinical decision support on prescribing, clinical and patient outcomes: a systematic review of the literature. *Int J Pharm Pract*. 2010;18(2):69–87.
72. Shebl NA, Franklin BD, Barber N. Clinical decision support systems and antibiotic use. *Pharm World Sci*. 2007;29(4):342–349.

73. Allen AS, Sequist TD. Pharmacy dispensing of electronically discontinued medications. *Ann Int Med*. 2012;157(10):700–705.
74. Urban R, Paloumpi E, Rana N, Morgan J. Communicating medication changes to community pharmacy post-discharge: the good, the bad, and the improvements. *Int J Clin Pharm*. 2013;35(5):813–820.
75. Mooranian A, Emmerton L, Hattingh L. The introduction of the national e-health record into Australian community pharmacy practice: pharmacists' perceptions. *Int J Pharm Pract*. 2013;21(6):405–412.
76. Hughes CA, Guirguis LM, Wong T, *et al*. Influence of pharmacy practice on community pharmacists' integration of medication and lab value information from electronic health records. *J Am Pharm Assoc*. 2011;51(5):591–598.
77. Xu X, Rocha RA, Bigelow SM, *et al*. Understanding nurses' information needs and searching behaviour in acute care settings. *AMIA Annu Symp Proc*. 2005:839–843 PMID: 16779158.
78. Brown PJ, Marquard JL, Amster B, *et al*. What Do Physicians Read (and Ignore) in Electronic Progress Notes? *Appl Clin Inform*. *2014*;5(2):430–444.
79. Zheng K, Padman R, Johnson MP, Diamond HS. An interface-driven analysis of user interactions with an electronic health records system. *J Am Med Inform Assoc*. 2009;16(2):228–237.
80. Creswick N, Westbrook JI. Social network analysis of medication advice-seeking interactions among staff in an Australian hospital. *Int J Med Inform*. 2010;79(6):e116–e125.
81. Hersh WR, Gorman PN, Biagioli FE, *et al*. Beyond information retrieval and electronic health record use: competencies in clinical informatics for medical education. *Adv Med Educ Pract*. 2014;5:205–212.
82. Friedman CP. What informatics is and isn't. *J Am Med Inform Assoc*. 2013;20(2): 224–226.
83. Flynn AJ. The current state of pharmacy informatics education in professional programs at US colleges of pharmacy. *Am J Pharm Educ*. 2005;69(4):490–494.
84. Fox BI, Flynn AJ, Fortier CR, Clauson KA. Knowledge, skills, and resources for pharmacy informatics education. *Am J Pharm Educ*. 2011;75(5):93.
85. Stead WW, Lin HS. *National Research Council. Computational Technology for Effective Health Care: Immediate Steps and Strategic Directions*. Washington, DC: The National Academies Press, 2009. doi:10.17226/12572.
86. Falconer N, Nand S, Liow D, Jackson A, Seddon M. Development of an electronic patient prioritization tool for clinical pharmacist interventions. *Am J Health Syst Pharm*. 2014;71(4):311–320.
87. Hough A, Vartan CM, Groppi JA, Reyes S, Beckey NP. Evaluation of clinical pharmacy interventions in a Veterans Affairs medical center primary care clinic. *Am J Health Syst Pharm* 2013;70(13):1168–1172.
88. Troiano D, Jones MA, Smith AH, *et al*. The need for collaborative engagement in creating clinical decision-support alerts. *Am J Health Syst Pharm*. 2013;70(2):150–153.
89. Kannampallil TG, Franklin A, Mishra R, *et al*. Understanding the nature of information seeking behavior in critical care: implications for the design of health information technology. *Artif Intell Med*. 2013;57(1): 21–29.
90. Webster L, Spiro RF. Health information technology: a new world for pharmacy. *J Am Pharm Assoc*. 2010;50(2):e20–e31, quiz e32-e34.
91. Hatfield MD, Cox R, Mhatre SK, Flowers WP, Sansgiry SS. Impact of computerized provider order entry on pharmacist productivity. *Hosp Pharm*. 2014;49(5):458–465.
92. Abramson EL, Barron Y, Quaresimo J, Kaushal R. Electronic prescribing within an electronic health record reduces ambulatory prescribing errors. *Jt Comm J Qual Patient Saf*. 2011;37(10):470–478
93. Turchin A, Shubina M, Goldberg S. Unexpected effects of unintended consequences: EMR prescription discrepancies and hemorrhage in patients on warfarin. *AMIA Annu Symp Proc*. 2011;2011: 1412–1417.
94. Gandhi TK, Weingart SN, Seger AC, *et al*. Outpatient prescribing errors and the impact of computerized prescribing. *J General Int Med*. 2005;20(9):837–841.
95. Palchuk MB, Fang EA, Cygielnik JM, *et al*. An unintended consequence of electronic prescriptions: prevalence and impact of internal discrepancies. *J Am Med Inform Assoc*. 2010;17(4):472–476.
96. Singh H, Mani S, Espadas D, *et al*. Prescription errors and outcomes related to inconsistent information transmitted through computerized order entry: a prospective study. *Arch Intern Med*. 2009;169(10): 982–989.
97. Carling CL, Kirkehei I, Dalsbo TK, Paulsen E. Risks to patient safety associated with implementation of electronic applications for medication management in ambulatory care—a systematic review. *BMC Med Inform Decis Mak*. 2013;13:133.
98. Traynor K. Privileging expands pharmacists' role. *Am J Health Syst Pharm*. 2014;71(9):686–687.
99. Abramowitz PW, Shane R, Daigle LA, Noonan KA, Letendre DE. Pharmacist interdependent prescribing: a new model for optimizing patient outcomes. *Am J Health Syst Pharm*. 2012;69(22):1976–1981.
100. Hutchison M, Lindblad A, Guirguis L, Cooney D, Rodway M. Survey of Alberta hospital pharmacists' perspectives on additional prescribing authorization. *Am J Health Syst Pharm*. 2012;69(22):1983–1992.
101. Victor RG. Expanding pharmacists' role in the era of health care reform. *Am J Health Syst Pharm* 2012;69(22):1959.
102. Owusu-Obeng A, Weitzel KW, Hatton RC, *et al*. Emerging roles for pharmacists in clinical implementation of pharmacogenomics. *Pharmacotherapy*. 2014;34(10):1102–1112.
103. Hagland M. Is there a pharmacist house? When it comes to clinical IT implementations, healthcare IT leaders are turning to the 'third discipline' for leadership and involvement in clinical informatics. *Healthc Inform*. 2010;27(12):18, 20, 22, passim.