Frontiers in Public Health Services and Systems Research

Volume 4 | Number 4 Article 3

July 2015

Implementation of Electronic Disease Reporting Systems by Local Health Departments

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Recommended Citation

Shah GH, Williams K, Shah BG. Implementation of electronic disease reporting systems by local health departments. Front Public Health Serv Sys Res 2015; 4(4):13–20. DOI: 10.13023/FPHSSR.0404.03.

Implementation of Electronic Disease Reporting Systems by Local Health Departments

Abstract

Background: Electronic disease reporting systems (EDRSs) are imperative for local health departments (LHDs) operating in the post-H1N1 and evidence-based public health practice era. Studies regarding functionality and factors responsible for variation in implementation are important but rare.

Purpose: This primary objective for this study was to provide evidence regarding the level to which LHDs have implemented electronic disease reporting systems and factors associated with variation in implementation of electronic disease reporting systems.

Methods: A quantitative analysis was performed of the 2013 Profile of Local Health Departments Survey conducted by the National Association of County and City Health Officials (NACCHO). The Profile study used a nationally representative sample of 625 LHDs and received an 81% response rate. Using a Multinomial Logistic Regression model, significant factors explaining variation were examined.

Results: Significant factors associated with the implementation of EDRSs were experienced (tenure) top executive, jurisdiction population size, region of geographic location, presence of Local Board of Health, type of governance, presence of health information specialist on staff, and number of clinical services performed.

Implications: For the advancement of public health surveillance in the 21st century, LHDs need the capacity for real time surveillance data collection and use, as well as, interoperable and integrated disease surveillance systems. Policies aimed at advancing disease surveillance in the United States might benefit from our findings on modifiable factors associated with the difference in EDRS implementation.

Keywords

Informatics, electronic disease reporting systems, surveillance, local health departments

Cover Page Footnote

No competing financial or editorial interests were reported by the authors of this paper.

Disease surveillance systems (DSS) are the cornerstone of health informatics for local health departments (LHDs) operating in the post-H1N1 and evidence-based public health practice era. An electronic disease surveillance system refers to a system for electronically transferring disease-related public health data from the healthcare facilities to LHDs (and state health agencies) for surveillance and early detection of outbreaks. The DSSs are instrumental for the prevention and control of disease, because they provide real-time information through continuous and "systematic collection, analysis, and interpretation of health data" to inform "planning, implementation, and evaluation of public health practice."[1] Disease surveillance systems can offer critical functionality and evidence to public health agencies as they provide an early warning and identify emergencies, guide policy, strategy, and interventions, and help with documenting program or intervention impacts.[1,2]

The functionality of surveillance systems vary at local, state, and federal levels by individual cases, scale, and type of situations that commonly occur in the jurisdiction.[1] Advances of technology have allowed public health agencies to receive information almost immediately, allowing for prevention of potential outbreaks, faster responses to actual outbreaks, and updates to registries.[1]

Data-Information System-Context (DISC) rings can serve as a guiding conceptual framework for assessing disease surveillance systems in public health agencies. Fu, Tolentino, and Franzke[3] developed the DISC rings to describe the environmental and organizational context effects on system design, development, implementation, and use. The information system goals inform the structure and representation of the system, and which data are collected. The information system components or structure includes people, process, and technology and the context components are environment and organization.[3] Our selection of the organizational factors explaining the variation in implementation of disease surveillance information systems by LHDs is guided by this framework.

Health departments' engagement in disease surveillance is not new, although in the absence of electronic disease surveillance systems, such surveillance was hampered by the quality and inadequacy of data. For instance, a systematic evaluation of the pre-electronic disease reporting revealed that the reporting of even the notifiable disease lacked completeness as it varied from 9% to 99% based on disease being reported.[3] Given the critical role and functionality of the electronic disease surveillance systems, it is important to know the level to which LHDs have implemented the electronic disease reporting systems and factors responsible in variation in implementation but such studies are rare, if any. This study uses the most recently available quantitative data to bridge the evidence gap regarding LHDs' use of electronic disease surveillance systems.

METHODS

Data. Data for the quantitative analysis were drawn from the 2013 National Profile of Local Health Departments Survey (Profile), collected by the National Association of County and City Health Officials (NACCHO). In addition to the core set of questions administered to all 2,532 LHDs across the country, a representative sample of LHDs received a questionnaire containing informatics-related questions. This nationally-representative sample consisted of 625 LHDs; 505 LHDs completed the survey (81% response rate). To account for the sampling design involving oversampling of larger LHDs, as well as for disproportional nonresponse rates by LHD size, appropriate statistical weights were applied to descriptive and multivariable analyses, accounting for jurisdictional size. Additional details about the Profile study design are available elsewhere.

The Institutional Review Board of Georgia Southern University approved this study as exempt from a full review.

Dependent variables for the quantitative analyses. The dependent variable, level of implementation of disease surveillance system, was operationalized through the question (in 2013 Profile study) in which LHDs were requested to indicate the level of activity for *electronic disease reporting system (EDRS)* in their LHD, with the following response categories: (1) no activity, (2) have investigated, (3) planning to implement, and (4) have implemented. Original categories (2) and (3) were combined to reflect a level of informatics capacity between "no activity" and have implemented. As a result, the outcome variable included in the multivariate model had three response categories, with "no activity" as the reference category for the outcome variable

Independent variables. Selection of the independent variables (Table 1) was guided by the conceptual framework mentioned earlier to the extent possible, given the use of secondary data in this research. Environmental and organizational context included scale and scope, operationalized through (log of) population size and number of clinical services provided, and infrastructural robustness, reflected by decentralized governance with respect to state vs. local authority, presence of a local board of health (LBOH), per capita expenditures and whether LHD had rollover reserve funds. Other independent variables indicating the organizational environment included length of top executive tenure (tenure in years); whether the LHD comprised metropolitan or nonmetropolitan jurisdictions, and geographic location of LHD by census regions (Northeast, Midwest, South, and West). People component of the model was represented by whether LHD has information system specialist on staff (yes, no).

Statistical analysis. Multinomial logistic regression was performed to model the dependent variable with three attributes, resulting in a Nagelkerke Pseudo R-Square of 0.22, indicating that 22% of variation was explained by the independent variables. The Likelihood Ratio (LR) Chi-Square had p-value<0.0001. Analyses for this study were performed using SPSS version 22.0 (IBM Corporation, Armonk NY).

RESULTS

Table 1 provides descriptive statistics on LHD characteristics included in the study. Multinomial logistic regression results for electronic disease reporting system are presented in Table 2. LHDs with experienced top executives (greater number of years as the top executives) had significantly higher odds of having implemented an EDRS. Jurisdiction population size also had significant positive association with implementation of EDRS compared to the reference category of no activity. Significant geographic variation existed with LHDs in the Census region "West" having significantly greater odds (AOR=6.22) to have implemented (vs. no activity) an EDRS than in the Mid-west. Having one or more LBOHs was significantly associated with elevated odds of EDRS implementation, rather than having no activity toward implementation (AOR=1.53 vs. no LBOH). Decentralized governance, having a health information specialist on staff, and 2nd and 3rd quartiles of clinical services (vs. first quartile) are associated with significantly increased odds of implementation of EDRS. Metropolitan or nonmetropolitan status was not significantly associated and per capita expenditure did not have a clear pattern of association with EDRS implementation.

Table 1. Descriptive statistics for LHDs infrastructural, governance, and financial characteristics

LHD Informatics Area	N (unweighted) N=505	% (weighted)
Electronic disease reporting system		
Have implemented	368	72.2
Have investigated or plan to implement	56	9.9
Not implemented	81	17.9
Geographic location		
Northeast	173	36.6
South	86	16.7
West	170	32.8
Mid-West	76	13.8
Local board of health (LBOH)		
No LBOH	160	30.2
One or more LBOH	345	69.8
Decentralized governance		
Decentralized	405	79.5
Centralized/Shared	100	20.5
Per capita expenditures		
Not reported	132	28.2
< $19	87	16.7
$19-$30	75	13.8
$31-$46	74	14.5
$47-$75	76	14.7
>= $75	61	12.1
Whether LHD had rollover reserve funds		
No/Don't Know	271	54.0
Yes	234	46.0
LHD has information system specialist on staff		
Yes	144	21.4
No	361	78.6
Number of clinical services		
< 8 services	143	31.2
8-11 services	105	20.8
12-15 services	151	29.8
>= 15 services	100	18.2
Metropolitan status of the jurisdiction		
Metropolitan or predominantly metropolitan	236	36.1
Nonmetropolitan or predominantly Nonmetropolitan		63.9
	Number	Mean (SD)
Length of tenure (Years)	488	7.8(7.2)
Population of LHD jurisdiction	505	124661(370074.0)

Table 2. Multinomial logistic regression of LHDs' level of activity in implementing electronic disease reporting system

LHD Characteristics	Implemented vs. No Activity				Investigated or plan to implement vs. No Activity			
	Adjusted Odds Ratio	*p*-value	95% CI for AOR		Adjusted Odds Ratio	*p*-value	95% CI for AOR	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Length of tenure (Years)	1.028	**0.003**	1.01	1.05	1.017	0.196	0.99	1.04
Population of LHD jurisdiction (log)	1.261	**0.000**	1.13	1.40	1.513	**0.000**	1.28	1.79
Geographic location								
North East	1.700	**0.007**	1.16	2.50	0.685	0.149	0.41	1.14
South	0.884	**0.600**	0.56	1.40	0.332	**0.001**	0.17	0.64
West	6.217	**0.000**	3.62	10.69	2.144	**0.031**	1.07	4.29
Mid West	……		……		……		……	
Local Board of Health								
One or more LBOH	1.527	**0.002**	1.16	2.00	1.546	**0.041**	1.02	2.33
No LBOH	……		……		……		……	
Decentralized Governance								
Decentralized	10.170	**0.000**	6.34	16.33	4.408	**0.000**	2.29	8.49
Centralized/Shared	……		……		……		……	
Per Capita Expenditures								
Not reported	0.608	**0.023**	0.40	0.93	0.966	0.916	0.51	1.82
2nd Quintile	0.392	**0.000**	0.24	0.63	0.919	0.801	0.47	1.78
3rd Quintile	0.626	0.074	0.37	1.05	1.425	0.316	0.71	2.85
4th Quintile	0.233	**0.000**	0.15	0.37	0.161	**0.000**	0.07	0.36
5th Quintile	0.676	0.174	0.38	1.19	1.836	0.108	0.87	3.85
1st Quintile	……		……		……		……	
Whether LHD had rollover reserve funds								
No/Don't Know	1.262	0.106	0.95	1.67	0.754	0.164	0.51	1.12
Yes	……		……		……		……	
LHD has information system specialist on staff								
Yes	1.635	**0.011**	1.12	2.39	2.191	**0.002**	1.33	3.60
No	……		……		……		……	
Number of Clinical Services								
2nd Quartile	1.729	**0.004**	1.19	2.52	1.099	0.717	0.66	1.84
3rd Quartile	1.831	**0.001**	1.26	2.66	0.557	**0.036**	0.32	0.96
4th Quartile	1.023	0.921	0.66	1.59	0.558	0.070	0.30	1.05
1st Quartile	……		……		……		……	
Metropolitan status of the jurisdiction								
Metropolitan or predominantly metropolitan	1.213	0.270	0.86	1.71	1.002	0.994	0.61	1.65
Nonmetropolitan or predominantly nonmetropolitan	……		……		……		……	

Note: Nagelkerke R-squared for the model =0.215; *p*-values in bold-face indicate significance of differences at $p \leq 0.05$; …… indicate reference category.

IMPLICATIONS

Results are encouraging in that over 72% of LHDs had already implemented electronic disease surveillance systems, but at the same time nearly 18% had not. More interesting implication is that EDRS as an informatics capacity is not uniform across LHDs. Variation existed in implementation status of EDRS by whether LHDs had experienced (tenure) top executive, jurisdiction population size, region of geographic location, presence of an LBOH, type of governance, presence of health information specialist on staff, and number of clinical services performed. Association of tenure of the top executive with the EDRS implementation might suggest that new or less experienced top executives might benefit from general training about the uses of EDRS. The relationship with presence of LBOH might indicate that having a governing body such as a LBOH might expose LHD staff to broader perspective about benefits of EDRS implementation. Population size can be an indication of economies of scale, and might hint at scale of resource-requirement/need for implementation of EDRS. Association of EDRS' implementation with the presence of health information specialist highlights the importance of program-specific staff in public health informatics capacity and performance. Lower tendency for state-governed LHDs to implement EDRS might be due to state level capacities and infrastructure available to state-governed LHDs, reducing the need for their own tracking systems. Our findings and their implications are important in that for advancement of public health surveillance in the 21st century, public health must address surveillance needs and have skilled workforce for timely access and use of data, and the management, storage and analysis of data.[5] Factors associated with the difference in EDRS implementation system must be considered by the policies aimed to advancing the disease surveillance in the United States.

Our research should be interpreted in view of the limitations characterizing secondary data. The Profile study data are self-reported and not independently verified. Further, given the current state of evidence, we are not sure about reasons for variation in implementation of EDRS and therefore recommend this as a future area of research.

SUMMARY BOX

What is already known on this topic? Engagement in disease surveillance is not new, but in the absence of electronic disease surveillance systems, such surveillance was seriously hampered by the quality and inadequacy of data.

What is added by this report? This research provides important evidence about the level to which LHDs have implemented electronic disease reporting systems, and factors responsible in variation in implementation, based on the most recently available quantitative data.

What are the implications for public health practice/policy/research? Empirical evidence indicates variation in implementation of EDRS by characteristics of LHDs, which can be used to inform policies to promote the implementation of EDRSs. Local Health Departments need to develop interoperable EDRSs to effectively perform surveillance for early detection and prevention of disease outbreaks.

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