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Public Health Integrating Data for Improved Outcomes: Phase 3 Report

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1. OVERVIEW

This report describes the results of Phase 3 of the Public Health Integrating Data for Improved Outcomes (PHIDO) project. The PHIDO project was designed to capture the impact of funding to Beacon Communities by the Office of the National Coordinator for Health Information Technology (ONC) on health information technology (HIT) capabilities and processes in the local health departments (LHDs) included, in part or total, within the geographic area of these communities. RTI International served as a subcontractor to the Public Health Institute, which led the study. RTI supported the PHIDO project by conducting baseline quantitative data analysis of secondary data, selecting matched controls for the set of local health departments included within the Beacon Communities (Phase 1), and analyzing data from the follow-up survey of Beacon Community and control health departments (Phase 3), as described below.

2. METHODS

The design of the PHIDO project was quasi-experimental (i.e., a “natural” experiment). The study compared “exposed” health departments (i.e., those that were physically located within Beacon communities) with “unexposed” health departments (i.e., those not located within Beacon communities) and attempted to measure HIT characteristics both before and after exposure.

This mixed-method study was conducted in three phases:

- Phase 1 involved baseline analysis of secondary data and selection of matched comparison health departments;
- Phase 2 focused on key informant interviews to inform design of Phase 3 data collection; and
- Phase 3 consisted of a follow-up survey to measure processes and outcomes and analysis of changes over time.

Appendix A of this report shows the timeline and timing of data collection. The hypotheses of the PHIDO study were as follows:

- LHDs that were located within Beacon Communities developed:
 - more robust electronic Public Health Record (PHR) data system capacities, and
 - more efficient reporting processes for communicable and chronic disease surveillance.

2.1 Sample and Unit of Analysis

All LHDs located within the geographic region of a Beacon Community were *eligible* to be included in the study sample. RTI used an approach we termed “intent to reach,” which meant that a LHD was included as exposed whether or not the LHD received Beacon funding or participated in Beacon activities.

Challenges to defining the sample included the existence of “regional” LHD districts that did not always correlate to the boundaries of a Beacon Community; standalone city LHDs that were nested within a county; and Beacon communities that crossed state lines. We excluded LHDs that were part of a Beacon geographic area but that did not respond to a 2010 profile survey conducted by the National Association of City and County Health Officers (NACCHO), as well as Beacon communities in states without LHDs (i.e., Rhode Island). Our final exposed sample consisted of 80 local LHDs within 17 states.

2.2 Defining Outcomes: Capabilities and Processes

The research team identified a set of a priori HIT capabilities and processes of interest based on expert knowledge of the field. In addition, Phase 2 of the PHIDO study provided additional metrics to use in the Phase 3 study. In general, the outcomes of interest were as follows:

- Robust LHD electronic data collection and reporting capabilities, including 1) internal data sharing and reporting on shared data platform rather than standalone, non-interoperable databases; 2) unidirectional data sharing and reporting with the local clinical care system or state health department; and 3) bidirectional data sharing with the local clinical care system or state health department.
- Efficient and complete LHD electronic data collection and reporting processes, including 1) the percentage of LHDs that initiate and complete communicable disease outbreak investigations within a given time standard; 2) the percentage of LHDs that can access and use electronic laboratory reports after receiving a report of an outbreak within a given time standard; and 3) the percentage of LHDs that can access and use information from a disease registry within a given time standard.

2.3 Data Sources

The data sources used for Phase 3 were the 2010 NACCHO Profile Survey; the Centers for Medicare and Medicaid Services (CMS) directory of health care providers participating in Meaningful Use; the Area Health Resource File from the U.S. Census Bureau; and a survey conducted as part of the PHIDO project in April through May 2015 of a sample of exposed LHDs and their matched controls.

2.4 Summary of Phase 1 Development of Comparison Group

Since Beacon funding was likely not random, changes in outcomes over time in Beacon LHDs may reflect unobserved differences in those Beacon LHDs rather than the effect of Beacon funding. Therefore, it was necessary to develop an appropriate comparison group to make causal inference. A comparison group was generated by identifying a matched LHD for each exposed LHD that was not located within a Beacon Community, but was located within the same state and was otherwise similar in terms of the key factors that might influence the outcomes of the study. Overall, the goal was to identify a comparison group that had no significant differences with respect to information technology (IT) infrastructure or capabilities at baseline, or other factors that might influence these outcomes.

The research team identified a set of characteristics as predictors in the propensity model, which were theoretically correlated with Beacon funding or outcomes. These characteristics

fell into three categories: organizational and financing characteristics of LHDs, activities and services of LHDs, and area-Level factors.

We estimated a propensity score for each LHD in NACCHO Profile using logistic regression model. We used nearest-neighbor matching without replacement and required that the matched LHD be in the same state. Each exposed LHD was matched with the non-exposed LHD that had the closest propensity score. The final matched sample consisted of 160 LHDs: 80 exposed and 80 unexposed.

Appendix B provides the results of the matching process. Table B1 displays the characteristics of Beacon Community LHDs compared to all control LHDs. Table B2 displays the logistic regression model for the propensity score analysis, including which characteristics were significant in the final model. Table B3 is similar to Table B1 and shows the characteristics of the Beacon Community LHDs and the matched sample of 80 unexposed LHDs. Table B4 shows the actual LHDs that were included in the matched sample. Finally, Table B5 and Figure B1 demonstrate the results of the matching process: bias was almost completely reduced; no covariates were statically different between Beacon Community and control LHDs; and the covariates were jointly insignificant.

2.5 Analysis Plan

The initial analysis plan for assessing the effect of Beacon funding was dependent on obtaining outcome data from the matched exposed and unexposed LHDs in the Phase 2 survey. Matching was essential to ensure that baseline differences between the Beacon Community LHDs and the control LHDs were not driving different trends in IT between the groups. The results of the matching process (see Appendix B) demonstrate that there were no observable differences between the 80 Beacon Community LHDs and the 80 control LHDs selected as matches. However, the response rate for the survey was only 24% (N=19) for the Beacon Community LHDs and 19% (N = 15) for the unexposed group, and few of the respondents were matched pairs. This means that the match was broken and there is a strong likelihood that the two groups were significantly different at baseline. Analysis of the bias between the Beacon Community LHDs and the control LHDs in the sample of respondents showed significant differences between the groups: mean standardized bias was 24.4% and median standardized bias was 21.3%. These differences are larger than those in the full sample of LHDs in the NACCHO profile dataset (where mean standardized bias was 14.2%, and median standardized bias was 11.4%), indicating that the bias in the sample actually increased due to the low survey response. Because of this increased bias, it is necessary to control for differences at baseline in the analysis. However, we anticipated difficulty controlling for the full range of potential confounders due to unobserved factors and the low sample size resulting in decreased degrees of freedom. Another concern

resulting from the low response rate was the reduction in statistical power to detect significant effects of Beacon funding.

Based on these concerns with the low response rate for the Phase 2 survey, RTI developed a revised analysis plan that addressed some of the concerns over bias in the Beacon and unexposed samples. We used regression analysis to control for baseline differences in observable characteristics that may be associated with the outcomes of interest. We included a similar set of variables chosen for matching in Phase 1 as controls:

- County characteristics: population, poverty rate; median income; MDs per capita; providers participating in Meaningful Use Program per capita;
- LHD characteristics: decentralized government; having a local board of health; per capita expenditure; FTEs per capita; fraction of revenue from CMS; fraction of revenue from local taxes and fees; employing a CIO; conducting any surveillance; conducting any screening; conducting any prevention; conducting immunization; conducting primary care; sharing an improvement plan with the state; and who is responsible for HIEs; and
- State health department (SHD) characteristics: conducting syndromic surveillance, conducting communicable disease surveillance, conducting chronic disease surveillance, and conducting risk factor surveillance.

The outcomes in the model were created from questions from the Phase 2 survey. The survey asked respondents if the LHD currently uses each one of a set of IT processes and whether they started using that process before or after 2010. RTI used these questions to create measures of IT process use before and after Beacon funding and measures of the change in use. The change in use after Beacon funding was the outcome variable used in regression analysis.

The IT processes examined were as follows:

- Use electronic health records (EHRs) for any clinical care services
- Use electronic public health records (EPHRs) for any non-clinical public health services
- Use a health information exchange (HIE) for any communicable disease data
- Use an HIE for any chronic disease data
- Use any disease registries
- Develop any new partnerships with the SHD
- Develop any new partnerships with the local healthcare system
- Send or receive any electronic data with the SHD

- Send or receive any electronic data with local healthcare system partners.

The second set of outcome variables examined was the change in the amount of time different IT activities take for the LHD to complete. The survey asked how long it takes the LHD to complete a set of IT processes and whether that amount of time decreased, stayed the same, or increased since 2010. Because our analysis was of changes over time, we examined the outcome of whether the time necessary to complete each process decreased since 2010.

The processes examined were as follows:

- Document and assign public health staff to initiate a communicable disease investigation after receiving notification of a possible outbreak
- Access external laboratory reports after receiving notification of an outbreak
- Access information from an immunization registry once a need for the information is identified
- Access information from a chronic disease registry once a need for the information is identified
- Prepare and share a syndromic surveillance report with public health staff
- Complete a routine outbreak investigation, and generate a shareable report using recommended procedures and protocols
- Prepare a shareable report of county-wide or city-wide chronic disease outcomes, screening outcomes, or behavioral risk factors.

The Phase 2 survey was fielded more broadly to LHDs in the state of California that were neither in the Beacon Community or matched unexposed groups; 10 LHDs from the California sample responded to the survey. Because the methodology was changed to be based on control variables rather than matching, RTI chose to include these LHDs in the final analysis sample in order to increase our sample size and statistical power.

3. FINDINGS

The use of each of the 8 of the 9 IT processes increased on average for both Beacon Community LHDs and control LHDs over the Beacon period (**Table 3-1**). The only process that did not increase was sending or receiving any electronic data with local healthcare system partners, which was not used by any LHDs either before or after Beacon funding. The proportions of LHDs reporting using each of the IT processes was similar in the post-Beacon period (**Table 3-1**). Between 5 and 26% of LHDs in Beacon Community LHDs and control LHDs reported decreased time to conduct each of the 7 processes over the Beacon period (**Table 3-2**), with no consistent patterns in prevalence of decreased conduct time between Beacon Community LHDs and control LHDs.

Regressions of the association between Beacon Community status and the use of IT processes show that the association is only statistically significant for the outcome sending or receiving any electronic data with the SHD (**Table 3-3**). Estimates show a 30 percentage point increase in the use of that process. All other coefficients are positive but not statistically significant because of the large standard errors resulting from the small sample size. Regression of the association between Beacon Community status and decreases in the time it takes LHDs to conduct processes show that there are no statistically significant associations (**Table 3-4**). Some coefficients are negative and some coefficients are positive, depending on the outcome measure.

Table 3-1. Fraction of LHDs using IT Processes Pre and Post-Beacon Period, by Beacon Community Status

IT Process	Beacon Community LHDs			Control LHDs		
	Pre-Beacon	Post-Beacon	Change	Pre-Beacon	Post-Beacon	Change
Use EHRs for any clinical care services	0.4	0.65	0.25	0.54	0.67	0.13
Use EPHRs for any non-clinical public health services	0	0.95	0.95	0.00	0.88	0.88
Use an HIE for any communicable disease data	0.4	0.6	0.2	0.42	0.54	0.13
Use an HIE for any chronic disease data	0.05	0.15	0.1	0.17	0.17	0.00
Use any disease registries	0.5	0.6	0.1	0.50	0.63	0.13
Develop any new partnerships with the SHD	0.3	0.45	0.15	0.25	0.58	0.33
Develop any new partnerships with the local healthcare system	0.2	0.45	0.25	0.13	0.46	0.33
Send or receive any electronic data with the SHD	0.75	0.85	0.1	0.67	0.79	0.13
Send or receive any electronic data with local healthcare system partners	0	0	0	0	0	0

Table 3-2. Proportion of LHDs Reporting a Decrease in Time Taken for Processes, by Beacon Community Status (2010 to 2015)

Process	Beacon Community LHDs	Control LHDs
Document and assign public health staff to initiate a communicable disease investigation after receiving notification of a possible outbreak	0.11	0.11
Access external laboratory reports after receiving notification of an outbreak	0.06	0.26
Access information from an immunization registry once a need for the information is identified	0.17	0.05
Access information from a chronic disease registry once a need for the information is identified	0.17	0.12
Prepare and share a syndromic surveillance report with public health staff	0.06	0.06
Complete a routine outbreak investigation, and generate a shareable report using recommended procedures and protocols	0.11	0.22
Prepare a shareable report of county-wide or city-wide chronic disease outcomes, screening outcomes, or behavioral risk factors	0.17	0.06

Table 3-3. Regression coefficients for the association of Beacon Community status with the use of IT processes

IT Process	Coefficient	Standard Error
Use EHRs for any clinical care services	0.36	(0.29)
Use EPHRs for any non-clinical public health services	0.21	(0.18)
Use an HIE for any communicable disease data	0.10	(0.22)
Use an HIE for any chronic disease data	0.12	(0.15)
Use any disease registries	0.16	(0.17)
Developed any new partnerships with the SHD	0.11	(0.14)
Developed any new partnerships with the local healthcare system	0.08	(0.27)
Send or receive any electronic data with the SHD	0.30**	(0.13)

Notes:

1. Regressions include controls for county characteristics, such as population, poverty rate, median income, MDs per capita, and providers participating in Meaningful Use Program per capita; LHD characteristics, such as decentralized government, having a local board of health, per capita expenditure, FTEs per capita, fraction of revenue from CMS, fraction of revenue from local taxes and fees, employing a CIO, conducting any surveillance, conducting any screening, conducting any prevention, conducting immunization, conducting primary care, sharing an improvement plan with the state, and who is responsible for HIEs; and SHD characteristics, such as conducting syndromic surveillance, conducting communicable disease surveillance, conducting chronic disease surveillance, and conducting risk factor surveillance.
2. ** Indicates $p < 0.05$

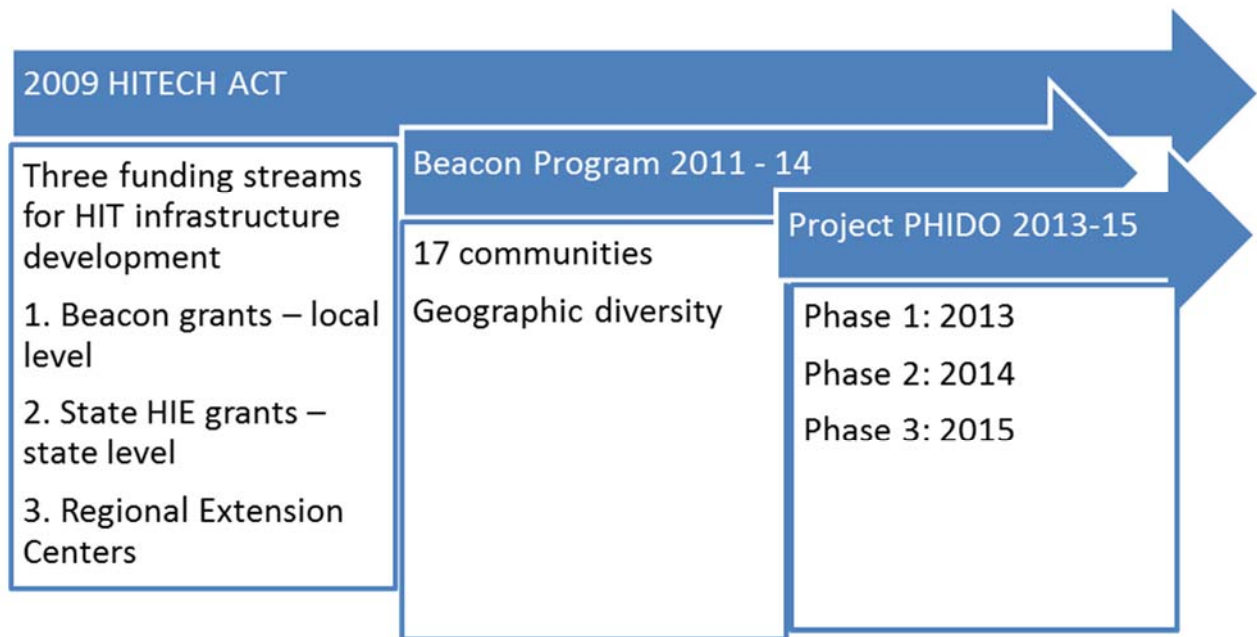
Table 3-4. Regression coefficients for the association of Beacon Community status with decreases in time taken for processes

Process	coeff icient	standar d error
Document and assign public health staff to initiate a communicable disease investigation after receiving notification of a possible outbreak	0.15	(0.30)
Access external laboratory reports after receiving notification of an outbreak	-0.17	(0.11)
Access information from an immunization registry once a need for the information is identified	0.05	(0.26)
Access information from a chronic disease registry once a need for the information is identified	-0.08	(0.28)
Prepare and share a syndromic surveillance report with public health staff	-0.01	(0.22)
Complete a routine outbreak investigation and generate a shareable report using recommended procedures and protocols	0.03	(0.13)
Prepare a shareable report of county-wide or city-wide chronic disease outcomes, screening outcomes, or behavioral risk factors	-0.11	(0.12)

Notes:

1. Regressions include controls for county characteristics, such as population, poverty rate, median income, MDs per capita, and providers participating in Meaningful Use Program per capita; LHD characteristics, such as decentralized government, having a local board of health, per capita expenditure, FTEs per capita, fraction of revenue from CMS, fraction of revenue from local taxes and fees, employing a CIO, conducting any surveillance, conducting any screening, conducting any prevention, conducting immunization, conducting primary care, sharing an improvement plan with the state, and who is responsible for HIEs; and SHD characteristics, such as conducting syndromic surveillance, conducting communicable disease surveillance, conducting chronic disease surveillance, and conducting risk factor surveillance.

APPENDIX A. TIMELINE FOR DATA COLLECTION



APPENDIX B. SUMMARY OF PHASE 1 SELECTION OF MATCHED LOCAL HEALTH DEPARTMENTS

Table B1. Summary Statistics for Local Health Departments in 2010, by whether Beacon Community Status of the LHD

	Beacon (N = 80)	Non- Beacon (N = 1699)
Variable	Mean	Mean
Population	266282	338344
<i>Race</i>		
White	86%	85%
Black	7%	8%
Hispanic	5%	5%
Other Race	3%	1%
<i>Education</i>		
Less than High School Degree	6%	8%
High School Degree or More	82%	79%
College Degree or More	21%	19%
<i>Area Economic Characteristics</i>		
Poverty Rate	13%	14%
Median Income	\$40145	\$38601
<i>Area Health Providers</i>		
MDs per 1000 people	2.14	1.69
Providers participating in meaningful use per 1000 people	0.70	0.63
<i>Local Health Department (LHD) Characteristics</i>		
Decentralized	75%	69%
Has Local Board of Health	85%	74%
Local Board of Health Advises and Sets Priorities	74%	68%
Led by Health Professional	60%	69%
Employs CIO	30%	20%
LHD was not able to Report Total Expenditure	10%	18%
Per Capita LHD Spending	\$50.21	\$54.58
LHD was not able to Report Total FTEs	10%	6%

FTEs per 1000 people	0.55	0.70
LHD was not able to Report Revenue from Medicare and Medicaid	31%	35%
Percent of Total Revenue from Medicare and Medicaid	14%	17%
LHD was not able to Report Revenue from Locally Generated Taxes and Fees	31%	38%
Percent of Total Revenue from Locally Generated Taxes and Fees	29%	29%
LHD Conducts Surveillance for Communicable Diseases	91%	95%
LHD Conducts Surveillance for Chronic Diseases	43%	45%
LHD Conducts Surveillance for Syndromic Diseases	41%	48%
LHD Conducts Surveillance for Risk Factors	39%	42%
LHD Conducts Screening for Cancer	48%	47%
LHD Conducts Screening for Cardiovascular Disease	30%	38%
LHD Conducts Screening for Diabetes	35%	48%
LHD Conducts Screening for High Blood Pressure	64%	70%
LHD Conducts Prevention for Chronic Conditions	70%	59%
LHD Conducts Prevention with Nutrition	86%	76%
LHD Conducts Prevention with Physical Activity	64%	58%
LHD Conducts Prevention for Tobacco	81%	76%
LHD Provides Immunization to Adults	98%	97%
LHD Provides Immunization to Children	99%	97%
LHD Provides Primary Care	13%	72%
LHD Shares Health Improvement Plan with the State	35%	39%
<i>State Health Department (SHD) Characteristics</i>		
CIO is Responsible for Health IT Decisions	65%	61%
Board or Committee is Responsible for Health IT Decisions	18%	15%
Other Person or Group is Responsible for Health IT Decisions	18%	24%
State Health Improvement Plan is Linked to Local Plans	26%	25%
SHD Conducts Syndromic Disease Surveillance	100%	95%
SHD Conducts Communicable Disease Surveillance	100%	95%
SHD Conducts Chronic Disease Surveillance	91%	93%
SHD Conducts Risk Factor Surveillance	91%	98%
SHD Sends or Receives Electronic Lab Reports	100%	95%
LHDs Send Electronic Health Reports to SHD	78%	96%
LHDs Receive Electronic Health Reports from SHD	96%	91%
SHD Provides Technical Assistance	99%	77%

Table B2. Marginal Effects from Logistic Regression of Propensity Score for Beacon Community Status

Variable	Marginal Effect on Propensity Score of Beacon Status
Population (in thousands)	-0.000063
	0.000158
<i>Race (Reference Group = % White)</i>	
% Black	0.00440**
	(0.00191)
% Hispanic	-0.00131
	(0.00320)
% Other race	-0.00148
	(0.00370)
<i>Education (Reference Group = % Less than High School)</i>	
% High School	0.000169
	(0.00369)
% College or more	-0.00131
	(0.00225)
<i>Area Economic Characteristics</i>	
Poverty rate	-0.000974**
	(0.000402)
Median household income (in thousands)	-0.00123
	0.00341
<i>Area Health Providers</i>	
MDs per 1000 people	0.0172***
	(0.00391)
Providers participating in meaningful use per 1000 people	-0.0155***
	(0.00503)
<i>Local Health Department (LHD) Characteristics</i>	
Decentralized	-0.0933
	(0.206)
Has Local Board of Health	0.0728***
	(0.0154)

Local Board of Health Advises and Sets Priorities	-0.113
	(0.0923)
Led by Health Professional	-0.0571***
	(0.0212)
Employs CIO	0.00679
	(0.0314)
Per Capita Expenditure	-0.000815**
	(0.000324)
LHD not able to report expenditure	-0.0191
	(0.0341)
FTEs per 1000 people	0.0107
	(0.0324)
LHD not able to report FTEs	0.0542
	(0.0425)
Percent of Total Revenue from Medicare and Medicaid	0.117
	(0.0872)
LHD unable to report revenue from Medicare and Medicaid	0.0661
	(0.0555)
Percent of Total Revenue from Locally Generated Taxes and Fees	0.0230
	(0.0568)
LHD unable to report Percent revenue from locally generated taxes and fees	-0.0783**
	(0.0340)
LHD conducts cancer screening	0.0453
	(0.0393)
LHD conducts CVD screening	-0.0171
	(0.0270)
LHD conducts diabetes screening	-0.0223*
	(0.0130)
LHD conducts blood pressure screening	0.0169
	(0.0234)
LHD Conducts Prevention for Chronic Conditions	0.0157
	(0.0257)

LHD Conducts Prevention with Nutrition	0.0438*
	(0.0238)
LHD Conducts Prevention with Physical Activity	-0.0420*
	(0.0240)
LHD Conducts Prevention for Tobacco	-0.00901
	(0.0423)
LHD Provides Immunization to Adults	0.0293
	(0.0559)
LHD Provides Immunization to Children	0.0218
	(0.0309)
LHD Provides Primary Care	0.00765
	(0.0392)

Notes:

1. Robust standard errors in parentheses
2. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
3. Model also includes dummy variable fixed effects for state

Table B3. Summary Statistics for Local Health Departments in 2010, Matched Sample

	Beacon (N=80)	Within state matched sample (N = 80)
Variable	Mean	Mean
Population	266282	239677
<i>Race</i>		
White	86%	85%
Black	7%	7%
Hispanic	5%	5%
Other Race	3%	2%
<i>Education</i>		
Less than High School Degree	6%	6%
High School Degree or More	82%	82%
College Degree or More	21%	21%
<i>Area Economic Characteristics</i>		
Poverty Rate	13%	13%
Median Income	\$40145	\$39757
<i>Area Health Providers</i>		
MDs per 1000 people	2.14	1.93
Providers participating in meaningful use per 1000 people	0.70	0.70
<i>Local Health Department (LHD) Characteristics</i>		
Decentralized	75%	75%
Has Local Board of Health	85%	84%
Local Board of Health Advises and Sets Priorities	74%	75%
Led by Health Professional	60%	55%
Employs CIO	30%	19%
LHD was not able to Report Total Expenditure	10%	11%
Per Capita LHD Spending	\$50.21	\$51.90
LHD was not able to Report Total FTEs	10%	8%
FTEs per 1000 people	0.55	0.54
LHD was not able to Report Revenue from Medicare and Medicaid	31%	39%
Percent of Total Revenue from Medicare and Medicaid	14%	14%

LHD was not able to Report Revenue from Locally Generated Taxes and Fees	31%	39%
Percent of Total Revenue from Locally Generated Taxes and Fees	29%	29%
LHD Conducts Surveillance for Communicable Diseases	91%	96%
LHD Conducts Surveillance for Chronic Diseases	43%	51%
LHD Conducts Surveillance for Syndromic Diseases	41%	45%
LHD Conducts Surveillance for Risk Factors	39%	53%
LHD Conducts Screening for Cancer	48%	50%
LHD Conducts Screening for Cardiovascular Disease	30%	30%
LHD Conducts Screening for Diabetes	35%	33%
LHD Conducts Screening for High Blood Pressure	64%	61%
LHD Conducts Prevention for Chronic Conditions	70%	71%
LHD Conducts Prevention with Nutrition	86%	86%
LHD Conducts Prevention with Physical Activity	64%	69%
LHD Conducts Prevention for Tobacco	81%	81%
LHD Provides Immunization to Adults	98%	95%
LHD Provides Immunization to Children	99%	96%
LHD Provides Primary Care	13%	10%
LHD Shares Health Improvement Plan with the State	35%	41%
<i>State Health Department (SHD) Characteristics</i>		
CIO is Responsible for Health IT Decisions	65%	65%
Board or Committee is Responsible for Health IT Decisions	18%	18%
Other Person or Group is Responsible for Health IT Decisions	18%	18%
State Health Improvement Plan is Linked to Local Plans	26%	26%
SHD Conducts Syndromic Disease Surveillance	100%	100%
SHD Conducts Communicable Disease Surveillance	100%	100%
SHD Conducts Chronic Disease Surveillance	91%	91%
SHD Conducts Risk Factor Surveillance	91%	91%
SHD Sends or Receives Electronic Lab Reports	100%	100%
LHDs Send Electronic Health Reports to SHD	78%	78%
LHDs Receive Electronic Health Reports from SHD	96%	96%
SHD Provides Technical Assistance	99%	99%
Mean difference in propensity score between treatment and control		0.044
(Standard Deviation)		(0.123)

Table B4. Beacon Community Local Health Departments and Matched LHDs, Within-State Matching

Beacon Community		Matched, Within-State, LHDs	
LHD name	State	LHD name	State
Greater THAN			
Cherokee County Health Department	OK	Carter County Health Department	OK
Creek County Health Department	OK	Lincoln County Health Department	OK
Muskogee County Health Department	OK	Grady County Health Department	OK
Okmulgee County Health Department	OK	Greer County Health Department	OK
Osage County Health Department	OK	Canadian County Health Department	OK
Rogers County Health Department	OK	Kingfisher County Health Department	OK
Tulsa City-County Health Department	OK	Ottawa County Health Department	OK
Wagoner County Health Department	OK	Love County Health Department	OK
Washington County Health Department	OK	Logan County Health Department	OK
Delta Blues			
Public Health District 1 - Northwest/Mississippi Department of Health	MS	Public Health District 7 - Southwest/Mississippi Department of Health	MS
Public Health District 3 - Delta/Hills / Mississippi Department of Health	MS	Public Health District 6 - East Central/Mississippi Department of Health	MS
Public Health District 5 - West Central/Mississippi Department of Health	MS	Public Health District 8 - Southeast/Mississippi Department of Health	MS
Greater Cincinnati			
Bracken County Health Department	KY	Fleming County Health Department	KY
Northern Kentucky Independent District Health Department	KY	Buffalo Trace District Health Department	KY
Three Rivers District Health Department	KY	Pennyrile District Health Department	KY
Cincinnati Health Department	OH	Cuyahoga County Board of Health	OH
Clermont County Health District	OH	East Liverpool City Health District	OH
Hamilton County General Health District	OH	Norwood City Health District	OH

Warren County Combined Health District	OH	Sharonville City Health District	OH
Central Indiana			
Boone County Health Department	IN	Wells County Health Department	IN
Brown County Health Department	IN	Marshall County Health Department	IN
Hamilton County Health Department	IN	Clark County Health Department	IN
Hancock County Health Department	IN	Howard County Health Department	IN
Hendricks County Health Department	IN	Bartholomew County Health Department	IN
Johnson County Health Department	IN	Carroll County Health Department	IN
Marion County Health Department	IN	LaGrange County Health Department	IN
Morgan County Health Department	IN	Ripley County Health Department	IN
Western New York			
Allegany County Health Department	NY	Westchester County Health Department	NY
Cattaraugus County Health Department	NY	Monroe County Department of Public Health	NY
Chautauqua County Health Department	NY	Oswego County Health Department	NY
Erie County Department of Health	NY	Tioga County Health Department	NY
Niagara County Health Department	NY	Livingston County Department of Health	NY
Orleans County Health Department	NY	Onondaga County Health Department	NY
Wyoming County Health Department	NY	St. Lawrence County Health Department	NY
Inland Northwest			
North Central District Health Department (Region 2)	ID	South Central District Health (Region 5)	ID
Panhandle Health District (Region 1)	ID	Southwest District Health Department (Region 3)	ID
Asotin County Health District	WA	Mason County Department of Health Services	WA
Benton-Franklin Health District	WA	Thurston County Public Health and Social Services Department	WA
Chelan-Douglas Health District	WA	Tacoma-Pierce County Health Department	WA
Garfield County Health District	WA	Wahkiakum County Health Department	WA

Grant County Health District	WA	Jefferson County Public Health	WA
Lincoln County Health Department	WA	Whatcom County Health Department	WA
Northeast Tri-County Health District	WA	Klickitat County Health Department	WA
Okanogan County Public Health	WA	Yakima County Health District	WA
Spokane Regional Health District	WA	Skagit County Health Department	WA
Walla Walla County Health Department	WA	Pacific County Health and Human Services Department	WA
Crescent City			
City of New Orleans Department of Health	LA	Region 7 (Northwest Regional Office)	LA
Region 1 (Metro Regional Office)	LA	Region 6 (Central Regional Office)	LA
Bangor Maine			
Central Maine District Public Health/MCDC	ME	Aroostook District Public Health/MCDC	ME
Downeast District Public Health/MCDC	ME	City of Portland Public Health Division	ME
Midcoast District Public Health/MCDC	ME	York District Public Health/MCDC	ME
Penquis District Public Health/MCDC	ME	Cumberland District Public Health/MCDC	ME
Keystone			
Northcentral District Office	PA	Erie County Department of Health	PA
Southeastern Michigan			
Detroit Health Department	MI	Central Michigan District Health Department	MI
Lapeer County Health Department	MI	Washtenaw County Public Health Department	MI
St. Clair County Health Department	MI	Genesee County Health Department	MI
Wayne County Health Department	MI	Berrien County Health Department	MI
Utah			
Salt Lake Valley Health Department	UT	Southwest Utah Public Health Department	UT
Summit County Public Health Department	UT	Weber-Morgan Health Department	UT
Tooele County Health Department	UT	Bear River Health Department	UT
Southern Peidmont			
Public Health Authority of Cabarrus County	NC	Mecklenburg County Health Department	NC

Rowan County Health Department	NC	Granville-Vance District Health Department	NC
Stanly County Health Department	NC	Lenoir County Health Department	NC
Southeastern Minnesota			
Fillmore County Public Health	MN	St. Paul-Ramsey County Public Health Department	MN
Freeborn County Public Health	MN	Waseca County Public Health Services	MN
Goodhue County Public Health Services	MN	Washington County Department of Public Health and Environment	MN
Houston County Public Health	MN	Hennepin County Human Services and Public Health	MN
Mower County Public Health Nursing Service	MN	Nicollet County Public Health Nursing Service	MN
Olmsted County Public Health Services	MN	Sherburne County Public Health	MN
Steele Community Health Services/Public Health Nursing	MN	Crow Wing County Health Services	MN
Wabasha Community Health Service	MN	Wright County Human Services	MN
Winona Community Health Services Agency	MN	Human Services of Faribault and Martin County	MN
San Diego			
County of San Diego HHS and Public Health Services	CA	Kings County Health Department	CA
Colorado			
Community Health Services, Inc.	CO	Dolores County Public Health Nursing Service	CO
Delta County Department of Health and Human Services	CO	El Paso County Department of Health and Environment	CO
Garfield County Public Health Nursing Service	CO	Summit County Public Health Nursing Service	CO
Gunnison County Public Health	CO	Northeast Colorado Health Department	CO
Mesa County Health Department	CO	Tri-County Health Department	CO
Montrose County Health & Human Services	CO	Jefferson County Department of Health and Environment	CO
Rio Blanco County Public Health Nursing Service	CO	Mineral County Public Health Nursing Service	CO

Table B5. Test results evaluating the goodness of the matching

Measure	Unmatched	Matched
Mean Bias	14.2%	5.6%
Median Bias	11.4%	3.2%
Number of Covariates with Statistically Significant Differences	7	0
Likelihood Ratio Chi ² p-value	0.000	0.961

Figure B1. Histogram of bias before and after matching

