Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

■ *Original Article*

Diabetes care quality indicators improve upon conversion to electronic health records

B Devkota, B Reichart, E Armbrecht, J Smith
Saint Louis University, USA

Abstract

Introduction: Electronic medical record (EMR) systems have been touted to improve quality and reduce cost of health care delivery. **Objectives:** To find out whether electronic health record is better than the paper medical records in recording the quality metrics for management of diabetes. **Methods**: We tested purported benefits in an academic primary care setting with a pilot of 50 randomly selected subjects with Type 2 diabetes with under continuous care by internists before and after EMR implementation. In comparison to the paper chart period, EMR was associated with better outcomes for glycated hemoglobin (A1C), blood pressure (BP), and smoking cessation counseling documentation using a paired analysis technique. **Results**: Goal BP (130/80) was achieved for 65% of patients during the paper chart period versus 88% in the EMR period (p = 0.007); mean A1c was 7.60 in the paper chart period versus 7.24 in EMR (p = 0.004); smoking cessation documentation rose from 30% to 84% (p < 0.001) between the paper chart and EMR periods, respectively. Change in mean LDL was not statistically significant (p = 0.636) between the two periods. **Conclusion:** This pilot study provides a favorable indication that EMR implementation contributes to clinical quality improvement and it also illustrates a feasible applied research method that can be employed by many provider organizations who are called up to conduct continuous quality improvement projects for diabetes care.

Keywords: diabetes, electronic health records

Introduction

The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030(1). Approximately 10% of Americans over the age of twenty have diabetes, accounting for 23.5 million people.[2] Those over the age of 60 have a high prevalence of diabetes, with approximately 25% of older adults (12.2 million people) with diabetes.[2]

There are two forms of diabetes, Type I and Type II. Type I is also called juvenile diabetes, as the onset occurs in childhood and adolescence. It accounts for about 5-10% of all diagnosed cases. It

occurs when the immune systems destroys the insulin producing beta cells in the pancreas causing a cessation of insulin production. Type II also called adult onset diabetes mellitus is the most common form of diabetes accounting for 90-95% of diagnosed cases. It occurs when the body does not recognize and use the produced insulin properly (insulin resistance). Eventually, beta cells of pancreas will burn out and stop producing insulin altogether. There are many adverse long term effects for people with diabetes including heart disease, stroke, high blood pressure, blindness, kidney disease, and amputation of lower limbs.[2] However, these serious health complications can be prevented or reduced by patient self-management in conjunction with support from their healthcare team, including doctors, nurses, and dietitians.[2]

Address for correspondence
Dr Bishnu Devkota MD, MHI, FRCS, FACP
Assistant Professor
Saint Louis University, USA
Email: bdevkota@slu.edu

Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

Diabetes is a chronic generally incurable disease which requires active participation of the patient and active support of the clinician. Diabetic patients have multiple co-morbidities that increase their risk of mortality. Various organizations have put forth criteria for optimal control of diabetes. In order to improve morbidity and mortality in diabetics there are additional metrics from the standpoint of comorbid conditions e .g. high blood pressure, increased cholesterol etc. These metrics will be taken in the context of optimal diabetic control will be compared in this study. These metrics are: Blood pressure goal less than 130/80 mm Hg. LDL cholesterol less than 100 mg/dl, annual urine microalbumin testing, annual diabetic eye examination and attainment of glycated hemoglobin less 7%, clinical examination of feet at each visit.

Multiple studies now demonstrate that computer-based decision support can improve physicians' performance and, in some instances, patient outcomes.[3-6] Is electronic health record better than the paper medical records in recording the quality metrics for management of diabetes? This is exactly what we are trying to find out from this study.

Optimal control of diabetes is essential to prevent cardiovascular or other complications of diabetes. American Diabetes Association and American College of Endocrinology has put out guidelines for good control of diabetes. Various diabetes quality indicators have been already described in the section of introduction.

Considering only a point-in-time controlled BP measurement provides an incomplete view of the quality of BP management in patients with hypertension or diabetes over a period of time.[7] Therefore, we are attempting to get the quality indicators over a four year period; 2 years in paper chart and 2 years in electronic chart. McKay et al concluded that greater attention should be focused on methods to sustain involvement with Internet-based intervention health promotion programs over time.[8] Analyzing the NHS data from the UK by Oluwatowoju et al found out that since the introduction of performance indicators for primary care and the incorporation of pay for performance in 2004, there has been marked improvement in the management of hyperglycemia and hypercholesterolemia among people with diabetes with data available in 2006 and 2008. However,

another newly introduced performance metric glyco-hemoglobin in 2009 with a target value < 7.0% will result in a further improvement in glycemic control awaits further study.[9] Addressing common psychosocial problems prevalent in diabetics may improve diabetes outcomes, but providers often lack critical resources for doing so, particularly skill, time and adequate referral sources.[10] A pilot multifaceted quality improvement intervention program for patients with diabetes and hypertension implemented in primary care set up in Cyprus showed promising results.[11]

Complete evaluations to validate strategies for extracting data from electronic databases are necessary before assuming that measures of quality of care will be the same regardless of the source of data.[12] Demonstrated major benefits on quality were found to be increased adherence to guideline-based care, enhanced surveillance and monitoring, and decreased medication errors; certainly the primary domain of improvement was preventive health.[13] Current public reports of physician quality of care, have significant limitations from both consumer and provider standpoints. New information sources for consumers challenges the presenting approach to reporting, and consumer and provider demands for more current information.[14]

New development of standardized quality measures should change from claims-based measures to clinical measures derived from an HER.[15] Tang et al noted that physicians who used a computer based patient record produced more complete documentation and documented more appropriate clinical decisions, as judged by an expert review panel.[16]

Solberg et al found out that using claim data for diabetes, heart diseases and newly treated depression produced unacceptably low positive predictive value of 0.20, 0.60 and 0.65 respectively with one ICD 9 code per year. However using more than one code for these conditions including medication data produced more robust positive predictive value of 0.97, 0.95 and 0.95 respectively and therefore, they conclude that for those wanting to use administrative data for case identification for performance measurement or quality improvement this approach is necessary.[17] Henderson et al's study found little evidence to support the claim that computerization of general practice in Australia has improved the quality of care provided to patients. They further

Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

claim that decision on 'best quality' is subjective; although literature and guidelines provide clear parameters for many measures, others are difficult to judge.[18]

Hebert' group found that to construct a method that is adequately sensitive (> or = 70%), highly specific (> or = 97.5%), and reliable (kappa > or = 0.80), researchers must combine information from different types of Medicare claims files, use 2 years of data to identify cases, and require at least 2 diagnoses of diabetes among claims involving ambulatory care.[19] Consistency of implementation, maintenance of results, and generalization of effects is required to translate research findings into practice. The basic D-Net intervention was implemented well and improvements were observed across a variety of patients, interventionists, and clinics.[20] In their diabetes education approach using internet Glasgow et al recognized difficulties in maintaining usage over time and additions of tailored self-management and peer support components generally did not significantly improve results.[20-21]

Methods

After the IRB approval for the project, data analyst assisted the researchers to find out the list of fifty diabetic patients seen at the general internal medicine division between August 2006 to July 2010 from IDX.[22] (It is a revenue cycle management system for medium to large physician groups, hospitals, and integrated delivery networks, and includes scheduling, billing and collections modules. It is written in the MUMPS programming language and runs on Inter Systems Caché. Patient scheduling and billing of this institution is done through IDX). Paper charts of these patients were used by the researchers to extract the data for diabetic quality indicators: A1C, LDL, blood pressure recorded, optimal blood pressure (i.e., <130/80), tobacco cessation counseling, eye exam, foot exam and microalbumin. A paired t-test was employed to assess differences in A1C and LDL values for the same patients across the two periods (paper chart vs. EMR). For the other quality indicators which had binary outcomes (e.g., eye exam vs. no eye exam), chi-square was used to compare the two periods. Cases with missing data for A1C or LDL were excluded from the analysis using these indicators. Failure of the provider to document any of the other quality indicators was classified accordingly; therefore, there were no missing values for the binary outcome quality indicators: blood pressure recorded, tobacco cessation counseling, eye exam, foot exam and microalbumin.

Table 1. Subject Demographics (n = 50)			
Gender		n	%
	Female	30	60%
	Male	20	40%
Age			
	45-54 yo	14	28%
	55-64 yo	19	38%
	65-74 yo	9	18%
	75+ yo	8	16%

Figure 1. Documentation of Care Quality Indicators During during Two-Year Intervals of Paper Chart and Electronic Medical Record Use
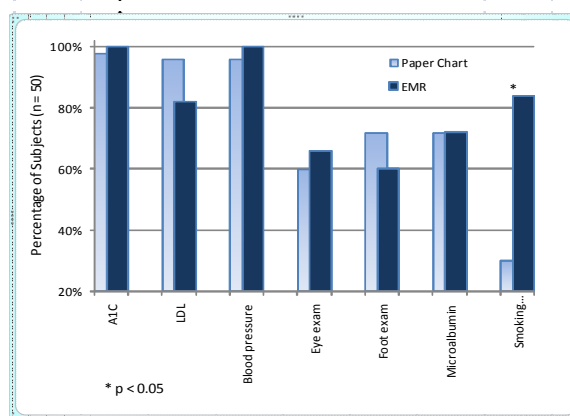
Table 2: A1C, LDL, and blood pressure measures during two-year intervals of paper chart and electronic medical record use

Quality Indicator	Evaluable Subjects (n)	Paper Chart		EMR		p-value
A1C: $\leq$ 7.0%	49	41%	(20/49)	57%	(28/49)	0.022
LDL: < 100	40	78%	(31/40)	85%	(34/40)	0.375
Blood Pressure: $\leq$ 130/80	48	67%	(32/48)	85%	(41/48)	0.007

A composite measure for metabolic control was created based on blood pressure, HbA1C and LDL values. Subjects were scored according to having met 0, 1, 2 or 3 of the guideline-based target for each, 130/80, 7.0% and <100, respectively.

Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

Figure 2: Percentage of patients with three key care management measures at goal (A1C, LDL, Blood Pressure) during two-year intervals of paper chart and electronic medical record use
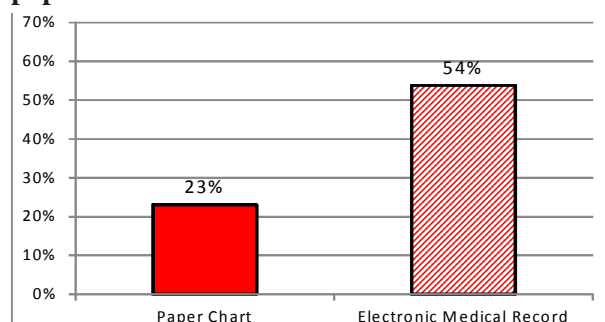
Statistical analysis

Sample statistics was calculated using SPSS 17. Chart documentation and quality improvement for different metrics of diabetic quality measures were taken into consideration to compare paper chart with electronic medical records.

Results

Our results showed that documentation for HbA1C was 98% in paper chart versus 100 % in EMR. Mean HbA1c level was 7.6 in paper chart versus 7.24 in EMR. P value was 0.007, which was statistically significant. LDL documentation was 96% in paper versus 82% in EMR. Mean LDL was 81.5 in paper chart versus 80.5 in EMR. P value was 0.636 which was not statistically significant. Goal LDL was achieved in 73% of sample in paper chart and 85% in EMR again p value was 0.375, which was not statistically significant.

Documentation of BP was 96% in paper versus 100% in EMR. Goal BP was achieved in 65% in paper record versus 88% in EMR with a p value of 0.007 (statistically significant).

Documentation of smoking was 84% EMR but 30% paper with a p value of 0.000 (highly statistically significant). Eye exam was 66% in EMR versus 60% in paper with a p value of 0.629; for urine micro-albumin documentation 72% on both paper and EMR. For feet exam documentation was 60% in EMR versus 72% in paper with a p value of 0.263 which was not statistically significant.

Discussion

The Institute of Medicine (IOM) and Purchaser Coalitions confirm that the use of health information technology in medical practice has grown steadily in the US and is buttressed by considerable state and federal government support. Studies have found that health information technology can improve the quality and efficiency of care delivery through better decision support.[6,23] Some of these benefits included avoidance of medication errors, greater adherence to health maintenance guidelines and reduction in cost of care.[23-25] Adherence to health maintenance guidelines in chronic disease management is very labor intensive and cumbersome if done manually. These guidelines can be automated in the electronic medical records and either sent to the providers as "for your information" (FYIs) or best practice alerts. Perhaps, very important measures that must not be missed, there should be a hard stop so that providers cannot ignore that measure.

This study of comparison of fifty medical records in the paper world with electronic medical records does show that there is significant improvement in the documentation of the important quality metrics for the management of one of the chronic disease e.g. diabetes. It also showed there is improvement in the quality for most of the metrics. For one of measures e.g. LDL, EMR was inferior to paper chart although it was not statistically significant. This is perhaps due to resistance to change of providers' behavior. There was no hard stop forcing the provider in this regard in the EMR. For smoking status documentation EMR was very superior to paper record which may be the automatic pulling of the content from the data base by the use of smart phrase. This should be investigated by the future studies. Recently, smoking status has been introduced as one of best practice alert (BPA) of our primary care practices and therefore, there is a hard stop for the provider to not only to document but also take action there.

Electronic Health Records are helpful to solve some of the problems facing US Health system in the twenty first century. In 2004, then President George W. Bush proposed that electronic health records should be widespread by 2014. This vision was strengthened when President Obama earmarked 19.2 billion dollars to health information technology infrastructure in the stimulus package.[26] Certainly, this will help fund the initial implementation of EMR in the small and perhaps rural physicians' practices which do not have adequate financial and technical resources.

Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

EHRs are not without peril. Without proper implementation, training, and system monitoring EHRs can lead to increased medication order errors and increased physician time investment.[27-32] Automation must help decrease the time investment for patient care otherwise physicians and other midlevel providers may not realize the full benefit of the product they are supposed to espouse. Additionally, it will create negative impact in the mindset of the supportive and early adopters of change from paper to electronic medical records. Change management is very important in implementation of electronic medical records. There must be a buy-in from the provider community and also the technology should continue to improve to provide better product in terms of quality management of the different difficult to manage disease processes by automation and active cooperation between IT and provider community. Software upgrades must not be expensive, otherwise small practices will not be able to afford to buy upgrade the system. Our LDL documentation in EMR was inferior to paper records. This is due to the fact that all providers did not click the health management screen which would have reminded them to order and document the cholesterol level for the diabetes management with every visit. Main limitation of our study was small sample size. This was done in a sample of fifty patients of one division of academic medical practice. These findings may not be generalizable.

Conclusion

Electronic medical records improve documentation of different quality metrics for the management of chronic diseases for example diabetes and hypertension. They also help improve quality of these metrics. The study showed improvement not only of documentation but also of quality for some measures. Whether a hard stop in the EMR for documentation of quality metrics improves their documentation across the enterprise should be answered by future studies. Additionally, future studies should look into the satisfaction of the end users in this regard. They should also explore whether it improves the overall quality of care of chronic illnesses like diabetes and hypertension in the community.

References

1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care. 2004 May;27(5):1047-53.

2. National diabetes fact sheet: General information and national estimates on diabetes in the United States, 2007. 2008 ed. Atlanta: Centers for Disease Control and Prevention; 2008.

3. Bates DW, Gawande AA. Improving safety with information technology. N Engl J Med. 2003 Jun 19;348(25):2526-34.

4. Johnston ME, Langton KB, Haynes RB, Mathieu A. Effects of computer-based clinical decision support systems on clinician performance and patient outcome. A critical appraisal of research. Ann Intern Med. 1994 Jan 15;120(2):135-42.

5. Raschke RA, Gollihare B, Wunderlich TA, Guidry JR, Leibowitz AI, Peirce JC, et al. A computer alert system to prevent injury from adverse drug events: development and evaluation in a community teaching hospital. JAMA. 1998 Oct 21;280(15):1317-20.

6. Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. JAMA. 1998 Oct 21;280(15):1339-46.

7. Mabotuwana T, Warren J, Elley CR, Kennelly J, Paton C, Warren D, et al. Use of interval based quality indicators in blood pressure management to enhance quality of pay for performance incentives: comparison to two indicators from the Quality and Outcomes Framework. Qual Prim Care. 2010;18(2):93-101.

8. McKay HG, King D, Eakin EG, Seeley JR, Glasgow RE. The diabetes network internet-based physical activity intervention: a randomized pilot study. Diabetes Care. 2001 Aug;24(8):1328-34.

9. Oluwatowoju I, Abu E, Wild SH, Byrne CD. Improvements in glycaemic control and cholesterol concentrations associated with the Quality and Outcomes Framework: a regional 2-year audit of diabetes care in the UK. Diabet Med. 2010 Mar;27(3):354-9.

10. Peyrot M, Rubin RR, Lauritzen T, Snoek FJ, Matthews DR, Skovlund SE. Psychosocial problems and barriers to improved diabetes management: results of the Cross-National Diabetes Attitudes, Wishes and Needs (DAWN) Study. Diabet Med. 2005 Oct;22(10):1379-85.

11. Samoutis GA, Soteriades ES, Stoffers HE, Philalithis A, Delicha EM, Lionis C. A pilot quality

Devkota B et al
Health Renaissance 2013; Vol. 11 No.1; 27-32
Diabetes care quality indicators & electronic health records

improvement intervention in patients with diabetes and hypertension in primary care settings of Cyprus. Fam Pract. 2010 Jun;27(3):263-70.

12. Benin AL, Vitkauskas G, Thornquist E, Shapiro ED, Concato J, Aslan M, et al. Validity of using an electronic medical record for assessing quality of care in an outpatient setting. Med Care. 2005 Jul;43(7):691-8.

13. Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Ann Intern Med. 2006 May 16;144(10):742-52.

14. Christianson JB, Volmar KM, Alexander J, Scanlon DP. A Report Card on Provider Report Cards: Current Status of the Health Care Transparency Movement. J Gen Intern Med. 2010 Jul 13.

15. Tang PC, Ralston M, Arrigotti MF, Qureshi L, Graham J. Comparison of methodologies for calculating quality measures based on administrative data versus clinical data from an electronic health record system: implications for performance measures. J Am Med Inform Assoc. 2007 Jan-Feb;14(1):10-5.

16. Tang PC, LaRosa MP, Gorden SM. Use of computer-based records, completeness of documentation, and appropriateness of documented clinical decisions. J Am Med Inform Assoc. 1999 May-Jun;6(3):245-51.

17. Solberg LI, Engebretson KI, Sperl-Hillen JM, Hroscikoski MC, O'Connor PJ. Are claims data accurate enough to identify patients for performance measures or quality improvement? The case of diabetes, heart disease, and depression. Am J Med Qual. 2006 Jul-Aug;21(4):238-45.

18. Henderson J, Miller G, Britt H, Pan Y. Effect of computerisation on Australian general practice: does it improve the quality of care? Qual Prim Care. 2010;18(1):33-47.

19. Hebert PL, Geiss LS, Tierney EF, Engelgau MM, Yawn BP, McBean AM. Identifying persons with diabetes using Medicare claims data. Am J Med Qual. 1999 Nov-Dec;14(6):270-7.

20. Glasgow RE, Boles SM, McKay HG, Feil EG, Barrera M, Jr. The D-Net diabetes self-management program: long-term implementation, outcomes, and generalization results. Prev Med. 2003 Apr;36(4):410-9.

21. Glasgow RE, Toobert DJ, Hampson SE, Strycker LA. Implementation, generalization and long-term results of the "choosing well" diabetes self-management intervention. Patient Educ Couns. 2002 Oct -Nov;48(2):115-22.

22. IDX system2009 [cited 2009 Nov 29,2009]: Available from: http://en.wikipedia.org/wiki/IDX_Systems.

23. Hsu J, Huang J, Fung V, Robertson N, Jimison H, Frankel R. Health information technology and physician-patient interactions: impact of computers on communication during outpatient primary care visits. J Am Med Inform Assoc. 2005 Jul-Aug;12(4):474-80.

24. Durieux P, Nizard R, Ravaud P, Mounier N, Lepage E. A clinical decision support system for prevention of venous thromboembolism: effect on physician behavior. JAMA. 2000 Jun 7;283(21):2816-21.

25. Evans RS, Pestotnik SL, Classen DC, Clemmer TP, Weaver LK, Orme JF, Jr., et al. A computer-assisted management program for antibiotics and other antiinfective agents. N Engl J Med. 1998 Jan 22;338(4):232-8.

26. Steinbrook R. Health care and the American Recovery and Reinvestment Act. N Engl J Med. 2009 Mar 12;360(11):1057-60.

27. Ash JS, Berg M, Coiera E. Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. J Am Med Inform Assoc. 2004 Mar-Apr;11(2):104-12.

28. Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N, et al. The impact of computerized physician order entry on medication error prevention. J Am Med Inform Assoc. 1999 Jul-Aug;6(4):313-21.

29. Berger RG, Kichak JP. Computerized physician order entry: helpful or harmful? J Am Med Inform Assoc. 2004 Mar-Apr;11(2):100-3.

30. Kilbridge P. Computer crash-lessons from a system failure. N Engl J Med. 2003 Mar 6;348(10):881-2.

31. McDonald CJ, Overhage JM, Mamlin BW, Dexter PD, Tierney WM. Physicians, information technology, and health care systems: a journey, not a destination. J Am Med Inform Assoc. 2004 Mar-Apr;11(2):121-4.

32. Rousseau N, McColl E, Newton J, Grimshaw J, Eccles M. Practice based, longitudinal, qualitative interview study of computerised evidence based guidelines in primary care. BMJ. 2003 Feb 8;326(7384):314.