Better Lives Utilizing Electronic Systems (BLUES): A Final Report and Lessons Learned

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Abstract

Purpose: Delta Health Alliance (DHA) and University of Mississippi Medical Center (UMMC) collaborated to assess the potential for electronic health records (EHRs) to facilitate patients outcomes tracking, improve provider communication, reduce medical errors, and improve quality of care.

Scope: The purpose of the BLUES initiative was to determine whether utilization of health IT in diabetes management would enhance delivery of healthcare and improve health outcomes among patients in the Mississippi Delta. Participants included four clinics that employ similar models of diabetes care; two with EHRs implemented (one urban, one rural) and two without (one urban, one rural). Baseline and point in time data from two non-EHR clinics and two EHR clinics were analyzed to show this effectiveness. Only baseline and end-of-study were included for the purpose of testing intervention effects on the primary outcome data.

Methods: The research design included three specific aims and an overall evaluation plan to assess the EHR's impact on patient care. Two clinics implemented an EHR and two remained paper-based practices. This design allowed for contemporaneous comparisons against an untreated control.

Results: Overall, the results in terms of EHR versus non-EHR sites were mixed, although the LDL results were consistent with a positive effect of the EHR. The lessons learned were invaluable in demonstrating that installation of EHRs alone do not improve outcomes for chronic disease, but must include significant clinician training, support and usage of HIT tools, like clinical decision support.

Key Words: electronic health records, diabetes, clinical processes of care, patient outcomes, health information technology

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PURPOSE

This study was designed to determine whether utilization of health IT, specifically EHRs, in diabetes management will enhance delivery of healthcare and improve health outcomes among patients. Four medical clinics that employ the similar models of diabetes care participated in this study: two with EHRs implemented (one urban, one rural) and two without (one urban, one rural). The specific project aims are found in Table 1.

Table 1. BLUES Study AIMS

Project Aim/ Milestone #1:	Successfully implement an electronic health record (EHR) system at two existing clinics located in Jackson, MS, UMMC Family Medicine Practice- Dr. Diane Beebe, and in Greenville, MS, at the Delta Regional Medical Center Diabetes Clinic, which focuses on the integration of an EHR system into clinician workflows.
Project Aim/ Milestone #2:	Evaluate the impact of the EHR system on clinical processes of care and patient outcomes.
Project Aim/ Milestone #3:	Based on the lessons learned and evaluation results, produce and distribute a generalizable, replicable model of care for implementing an integrated health IT system for diabetes management care throughout the U.S.

SCOPE

Background. The Mississippi Delta is among the poorest and most disadvantaged areas in the U.S. The eighteen counties that comprise the Mississippi Delta share several characteristics that impact the health of their residents: they are located in rural areas, have high levels of poverty, and their populations have relatively high percentages of African Americans, making them particularly vulnerable to the disproportionate disease burden that accompanies our nation's existing racial and ethnic health disparities. The targeted service area of this effort includes the eighteen counties of Desoto, Tunica, Tate, Panola, Quitman, Coahoma, Tallahatchie, Bolivar, Sunflower, Carroll, Leflore, Washington, Humphreys, Holmes, Yazoo, Sharkey, Issaquena, and Warren. The vast majority of this area is rural, with thirteen of the eighteen counties served having a population under 30,000 residents. (U.S. Census 2010).

Diabetes remains the leading cause of blindness, end-stage renal disease, and non-traumatic limb amputations—both throughout the U.S. and within Mississippi. Approximately 65 percent of all diabetics will die of heart attack or stroke (NIDDK 2005) while the overall risk

for death among people with diabetes is about twice that of people without diabetes of similar age. The per capita cost of the diabetic patient is more than twice that of a non-diabetic patient, whether in-patient or out-patient. Total costs of diabetes in the U.S. during 2002 were estimated at $132 billion: $92 billion in direct medical costs and $40 billion in indirect costs (the costs of short-term and permanent disability and premature death) (NIDDK 2005). Diabetes accounts for 25 percent of all Medicare costs and 15 percent of all U.S. healthcare costs; the bulk of that cost is consumed in the care of complications from diabetes (Leese 1992).

Table 2: Demographics of Targeted Service Area

County	Population (2010)	% Black / African American (2010)	% Adults HS Graduates (2009)	Per Capita Income (2009)	% Individuals Below Poverty (2009)	Diabetes Mellitus Mortality Rate per 100,000 (2005)
Coahoma	26,151	75.5%	74.1%	$15,148	39.4%	51.7
Washington	15,137	71.3%	71.4%	$16,018	32.0%	23.6
Hinds	245,285	69.1%	83.9%	$20,992	23.3%	14.4
Bolivar	34,145	64.2%	69.0%	$15,051	35.1%	54.3
Claiborne	9,604	84.4%	86.2%	$12,179	39.2%	26.1
Copiah	29,449	50.9%	75.3%	$16,720	26.3%	37.7
Humphreys	9,375	74.5%	62.7%	$13,490	44.3%	19.0
Issaquena	1,406	64.4%	60.2%	$11,275	45.5%	*N/A*
Madison	95,203	38.2%	86.8%	$30,930	12.7%	21.4
Quitman	8,223	69.6%	63.3%	$12,722	39.9%	42.0
Rankin	141,617	18.8%	87.1%	$25,971	11.2%	9.1
Sharkey	4,916	71.0%	70.2%	$15,503	39.3%	33.5
Simpson	27,503	35.1%	76.5%	$18,112	24.7%	3.6
Sunflower	29,450	72.9%	70.1%	$11,666	37.1%	24.8
Tallahatchie	15,378	56.4%	64.0%	$12,664	32.0%	21.1
Tunica	10,778	73.5%	70.0%	$14,818	26.8%	67.8
Warren	48,773	47.0%	80.6%	$21,228	22.2%	16.3
Yazoo	28,065	57.1%	73.5%	$14,328	36.4%	81.6
Avg/Total for BLUES Project Counties	**780,458**	**60.8%**	**73.6%**	**$16,601**	**31.5%**	**32.2**
Mississippi	**2,967,297**	**37.0%**	**78.9%**	**$19,534**	**21.8%**	**27.2**
United States	**308M**	**12.6%**	**84.6%**	**$27,041**	**14.3%**	**24.8**

(Data from U.S. Census, Mississippi Department of Health, and American Heart Association)

Prevalence. Unlike many other major diseases such as heart disease or cancer, the prevalence of diabetes is increasing at an alarming rate. In the last 10 years alone, the prevalence of type 2 diabetes has increased by a factor of 49 percent, while among 30-year olds

the prevalence has increased by 76 percent (Mokhad et al. 2000). In the pediatric population, the prevalence of type 2 diabetes appears to have increased tenfold since 1991 (Rosenbloom et al. 1999). This rapid increase in diabetes goes hand-in-hand with the epidemic of obesity now rampant in this country: obesity prevalence has increased by 61 percent since 1991 (Mokhad et al. 1999). Being overweight is the principle risk factor for type 2 diabetes.

As troubling as health statistics are for Mississippi as a whole, the service area targeted by the BLUES Project (see Table 2) reports even worse outcomes than state and national averages for demographics associated with poor diabetic outcomes. In addition to the highest prevalence of diabetes in the nation, Mississippi's death rates due to cardiovascular disease are also higher than any other state. Mississippi ranks high in rates of heart failure, heart attacks, and kidney failure. Rates of cigarette smoking, poor eating habits, and lack of exercise are higher than national averages, all of which are significant risk factors for poor diabetes outcomes. Moreover, racial and ethnic minority populations have significantly higher incidence rates of type 2 diabetes than non-Hispanic whites, and the targeted service area has a very large minority population compared to the nation as a whole. Research has shown that all long-term complications of diabetes—including premature death—occur more frequently in non-white minorities. Lastly, studies indicate disparities in access to care and quality of metabolic control in diabetic patients are a function of demographic and socioeconomic characteristics.

Context. Electronic health information systems have the potential to improve the efficiency with which care is delivered to patients, reduce delays in care, increase conformity with recognized standards of care, and to serve as a launching pad for numerous potential health-improving interventions. A recent large-scale survey of empirical evidence related to health information technology, which includes electronic health records, found three major benefits to quality of care: 1. increased adherence to guideline-based care; 2. enhanced surveillance and monitoring; 3. and decreased medication errors. Improvements were primarily in the realm of preventive health care. The major efficiency benefit was decreased utilization of care, though the effects on time utilization by providers were mixed and evidence on cost data were limited (Chaudry et al. 2006).

Settings. Initially, the BLUES Project proposed the following four ambulatory care clinic locations:

- The Medical Mall Diabetes Clinic in Jackson (Hinds County);
- the UMMC Beebe Diabetes Clinic in Jackson (Hinds County);
- the Northwest Regional Medical Center Metabolic Clinic in Clarksdale (Coahoma County);
- the Delta Regional Medical Center Diabetes Clinic in Greenville (Washington County).

During the project implementation, there were three site modifications, noted in Table 3.

Table 3: Test and Control Sites Modified

Original Site	Type of Site	Replaced by	Reason/ Comments
Delta Regional Medical Center Diabetes Clinic	Test Clinic/ Rural	The Greenville Clinic	Physician moved and closed clinic. Greenville Clinic follows similar workflows and would be a referral for DRMC Diabetes Clinic
Northwest Regional Medical Center Metabolic Clinic	Control Clinic/ Rural	The Gorton Clinic	Reduction of DPP Program Sites. The Gorton Clinic had similar patient demographics as NWRMC patients.
Jackson Medical Mall Diabetes Clinic	Control Clinic/ Urban	Jackson Medical Mall Internal Medicine Clinic	Closed June 30, 2009. Most Patients were referred to the Internal Medicine Clinic in the same building.

Participants. Because the purpose of the study was to compare longitudinal outcomes of two intervention arms, all patients aged 19 years and over were eligible for inclusion except for those who do not return after the initial visit. This exception applied to all patients regardless of age. We did not include patients under the age of 19 years because their compliance with medication management is often a function of the influence of the minor patient's parent or guardian, and because patients under the age of 19 years represent a small percentage (less than 2 percent) of the target patient population at the participating clinics.

The targeted service area of this project incorporates communities that include a disproportionate share of vulnerable populations, including 58.5 percent African American. We obtained our sample in the baseline data collection by visiting each clinic on random days. The single point of contact at each clinic would run a list of active diabetes patients, from which each third chart would be selected. This method was utilized during the point-in-time data collection at the paper chart clinics, and again at those clinics during the end of study look back period. The demographics of the participants enrolled in the study are detailed in Table 4, as compared to the targeted enrollment anticipated in the grant application.

It should be noted that almost seventeen percent of records did not reflect an appropriate answer or responded with "other" or "unknown" on questions about race and ethnicity. The majority of unresponsive answers were from abstractions from the two rural clinics throughout the study. There are a number of potential causes of this, from the lack of selections (many in the minority populations do not identify with just one heritage); because clinics do not collect this information as it is not a requirement for billing; or from an error in coding at the clinic or researcher level.

Additionally, the IRB process excluded the collection of gender in the chart abstraction process, stating that in small, rural areas, collection of gender could increase the likelihood that someone could be identified by the data collected and thereby eliminating this study from exempt status of IRB. To demonstrate compliance with our targeted population, we have provided the sample of patients enrolled in the patient survey sample, which the IRB did allow the collection of gender data due to the fact that patients were signing their own consent forms for this portion of the study.

Table 4. Targeted Versus Actual Enrollment, BLUES Project.

BY ETHNICITY	Targeted/Planned Enrollment		Actual Enrollment	
	Total	Percent of Total	Total	Percent of Total
Hispanic or Latino	14	0.5%	14	0.3%
Not Hispanic or Latino	2943	99.5%	3900	83.0%
Did Not Respond/ Unknown	n/a	n/a	783	16.7%
Ethnic Category Total of All Subjects	2957	100.0%	4697	100.0%
BY RACE				
American Indian/Alaska Native	0	0%	0	0.0%
Asian	2	0%	3	0.1%
Native Hawaiian or Other Pacific Islander	0	0%	0	0.0%
Black or African American	2159	73.0%	2816	60.0%
White	796	27.0%	1087	23.1%
Did Not Respond/ Unknown	n/a	n/a	791	16.8%
Racial Categories: Total of All Subjects	2957	100.0	4697	100.0%
BY GENDER				
Male	1035	35.0%	107	27.2%
Female	1922	65.0%	267	67.9%
Did not respond	n/a	n/a	19	4.8%
Total	2957	100.0%	393	99.9%

METHODS

Study Design. Specific to the BLUES project was the collection of measures related to process and outcomes associated with diabetes. Diabetic patients were identified at each of the 4 clinic sites finally selected for the project. A minimum of 100 diabetic charts per clinic were randomly selected and abstracted to obtain pre-period measures. Charts were required to

represent "active" diabetic clinic patients, which was defined as those who had been a patient of the clinic for at least one year with at least one visit within the last 4 months (i.e., at least 2 visits within the last year).

Interventions.   Two intervention arms were compared to determine the effectiveness and assess the impact of implementing an EHR system on patient outcomes and healthcare delivery. The first intervention arm was composed of one urban (Beebe) and one rural (Greenville) clinic, both of which had an EHR system added to their model of care (treatment group). The second intervention arm was comprised of one urban (Medical Mall) and one rural (Gorton) clinic, which did not have an EHR system added to their model of care (control group). Outcome variables were measured at baseline and at six month intervals for a period of two years. This yielded a maximum of five total time points. Only two visits, baseline and end-of-study (24 months)were included for the purpose of testing intervention effects on the primary outcome data.

Data Sources/Collection. Data collection for the study results presented in this report are from baseline: 1) at the start of the project period (pre-EHR implementation) at each site for baseline data; and (2) at 18 months post-implementation at the EHR sites, and an equivalent time period at the control (non-EHR) sites. In all cases a 12-month look-back period was employed. For the EHR sites the 12-month look-back window allowed for a 6-month post-EHR implementation transition period so observations would be less influenced by the comparative novelty of the EHR system and the attendant difficulties that could arise. All data items were obtained via chart review and practice records for baseline information (utilizing a randomized sample of an estimated 100 patients per clinic) and post-implementation, via Allscripts reporting modules and practice records.

Chart Abstraction and Data Entry. Chart abstraction was conducted for baseline purposes at all four clinics for 100 charts, and continued at "paper clinics" for the two non-EHR clinics for the remainder of the study. The Data Collection Tool instrument, found in the Research Guide, was utilized. A total of one hundred (100) chart abstractions at each clinic were done during each interval. The process involved establishing a contact at each clinic; often the office manager or head nurse, to obtain permission to come into the clinic to collect the chart abstraction. The clinic staff provided a listing of the diabetes patients seen during the appropriate time period. From this listing, a random selection was made of each third patient's chart to abstract the necessary data for the specified six-month collection period. Each abstract was assigned an individual number along with the particular site code for that site. The paper health records varied by clinic and finding certain information was sometimes cumbersome. For example, each clinic used different forms for collecting patient history or lab work. Each clinic arranged their charts in a different manner. Therefore, assistance from clinic staff was sometimes necessary.

Following each batch of data entry, files were reviewed for obvious errors (dates entered with years outside of the date range, lab values out of standard format) and errors were rectified. In addition a 10% random sample of chart abstractions were spot-checked for errors. If numerous errors were present, all the entries were reviewed for errors.

EHR Data Acquisition. On a weekly basis, the discrete data elements from participating physician's offices' servers are extracted from the production EHR database and copied to an SQL database called the Data Warehouse. The extract tool is a standard Microsoft tool which has been modified by Allscripts so that when the data is copied to the Data Warehouse the data is structured in a way that is more conducive to writing ad hoc reports by the client.

For the BLUES Project, a member of the research team from the Delta Health Alliance EHR department used data from the Data Warehouse and wrote SQL queries to pull the data that was needed for the BLUES reports. These queries were determined from discussion and testing between the research team, during different stages of the project. These queries are based on the time frames requested and follow the established time frames for chart abstractions: queries were written to extract data from the data repository 18 months following the implementation of the EHR into the study reviewing a 12-month interval.

Final Analytic Sample. Because of significant under-reporting of lab values found in the EHR sample, we restricted all analyses to patients that had lab values for the three outcomes of interest: HbA1c, LDL, and blood pressure.

Patient Satisfaction Surveys. Another part of data collection included collecting and entering data from the patient satisfaction surveys, which were conducted at all four sites. Fifty surveys were collected from each site at two intervals (baseline and end of study) for a total of one hundred surveys per site. The researcher made arrangements at each site to conduct the surveys. Surveys were conducted with patients who were sitting in the waiting area. The researcher approached the potential patient and introduced themselves. The researcher explained why they were collecting data and asked the patient if they would like to participate. It was explained to the patient that the information collected would be kept confidential and anonymous. The patient either agreed to participate or declined. The researcher asked if they would like the survey questions to be read to them or they could complete the survey themselves. In some instances, the researcher read the questions to the patient and recorded their answers appropriately. In most cases, patients were willing to participate.

Patient satisfaction was assessed using the modified CAHPS survey instrument, which is included in the Research Guide. This questionnaire asks about patients' use of and satisfaction with health care services, such as care from a regular doctor, specialists, and interactions with their health plan. Many challenges with data collection for the patient satisfaction surveys resulted from having a long survey. Some of the patients did not complete the surveys in the

waiting rooms. It was cumbersome keeping track of patients who had taken the survey in the back with them to finish. Depending on the flow of patients at the sites, it was time consuming waiting on patients. Therefore, the researcher had to visit the site more than once to collect the required fifty surveys. When administering the CAHPS survey, the BLUES team encountered both resistance and enthusiasm. For example, seven (7) patients refused to participate; one (1) disliked the survey and the use of technology because "they couldn't find my records;" one (1) stated that the survey was confusing because it did not ask questions about the utilization of computers; and two (2) patients were very excited to participate and stated that they were glad that someone was asking these questions.

Limitations. There are at least two general concerns regarding pre-period data acquired from chart reviews. The first is in regards to the sample size necessary to detect meaningful changes in outcomes of interest: a random sample of 100 charts may not be sufficient to achieve sufficient power. For particular outcomes of interest (e.g., outcomes only relevant for a subpopulations such as mammography and colonoscopy), 100 charts may not provide sufficient sample size. In this case, there could be efforts to increase the number of charts available for pre period analysis, or some of the outcomes may have to be dropped. The second is the potential for coding errors and incomplete information in charts. Indeed this is one of the arguments in favor of switching to an EHR.

The description of the chart abstraction and data entry procedures illustrate many of the limitations of this study. There was inconsistency among the sites in how charts were kept, organized, and, thus, creating difficulty in abstraction. Further, in considering the results, it is important to note that the large changes seen in patient demographic characteristics across the pre and post period are difficult to explain.

RESULTS

Principal Findings. Table 5 shows the demographic characteristics of the final sample of patients in each site for the pre and post periods. There was a substantial difference seen in the percent African American in the pre and post periods in all of the sites, and large changes in the percentage covered by Medicaid except in site 3.

Table 5. Demographic Measures

Site name	UMC: Urban Non-EHR		Beebe: Urban EHR		Gorton: Rural Non-EHR		Greenville: Rural EHR	
Time	Pre	Post	Pre	Post	Pre	Post	Pre	Post
N	89	69	84	240	40	80	85	265
Age	57	53	65	59	66	62	68	66
% Af.	67.4	79.7	91.7	58.8	62.5	75	49.4	56.3

American							
% on Medicaid	31	17	35	6	55	51	55	20

Table 6 shows the results for the HbA1c levels. Here the results generally showed small increases in HbA1c levels across baseline and follow-up, with a decrease seen only in the Rural Non-EHR site. Changes in the percent of patients with an average HbA1c level below 9 were mixed and generally small.

Table 6. HbA1c Measures

Site name	UMC: Urban Non-EHR		Beebe: Urban EHR		Gorton: Rural Non-EHR		Greenville: Rural EHR	
Time	Pre	Post	Pre	Post	Pre	Post	Pre	Post
N	89	69	84	240	40	80	85	265
Number of tests	3.51	3.10	2.19	2.08	1.875	2.24	2.62	2.03
Mean HbA1c	7.94	8.23	7.71	7.83	7.70	7.46	7.16	7.50
% HbA1c <9*	75.28	75.36	82.14	79.58	80.00	86.25	88.23	85.66

* %a1c< 9 is the percentage of patients with an observed HbA1c that have an average HbA1c level below 9.

Table 7 shows the results for Blood Pressure. Note that here the results reflect the latest Blood Pressure value observed because of the quantity of Blood Pressures seen in the post data for the EHR sites. Here generally changes were small with the exception of a sizable increase in the percent with low overall blood pressure in the Rural Non-EHR and a very large drop in percent with low overall blood pressure in the Rural EHR site.

Table 7. Blood Pressure Measures*

Site name	UMC: Urban Non-EHR		Beebe: Urban EHR		Gorton: Rural Non-EHR		Greenville: Rural EHR	
Time	Pre	Post	Pre	Post	Pre	Post	Pre	Post
N	89	69	84	240	40	80	85	265
Mean systolic	132.35	134.17	137.42	135.4	135.6	128.48	132.42	137.54
Mean Diastolic	70.77	69.81	77.87	76.10	77.4	77.35	78.76	79.11
Below 140/90	65.96	69.56	52.38	57.5	57.5	65.00	71.76	54.34

*Note that these are based on the latest available BP number if there was more than 1 value.

Table 8 shows the results for LDL. Here there are substantially lower LDL levels seen in the post relative to the pre levels in the urban and rural EHR and slight increases in LDL in the urban non-EHR and the rural non-EHR.

Table 8. LDL Measures

Site name	UMC: Urban Non-EHR		Beebe: Urban EHR		Gorton: Rural Non-EHR		Greenville: Rural EHR	
Time	Pre	Post	Pre	Post	Pre	Post	Pre	Post
N	89	69	84	240	40	80	85	265
number of tests	1.72	1.26	1.54	1.49	1.10	1.56	1.48	2.51
Mean LDL	103.86	110.64	113.16	96.94	98.52	100.23	105.71	71.13
% Low LDL* (<130)	78.65	68.11	64.28	81.66	85.00	83.75	72.94	99.25

*% low ldl is the percentage of patients with an observed ldl level that have a mean ldl level below 130.

Tables 9 and 10 (next page) show select results of the Patient Satisfaction Surveys. Socio-demographic characteristics were first examined to see if there were differences among sites or at the same site between time periods (Table 9). There were some significant findings. Patients at the Greenville Clinic showed a significant positive change in self-reported health status from baseline to the post-period ($p < .05$). More than half of patients saw a health care provider three or more times for the same condition in the previous 12 months, including a significant increase from 27.9% to 53.1% also at the Greenville Clinic ($p < .05$).

Other potentially significant factors were noticed between clinics in rural and urban settings. Occasional differences were noted between pre and post test questions in specific clinics. In most cases, the average pre and post test scores among the four clinics were not significant. A detailed review of this questionnaire and results are available upon request.

Table 9. Socio-demographic Characteristics of Patient Satisfaction Survey Respondents

Site	Pre Baseline UMC Jackson Med Mall	Post Baseline UMC Jackson Med Mall	Pre Baseline UMC Beebe	Post Baseline UMC Beebe	Pre Baseline Gorton Clinic	Post Baseline Gorton Clinic	Pre Baseline Greenville Clinic	Post Baseline Greenville Clinic	Pre Baseline Total	Post Baseline Total
N	49	50	50	50	50	48	45	51	194	199
GENDER Male	34.10%	18.40%	30.40%	32.70%	20.40%	31.10%	31.00%	32.00%	28.70%	28.50%
Female	65.90%	81.60%	69.60%	67.30%	79.60%	68.90%	69.00%	68.00%	71.30%	71.50%
Race										
White	19.10%	22.00%	38.00%	30.60%	22.50%	25.00%	52.40%	39.20%	32.60%	29.30%
Black	78.30%	74.00%	60.00%	67.40%	75.50%	75.00%	47.60%	58.80%	65.80%	68.70%
Other	2.20%	5.00%	2.00%	2.00%	2.00%	0.00%	0.00%	2.00%	1.60%	2.00%
Hispanic (% yes)	2.30%	2.20%	2.10%	2.30%	0.00%	4.60%	0.00%	0.00%	1.10%	2.20%
Education										
8th grade or less	6.80%	2.00%	4.00%	6.00%	23.40%	10.40%	2.50%	0.00%	9.40%	4.60%
Some high school	31.80%	24.00%	6.00%	24.00%	17.00%	16.70%	7.50%	4.00%	15.50%	17.20%
High school graduate/GED	29.60%	36.00%	40.00%	30.00%	19.20%	31.30%	25.00%	32.00%	28.70%	32.30%
Some college or 2-year degree	22.70%	32.00%	20.00%	28.00%	21.30%	27.10%	40.00%	36.00%	25.40%	30.80%
4-year college graduate	2.30%	0.00%	12.00%	4.00%	10.60%	8.30%	5.00%	10.00%	7.70%	5.60%
More than 4-year college graduate	6.80%	6.00%	18.00%	8.00%	8.50%	6.30%	20.00%	18.00%	13.30%	9.60%
Age										

18-24	4.40%	2.00%	0.00%	4.20%	6.10%	6.50%	10.00%	5.90%	4.90%	4.60%
25-34	4.40%	8.00%	22.00%	4.20%	10.20%	21.70%	17.50%	9.80%	13.50%	10.80%
35-44	15.20%	18.00%	12.00%	22.90%	14.30%	26.10%	17.50%	9.80%	14.60%	19.00%
45-54	23.90%	38.00%	30.00%	27.10%	20.40%	13.00%	17.50%	15.70%	23.20%	23.60%
55-64	28.30%	24.00%	26.00%	29.20%	24.50%	17.40%	25.00%	23.50%	26.00%	23.60%
65-74	17.40%	8.00%	6.00%	10.40%	14.30%	8.70%	7.50%	27.50%	11.30%	13.90%
75+	6.50%	2.00%	4.00%	2.10%	10.20%	6.50+	5.00%	7.80%	6.50%	4.60%
Insurance										
Medicaid	17.00%	14.00%	14.00%	26.00%	34.00%	29.20%	6.70%	5.90%	18.20%	18.60%
Medicare	25.50%	12.00%	12.00%	22.00%	12.00%	10.40%	15.60%	35.30%	16.20%	20.10%
Medicaid/Medicare	10.60%	12.00%	16.00%	12.00%	16.00%	14.60%	4.40%	7.80%	12.00%	11.60%
Private	14.90%	10.00%	40.00%	20.00%	16.00%	20.80%	57.80%	43.10%	31.80%	23.60%
Self Pay	27.70%	44.00%	12.00%	4.00%	20.00%	18.80%	13.30%	2.00%	18.20%	17.10%
Other	4.30%	8.00%	6.00%	16.00%	2.00%	6.30%	2.20%	5.90%	3.70%	9.10%
Health Status										
Excellent	4.40%	6.00%	14.30%	12.50%	6.40%	15.20%	13.60%	2.00%	9.70%	8.80%
Very Good	6.50%	12.00%	22.50%	12.50%	10.60%	26.10%	38.60%	32.00%	19.40%	20.60%
Good	23.90%	24.00%	34.70%	33.30%	42.60%	30.40%	27.30%	43.00%	32.30%	32.50%
Fair	52.20%	40.00%	18.40%	33.30%	21.30%	21.70%	15.90%	18.00%	26.90%	28.40%
Poor	13.00%	18.00%	10.20%	8.30%	19.20%	6.50%	4.60%	6.00%	11.80%	9.80%
Need Help Filling Out Survey	33.30%	26.00%	10.20%	14.00%	20.80%	10.40%	11.90%	17.70%	19.30%	17.10%

Table 10. Patient Satisfaction Results, By Site and Time Period*

Site	Pre Baseline UMC Jackson Med Mall	Post Baseline UMC Jackson Med Mall	Pre Baseline UMC Beebe Family Med Clinic	Post Baseline UMC Beebe Family Med Clinic	Pre Baseline Gorton Clinic	Post Baseline Gorton Clinic	Pre Baseline Greenville Clinic	Post Baseline Greenville Clinic	Pre Baseline Total	Post Baseline Total
N	49	50	50	50	50	48	45	51	194	199
Did you need care right away in a clinic, ER, or doctor's office? (% yes)	46.90%	62.00%	55.10%	55.10%	45.80%	38.30%	38.60%	40.00%	48.60%	49.00%
What number would you use to rate all your health care in the last 12 months? (scale 0-10)	n=33	n=47	n=46	n=42	n=42	n=43	n=30	n=44	n=159	n=176
6 or lower	21.20%	25.50%	13.00%	23.80%	16.70%	30.20%	7.90%	13.60%	14.50%	23.30%
7 or 8	30.30%	23.40%	32.60%	21.40%	28.60%	14.00%	23.70%	25.00%	28.90%	21.00%
9 or 10	49.50%	51.10%	54.40%	54.80%	54.80%	55.80%	68.40%	61.40%	56.60%	55.70%
Have you seen a doctor or other health provider 3 or more times for the same condition or problem? (exclude pregnancy or menopause) (% yes)	56.50%	62.00%	65.30%	59.20%	54.20%	42.20%	27.90%	53.10%	51.60%	54.40%
If yes, is this a condition or problem that has lasted for at least 3 months? (% yes)	72.00%	83.90%	90.30%	78.60%	68.00%	68.40%	75.00%	87.50%	77.40%	80.40%

	Col1	Col2	Col3	Col4	Col5	Col6	Col7	Col8	Col9	Col10
Do you now need or take medicine prescribed by a doctor? (% yes)	86.70%	85.40%	92.00%	77.10%	83.00%	71.70%	71.40%	79.60%	83.70%	78.50%
Did you try to make any appointments to see a specialist? (% yes)	40.40%	26.00%	58.30%	61.70%	45.80%	47.80%	40.90%	44.00%	46.50%	44.60%
Did you try to get any kind of care, tests, or treatment through your health plan? (% yes)	39.10%	44.00%	63.30%	68.80%	48.90%	50.00%	59.50%	70.00%	52.70%	58.30%
If yes, how often was it easy to get the care, tests, or treatment you thought you needed?	n=18	n=22	n=31	n=33	n=22	n=23	n=25	n=34	n=96	n=112
Never/Sometimes	16.70%	18.20%	16.10%	18.20%	4.50%	21.70%	4.00%	5.90%	10.40%	15.20%
Usually	5.60%	27.30%	32.30%	18.20%	27.30%	13.00%	20.00%	26.50%	22.90%	21.40%
Always	77.80%	54.50%	51.60%	63.60%	68.20%	65.20%	76.00%	67.60%	66.70%	63.40%
Did you try to get information or help from the customer service of the company that pays for your doctors' visits? (% yes)	22.20%	20.00%	50.00%	25.50%	30.40%	21.70%	18.60%	27.10%	30.80%	23.60%
If yes, how often did that company's customer service treat you with courtesy and respect?	n=10	n=10	n=24	n=12	n=12	n=10	n=8	n=13	n=54	n=45
Never/Sometimes	0.00%	10.00%	20.80%	8.30%	25.00%	30.00%	25.00%	38.50%	18.50%	22.20%
Usually	40.00%	10.00%	20.80%	0.00%	25.00%	30.00%	12.50%	23.10%	24.10%	15.60%
Always	60.00%	80.00%	58.30%	91.70%	50.00%	40.00%	62.50%	38.50%	57.40%	62.20%

As the research team reviewed data on a quarterly, monthly, and sometimes weekly basis, we would often troubleshoot concerns about what we were or were not seeing in the numbers or practically, in the clinics while conducting our research or data gathering. This resulted in the formulation of the foundation of the Beacon Project, funded by ONC, which is now providing Physician Coaching, training in Clinical Decision Support, Performance Improvement and Incentivization, and the formation of Learning Collaboratives for HIT initiatives. Now, in addition to the installation of an EHR, a clinic can count on a full array of support services that will guarantee the ability to manage a patient's chronic disease and monitor their overall performance and improvement in healthcare on a number of quality indicators.

Outcomes. The BLUES Project resulted in a number of actual outcomes. The Greenville Clinic and the UMMC Beebe Family Medicine Clinic had Allscripts Electronic Health Records installed and their physicians and clinicians began the process of meeting the new "meaningful use" criteria, as set forth by the Center for Medicare and Medicaid Services. Through the execution of this research project, the DHA research team learned a number of invaluable lessons regarding the implementation of EHR projects and necessary steps for improving healthcare and health outcomes for diabetes patients. The process lessons learned led to more efficient roll out of EHRs and better internal controls for process in training of providers as EHRs are implemented in rural clinics.

Overall, the results in terms of EHR versus non-EHR sites were mixed, although the LDL results were consistent with a positive effect of the EHR. This pilot study revealed some inherent difficulty in data collection for the purpose of evaluating the impact of obtaining an EHR. Two primary challenges are the necessity of a paper chart control group and the large number o f missing lab values that existed in the initial EHR data. As the EHR continues to develop it is highly likely that the data generated will be much improved. Further, the EHR complements several potential interventions and improvements at the clinic level. Hence, more consistent and more substantial gains to patients may be found in the years to come. Clearly, there is room for further research in terms of the potential impact of the EHR on diabetic patients and greater efforts should be made in this area.

Discussion. EHRs, in and of themselves, cannot improve healthcare. There must be a deliberate formula for installation, training, utilization review, and re-training, when necessary. Delta Health Alliance has become leader in installation of Electronic Health Records in the Delta, but it is the BLUES Project that has brought us to fully understand the bigger picture of how to help a physicians' office embrace the technology, and this is something that takes much longer than the scope of the BLUES project would have allowed. The data and information gleaned from this study enabled the principal organization to design and secure future programs that are addressing the deficiencies often seen in the MS Delta. Without this study, it would not have been revealed the level of technological literacy and training that is needed in rural clinics so that they may implement health information technology, including EHRs, in their clinics in order to serve this disparate population in a more connected way.

Significance. Findings in this study show us that deploying EHRs in and of themselves do not improve health care for diabetic patients. However, these findings can be used to imply that the promotion of best practices for disease management and care coordination in conjunction with the implementation of Health IT do improve health outcomes for patients. There is room for improvement of workflow processes and the education of providers and patients alike during the implementation of EHRs. Additionally, if workflows are not improved when the upgrade from paper to computers is made, improvement of monitoring systems for diabetes control cannot exist.

Implications. There are a number of implications from installation of electronic health records into ambulatory clinics, and from the overall lessons learned from the BLUES project. EHRs when coupled with training and all appropriate tools, can result in improved process of care measures (timely and appropriate exams and lab testing, for example), greater patient satisfaction, enhanced diabetes-related outcomes, improved provider satisfaction, better medication management, increased patient safety and reduced costs related to care. Future studies might focus on how to best implement training programs in clinics to speed up the process of EHR implementation and clinician training.

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