Menu Case Study: Ambulatory Diabetes Care

Executive Summary

The MetroHealth System (MHS) is the primary care provider for over 10,000 adult patients with diabetes, which is one of the top ten adult diseases associated with morbidity and mortality in the US, and causes billions of dollars in annual healthcare costs. Over the last decade, MHS has deployed a number of electronic health record (EHR) features as part of its overall programs and strategies to improve the care of adult diabetic patients. EHR-based initiatives designed to improve the care of diabetic patients included:

- EHR report generated and standing order for pneumonia vaccines (for diabetic and non-diabetic patients) (2003)
- Standardized EHR reports of diabetic patients for each provider (beginning 2005; updated 2013)
- Diabetic patient clinical decision support (best practice alerts and health maintenance reminders) (initial 2005; revised 2007)
- Diabetic patient care plans (2010 by letter; 2012 by goals, barriers and interventions)
- Diabetic foot exam and eye exam discrete documentation tools (2011)
- Regular comparative reports showing how each provider compares to others on key diabetes performance measures (2009) and then tied to financial quality incentives (2011)
- Diabetes "Synopsis reports" (which summarizes diabetes care for a given patient) (2012)

Effectiveness measures were broken down in two groups – more care process/MD-centric measures (diabetic eye exam rates, pneumococcal vaccination rates, monitoring or treating kidney impairment with appropriate angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs), checking hemoglobin A1C (HbA1c) and control of cholesterol through LDL ≤100mg/dl or patient being on a statin cholesterol-lowing medication) and more outcome/patient-centric measures (achieving optimal glycemic control (HgA1C <7%), blood pressure <130/80 mmHg, body mass index <30 and not smoking).

Overall, over the ten year period, process and outcome composite measures improved over 30%, with outcomes composite measure improvement lagging several years behind process composite measure improvement. These changes in care caused an estimated 10% decrease in the costs of care for diabetic patients. As these EHR tools are very scalable across MHS and are applied across the population of over 10,000 diabetic patients, the cost savings is approximately $1 million per year.

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Local Problem

In the mid 2000s, the MHS identified diabetes as a major adult chronic disease that consumes significant resources and leads to significant patient morbidity and mortality. The MHS also recognized that significant value (quality/cost) improvement opportunities probably existed in the care for diabetic patients and that these value opportunities could probably be catalyzed be the EHR.

The challenge was to develop the people, processes and cultural changes needed to use the EHR in continuing processes to improve the value (increase the quality of care and/or decrease the cost of care) of care for diabetic patients.

Design and Implementation

Funded for the first two years (2005-2006) through an Agency for Health Research and Quality as the Diabetes Improvement Group-Intervention Trial initiative and then funded as a Robert Wood Johnson Foundation Regional Quality Improvement Collaborative (2007-2014) which has now become the Better Health Partnership (http://www.betterhealthpartnership.org/), the long-term effort to improve diabetes care brought together health services researchers, clinical informaticians, information services staff, statisticians, clinicians and support staff. These individuals have met in clinical and technical standing committees and various "ad hoc" work groups to design, build, test, train, implement and evaluate all of the measures and tools used to improve diabetes care.

These ad hoc working groups agreed the appropriate measures (care process and outcomes) for outpatient diabetic care. Once conceptual measures were agreed to, details of the specific EHR elements to define the measures were determined and regular data extraction, analysis and reporting occurred. This allowed the group to establish a baseline of adult diabetes measures and to track measures over time as various EHR tools were implemented.

In parallel to the diabetes measure development, teams began to identify potential EHR tool enabled work-flow changes that could improve diabetes care and outcomes. Over time, seven different tools have been implemented and revised to date. The tools implemented generally fall into three categories 1) decision support tools for evidence based best practice diabetes care, 2) documentation tools to document appropriate care and care plans, 3) reports (at the patient, provider and system level) to summarize diabetic care provided and eventually tied to financial incentives for providers.

How Health IT Was Utilized

Health IT was used in a number of ways to continuously support the care of diabetic patients throughout the MHS ambulatory clinics. The continued commitment to EHR based tools over the last decade has led to an average of one new tool per year.

Initial tools (2005) focused on best practice alerts (Figure 1), first without the ability to easily

order the evidence items recommended, and then next generation best practice alerts (2007) (Figure 2) which allow easy ordering of evidence items recommended.

Another early focus of EHR tools for diabetic care support for providers was provider level reports showing key characteristics for all of their diabetic patients in a single report (2005, revised 2013) (Figure 3 and Figure 4). Over time, additional reporting included comparative reports where a provider could compare their performance to peers (2009). Next, financial incentives were tied to comparing performance metrics (2011).

Additional EHR tools were built to capture structured data for diabetic care documentation (foot exams and eye exams) (2011).

Care plan tools were also built to clearly capture diabetic care plans. These tools allow diabetic care plans to be clearly identified and tracked over time, as well as communicated to patients (initial version 2011 and updated version 2013).

In 2012, the MHS also implemented Epic's synopsis tool for diabetes. This tool provides a longitudinal picture at a patient level of important metrics related to a patient's diabetes over time (Figure 5).

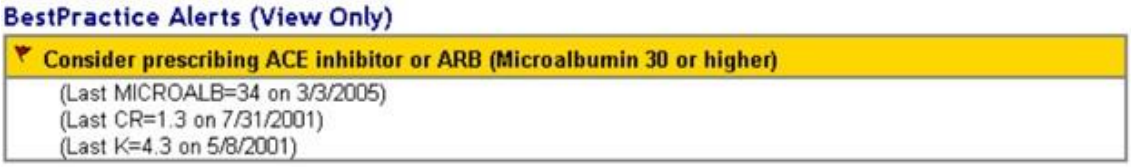


Figure 1 – Electronic health record screen shot of initial diabetes best practice advisory

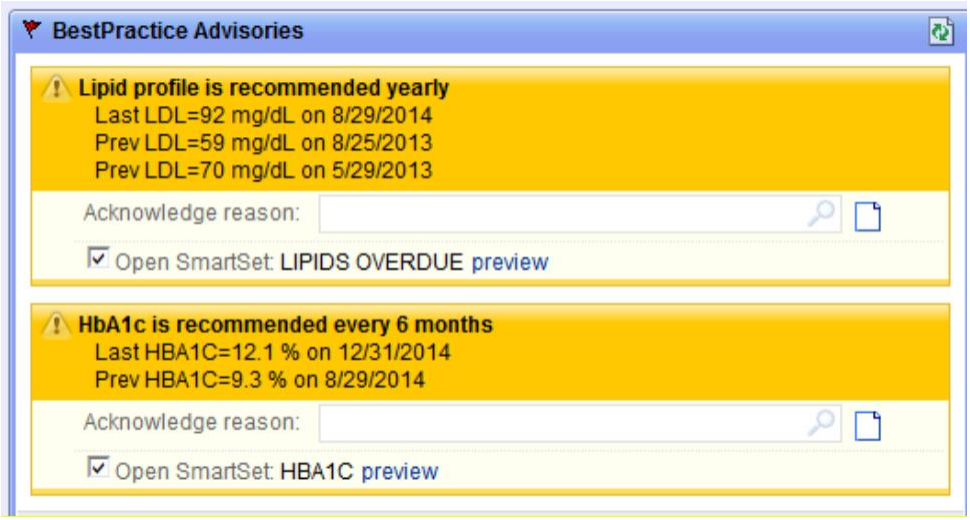
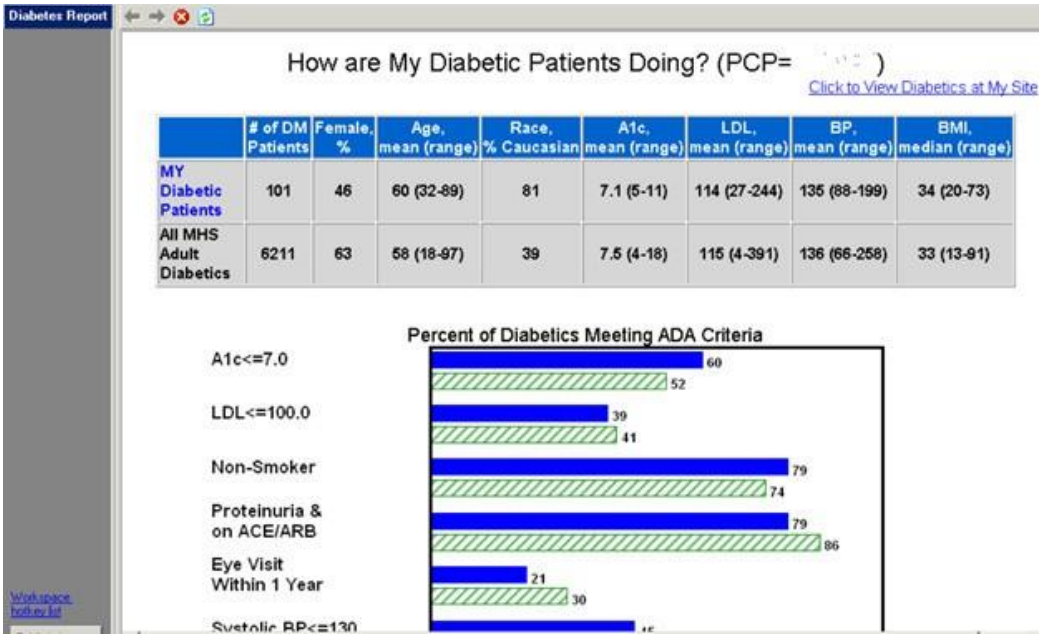


Figure 2 – Electronic health record screen shot of current diabetes best practice advisory



	# of DM Patients	Female, %	Age, mean (range)	Race, % Caucasian	A1c, mean (range)	LDL, mean (range)	BP, mean (range)	BMI, median (range)
MY Diabetic Patients	101	46	60 (32-89)	81	7.1 (5-11)	114 (27-244)	135 (88-199)	34 (20-73)
All MHS Adult Diabetics	6211	63	58 (18-97)	39	7.5 (4-18)	115 (4-391)	136 (66-258)	33 (13-91)

Figure 3 – Electronic health record screen shot of initial diabetes provider level population report

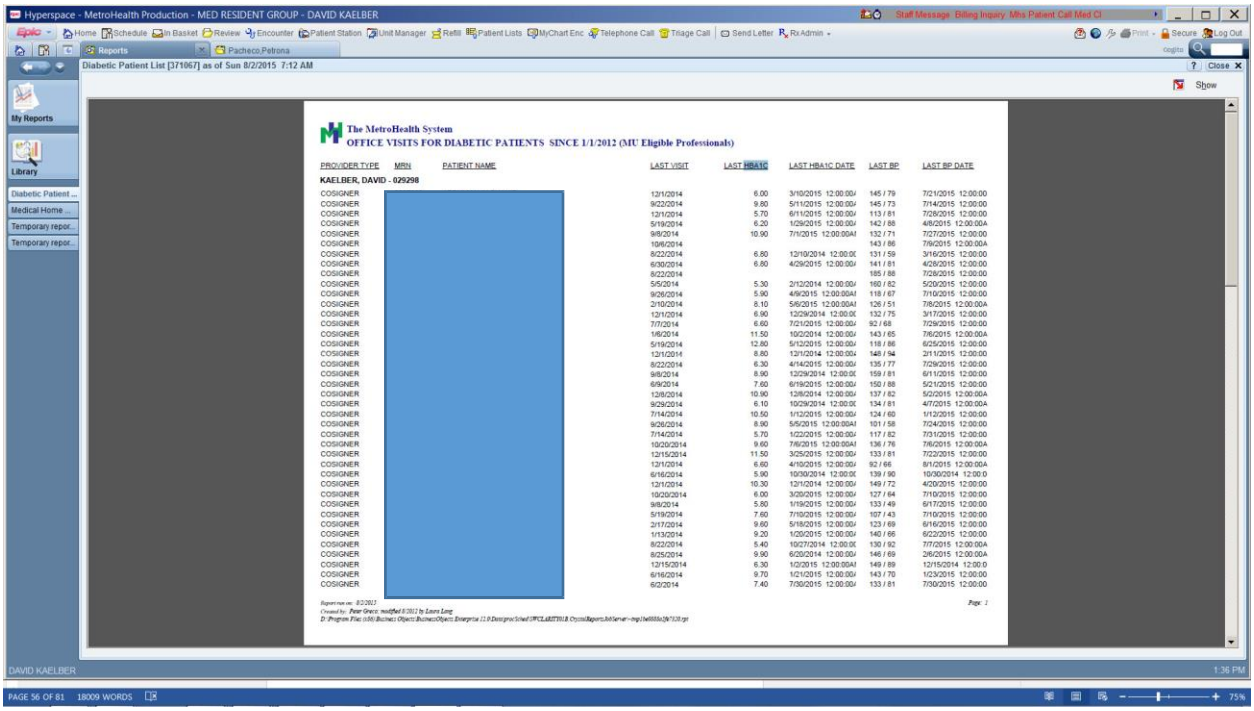


Figure 4 – Electronic health record screen shot of current diabetes provider level population report

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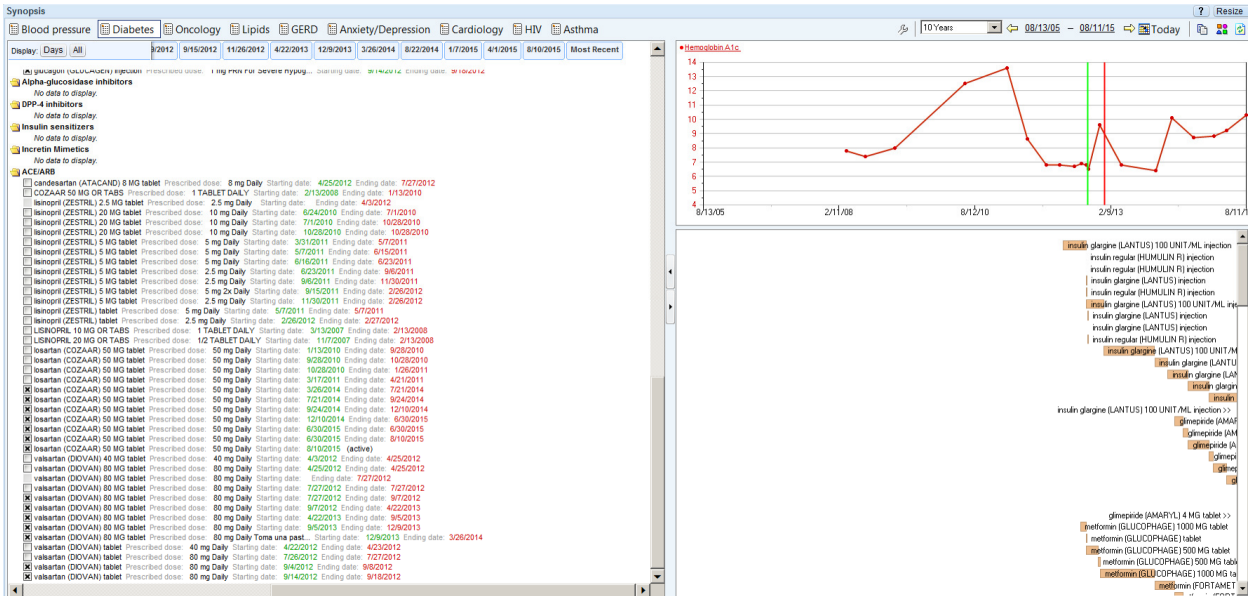

Figure 5 – Electronic health record screen shot of diabetes "Synopsis" report tool that provides summary level diabetes "snapshot" at a patient level

Value Derived

To evaluate the value derived from the MHS's decade-long initiative to improve diabetes care process (MD-centric) and other (patient-centric) outcome measures, composite scores were evaluated over two points in time 2005-2006 and 2007-2014.

During the 2005-2006 period, the composite measure for MD-centric measures (Figure 6) was made up of the percent of patients who achieved all of the following:

- diabetic eye exam performed
- pneumococcal vaccination
- monitoring or treating kidney impairment with ACE inhibitors or ARBs
- control of cholesterol through LDL less than 100mg/dl or patient being on a statin cholesterol lowering medication

During the 2005-2006 period, the composite measure for Other (patient–centric) measures (Figure 6) was made up of the percent of patients who achieved all of the following:

- non-smoking
- body mass index <30
- achieving optimal glycemic control (HbA1c <7%)
- blood pressure <130/80 mmHg

Overall, the EHR tools implemented at the beginning had an ~10% increase in MD-centric measures, which developed and then leveled off over the first 12 months of the study period. These EHR tools had no net effect on Other (patient-centric) measures during the initial two-year study period.

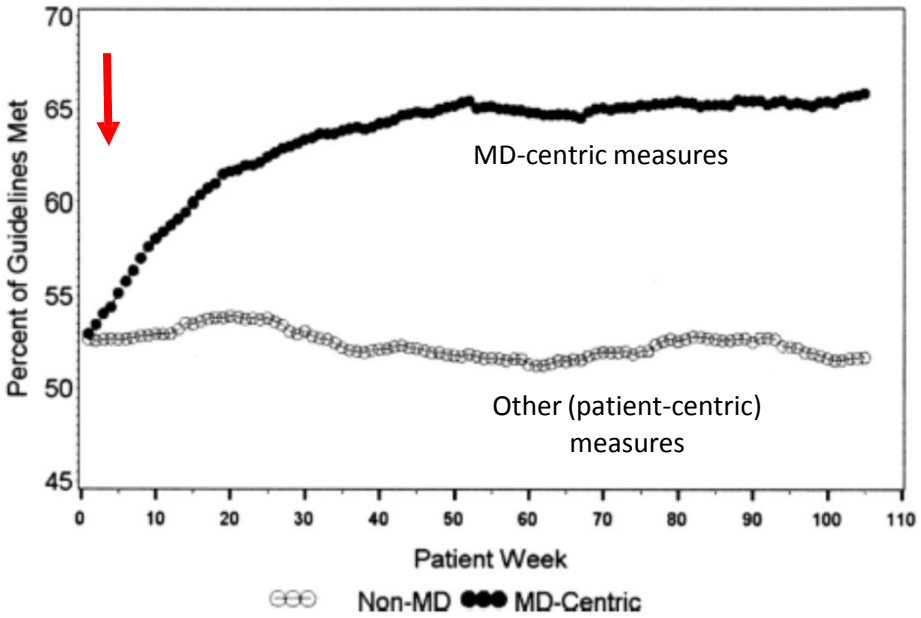

Figure 6 – Diabetes care process (MD-centric) and outcome (Other [patient-centric] measures), 2005-2006. Initial diabetic best practice advisories and provider level diabetes population level report implemented at Patient Week "0" (red arrow)

During the 2007-2014 period, the composite measure for care process measures (Figure 7 summary and Figure 9 detailed) was made up of the percent of patients who achieved all of the following:

- diabetic eye exam performed (EYEEX)
- pneumococcal vaccination (PNEUMO)
- monitoring or treating kidney impairment with ACE inhibitors or ARBs medication (NEPHRO)
- hemoglobin A1c performed (A1CDONE)

During the 2007-2014 period, the composite measure for outcome measures (Figure 8 summary and Figure 10 detailed)) was made up of the percent of patients who achieved at least 4 of the following:

- non-smoking (NONSMOKING)
- body mass index <30 (BMILT30)
- achieving optimal glycemic control (HbA1c <8%) (A1CLT8)
- blood pressure <140/90 mmHg(BPLT14090)
- LDL < 100 or on statin (LDLLT100STAT)

Overall, the EHR tools implemented from 2007-2014 have been associated with a gradual, generally steady increase over 7 year study period. Composite care measures increased about 20% overall from 40.1% in 2007 to 48.5% in 2014. Composite outcome measures increased almost 30% overall from 31.0% in 2007 to 39.5% in 2014. Composite outcomes measure improvement lagged behind composite care measures typically by several years.

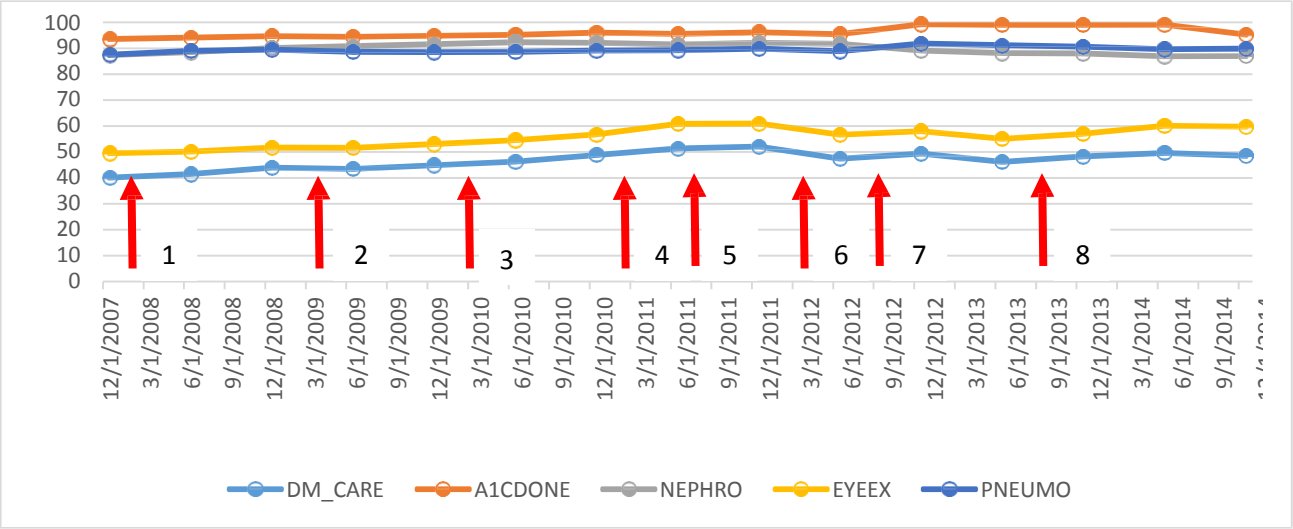

Figure 7 – Summary diabetes care measures 2007-2014. Red arrows indicate EHR interventions: 1-updated best practice advisories, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports with financial incentive, 6 – updated diabetic patient care plans (goals, barriers and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists. DM_CARE is overall composite diabetes care measure. A1CDONE is hemoglobin A1C performed. NEPHRO is monitoring or treating kidney impairment with appropriate medications (angiotensin converting enzyme [ACE] inhibitors or angiotensin receptor blockers [ARBs]). EYEEX is diabetic eye exam performed. PNEUMO is pneumococcal vaccination given.

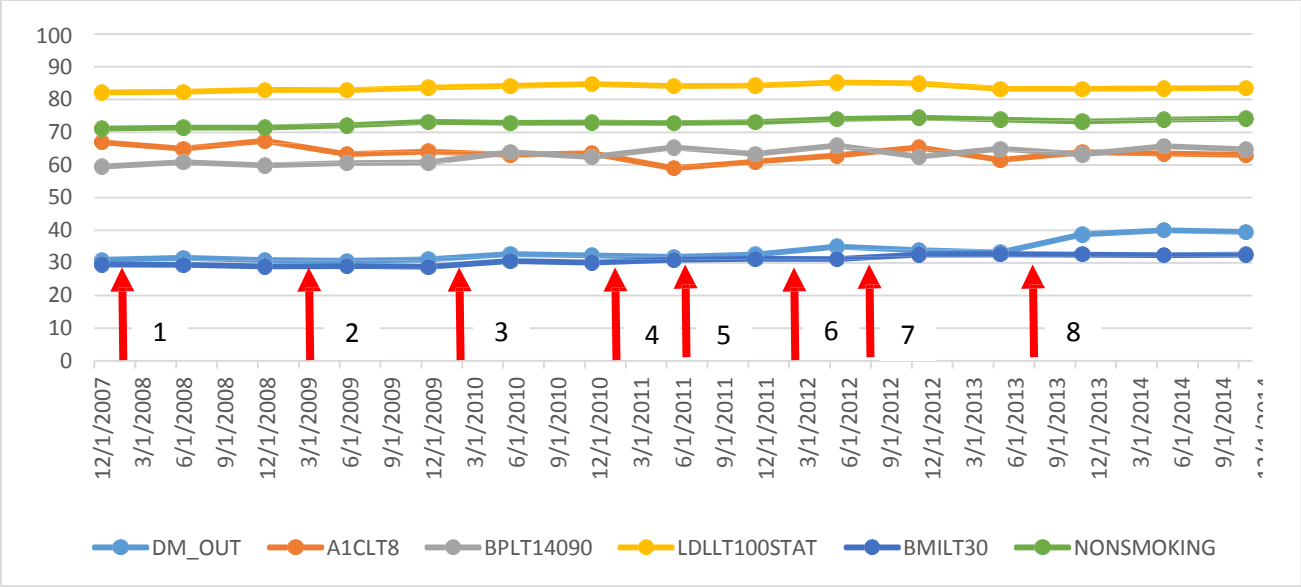

Figure 8 – Summary diabetes outcome measures 2007-2014. Red arrows indicate EHR interventions: 1-updated best practice advisories, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports with financial incentive, 6 – updated diabetic patient care plans (goals, barriers and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists. DM_OUT is overall composite diabetes outcomes measure. A1CLT8 is hemoglobin A1C less than 8. BPLT14090 is blood pressure less than 140/90. LDLLT100STAT is low density lipoprotein less than 100 or patient has been prescribed a statin medication. BMILT30 is body mass index less than 30. NONSMOKING is patient indicates that they are not a current smoker.

Figure 9 – Detailed diabetes care measures for each diabetes care measure shown in Figure 7. Red arrows indicate EHR interventions: 1-updated best practice advisories, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports with financial incentive, 6 – updated diabetic patient care plans (goals, barriers and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists. DM_CARE is overall composite diabetes care measure. A1CDONE is hemoglobin A1C performed. NEPHRO is monitoring or treating kidney impairment with appropriate medications (angiotensin converting enzyme [ACE] inhibitors or angiotensin receptor blockers [ARBs]). EYEEX is diabetic eye exam performed. PNEUMO is pneumococcal vaccination given.

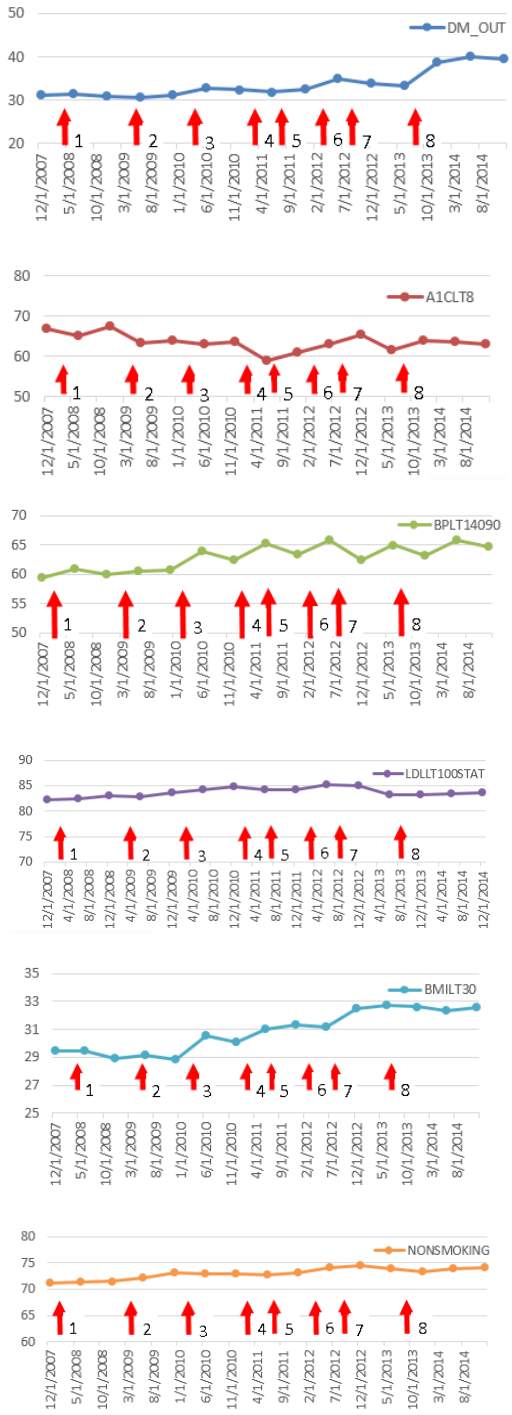

Figure 10 – Detailed diabetes outcome measures for each diabetes outcomes measure shown in Figure 8. Red arrows indicate EHR interventions: 1-updated best practice advisories, 2 – comparative reports (initial), 3 – diabetic patient care plans (letters), 4 – discrete documentation for eye and foot exams, 5 – comparative reports with financial incentive, 6 – updated diabetic patient care plans (goals, barriers and interventions functionality), 7 – Synopsys reports, 8 – updated provider level diabetic patient lists. DM_OUT is overall composite diabetes outcomes measure. A1CLT8 is hemoglobin A1C less than 8. BPLT14090 is blood pressure less than 140/90. LDLLT100STAT is low density lipoprotein less than 100 or patient has been prescribed a statin medication. BMILT30 is body mass index less than 30. NONSMOKING is patient indicates that they are not a current smoker.

Lessons Learned

The primary lesson learned from this example is that through a longitudinal (currently ~10 years), comprehensive, EHR enabled and catalyzed program, significant progress can be made in the quality of care and outcomes for patients with chronic diseases, such as diabetes. From the EHR perspective, such programs can utilize standard EHR tools and data so that there are not significant additional software or hardware costs. The primary costs of developing such programs are people. The teams needed to successfully implement such programs include technical, clinical, analytics and operational representatives. "One tool" will not be sufficient, but rather a suite of tools acting in concert is the most effective approach. When applicable, clinical decision support tools should follow best standards.[1,2] For example, when order sets should be used, alerts should make use of the appropriate order set(s) as obvious and efficient as possible. Additionally, the EHR data and tools are necessary, but not sufficient in themselves for a successful program. Their success is dependent upon having them "wrapped" within programs that educate providers as to overall goals and how the technology tools work, and ideally tie achievement to provider incentives (for example reporting to show how the provider compares to other providers and/or a financial quality incentive). Finally, comprehensive programs such as the adult diabetes one described here have a larger impact on short-term process measure then long-term outcomes measures, although there is an effect on both.

The example and its equivalent application in other healthcare systems, showing the reproducibility of EHR catalyzed initiatives to improve diabetes are in other healthcare systems in Northeast Ohio, has been more fully described and documented in our New England Journal of Medicine article – *Electronic Health Record and Quality of Diabetes Care*.[3] This article shows that EHRs can be used to improve care and outcomes diabetes measure across multiple healthcare systems. This article also describes that systems with EHRs provide higher quality patient care and are able to improve the quality of the care they provide more quickly than health systems with paper based records (Figure 11).

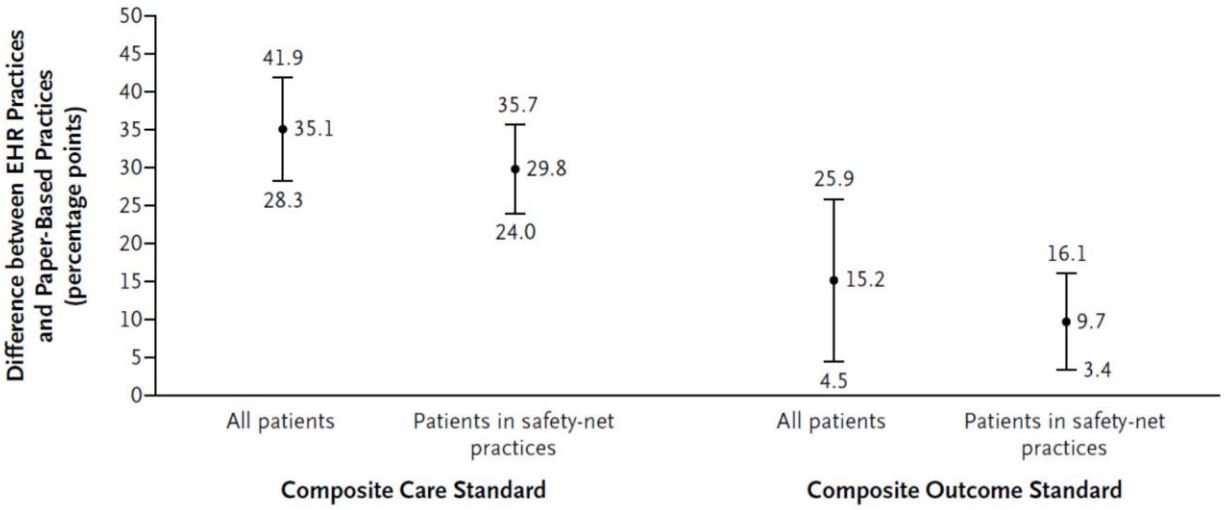

Figure 11 – Composite diabetes score improvements comparing EHR and paper-based practices

Financial Considerations

All of the diabetic EHR-catalyzed initiatives described here used data, tools, and/or functionality already existing in our EHR. Over the ten years of this continuing and evolving effort, a many hundreds of hours of staff time have been spent on the EHR tools designed, build, tested, implemented and continually refined.

In terms of cost savings for this diabetic population, others have estimated that improved diabetes control, as measured by the type of diabetes outcomes measures reported here, saves on the order of 7-10% of healthcare expenses for diabetic patients (~$75-$100 per patient per month or $900-$1200 per patient per year).[4] This cost savings is a combination of decreased ambulatory and inpatient costs because of improved care leading to decreased long-term complications of diabetes. Among the 10,442 patients in this population, 8.44% (881) had improved outcomes. This represents an annual savings on the order of $900,000 in avoided healthcare costs or $3.5 million in avoided healthcare costs over the last decade. Embedded in this cost savings is the estimated at least 17 lower extremity amputations that we avoided because of improved diabetes care among this population, as well as hundreds of hospitalizations.

The estimated initial and on-gong EHR technology and implementation cost of the diabetes technology-enabled interventions was relatively low and decreased over time as “custom” interventions were replaced with interventions using standard EHR functionality and we choose to only implemented standard EHR functionality tools as the standard EHR functionality and tools significantly improved over the decade of this initiative. No additional hardware, software, licensing, or consulting costs were inured initially or on an ongoing basis. The only costs were associated were healthcare researchers, physician informaticists and information services analysts designing, building, testing and maintaining the interventions over time, with some training for providers to understand the details and evidence behind the overall effort and individual initiatives. These costs, per intervention, were estimated to

be on the order of about $10,000 on average for the initial build (combination of 20-60 hours of analyst time at about $50 per hour with benefits and ~50-75 hours of physician time at about $125 per hour with benefits) and about $1,000 on average for annual ongoing maintenance (combination of 0- 10 hours of analyst time at about $50 per hour with benefits and about 0-8 hours of physician time at about $125 per hour with benefits). Therefore, costs were approximately $20,000 for the initial build and about $2,000 per year for ongoing maintenance.

References

1. Bates, DW, Kuperman GJ, Wang S, Gandhi T, Kittler A, Volk L, Spurr C, Khorasani R, Tanasijevic M, and Middleton B. *Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality*. Journal of the American Medical Informatics Association. Nov-Dec:10(6):523-30. 2003.

2. Sirajuddin AM, Osheroff JA, Sittig DF, Chuo J, Velasco F, and Collins DA. *Implementation pearls from a new guidebook on improving medication use and outcomes with clinical decision support. Effective CDS is essential for addressing healthcare performance improvement imperatives*. Journal of Healthcare Information Management. 23(4):38-45. 2009.

3. Cebul RD, Love TE, Jain, AK, and Hebert CJ. *Electronic health records and quality of diabetes care*. New England Journal of Medicine. Sep 1;365(9):825-33. 2011.

4. Fitch K, Pyenson BS, and Iwaasaki K. *Medical Claim Cost Impact of Improved Diabetes Control for Medicare and Commercially Insured Patients with Type 2 Diabetes*. Journal of Managed Care Pharmacy. 19(8):609-620. 2013.