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ABSTRACT

This study used a unique approach to examine Florida county health department environmental health (EH) program performance of the 10 Essential Environmental Public Health Services (EEPHS) and its relationship with environment-related disease, described by enteric disease rates. Correlation analysis tested the association between performance of each EEPHS and five different enteric disease rates, while multivariate regression analysis further examined the relationships while considering program organizational characteristics as potential confounders. Correlation analyses revealed cryptosporidiosis was associated with EEPHS 2 diagnose (T_b = .195, p = .027) and EEPHS 8 workforce (T_b = .234, p = .006), and salmonellosis with EEPHS 4 mobilize (T_b = .179, p = .042) and EEPHS 6 enforce (T_b = .201, p = .020). Multivariate regression results showed EEPHS 2 diagnose (p = .04) and EEPHS 4 mobilize (p = .00) had statistically significant associations with cryptosporidiosis and salmonellosis, respectively, and suggested that improved performance of these two EEPHS may have decreased disease incidence. EH programs may benefit from improving the performance of EEPHS to address the incidence of certain enteric diseases. Continued efforts to develop a robust understanding of EH program performance and its impact on environment-related disease could enhance EH services delivery and ability to improve health outcomes.

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BACKGROUND

Local health departments (LHD) provide a range of public health programs and services that includes environmental health (EH) as a recognized foundational area that seeks to ensure and promote a safe and healthful environment (Leider et al., 2015). LHDs most commonly provide EH services associated with food safety, vector control, and drinking water quality, as well as regulating and licensing facilities such as restaurants, schools, daycares, and swimming pools (NACCHO, 2013). EH programs provide these services with the intention of preventing environment-related diseases, a category that includes enteric diseases such as giardiasis and salmonellosis (Salvato, 1992; Newbold, McKeary, Hart & Hall, 2008; Wohlgenant, Fraser, Chapman & Chen, 2014).

LHD EH program responsibilities span beyond the performance of routine regulatory and inspection services with activities such as conducting surveillance, education, and developing policy. The 10 Essential Environmental Public Health Services (EEPHS) represent these broader responsibilities by describing necessary actions for protecting and improving EH (CDC, 2014). The Environmental Public Health Performance Standards (EnvPHPS) provide a self-assessment framework that EH programs, or systems that include partner agencies, can use to examine their performance of the 10 EEPHS. The EEPHS and EnvPHPS were adapted from the 10 Essential Public Health Services and National Public Health Performance Standards to specifically address EH program performance (Sarisky, 2008; Gerding & Price, 2012; Gerding et al., 2016).

The 10 Essential Public Health Services and National Public Health Performance Standards were catalysts for research efforts that examined relationships between public health department performance, health department structural capacity, and population health outcomes (Scutchfield, Knight, Kelly, Bhandari & Vasilescu, 2004; Bhandari,

Scutchfield, Charnigo, Riddell & Mays, 2010; Ingram, Scutchfield, Charnigo & Riddell, 2012). The constructs of structure, process, and outcomes are derived from Donabedian's quality assurance model (Donabedian, 2003). Conceptual models for public health performance research drew from this model to describe connections between health department structural capacity and organizational characteristics, processes described by the performance of the essential services, and outcomes regarding effectiveness, efficiency, and equity (Handler, Issel & Turnock, 2001; Kennedy, 2003). The availability of the 10 EEPHS and EnvPHPS presented an opportunity to engage in similar research specific to EH.

Purpose

The purpose of this study was to examine the relationship between environment-related diseases and Florida Department of Health (FDOH), county health department, EH program performance, by using EnvPHPS self-assessment results and county-level enteric disease rates. A sound understanding of LHD EH program performance could potentially supply critical information for establishing effective policies and making decisions about services and activities to improve health outcomes (Erwin, 2008; Mays et al., 2009). Despite the performance-based research conducted for public health, there remain gaps in understanding the relationships between structure, performance, and outcomes when applied to local or county health department EH programs. Specifically, there was a recognized need for research to describe relationships between EH program performance and environment-related disease (Bohan, 2007).

METHODS

This cross-sectional study included EnvPHPS performance self-assessment results representing all 67 Florida county health department EH programs. However, two EH programs conducted a joint assessment resulting in 66 total observations. The EH programs completed their self-assessments between the years 2011 and 2014. The EnvPHPS Version 2.0 document describes the 10 EEPHS, provides standards for each essential service, and contains a total of 64 scaled measures organized by the EEPHS (see Table 1 for a list of the 10 EEPHS). The performance measures allow five possible responses including no activity (0%), minimal (>0 – 25%), moderate (>25 – 50%), significant (>50 – 75%), and optimal activity levels (>75 – 100%) (CDC, 2014). The number of staff participating in the self-assessments varied, some assessments included representatives from other health department programs or agencies. During the self-assessment process, EH program employees and representatives contributing to the assessment discussed and considered a response for each measure. Following the self-assessments, responses were recorded and entered into a tool that calculated an overall composite result as a percentage of fully performing the EEPHS (CDC, n.d.). The FDOH provided electronic copies of each EH program's completed tool containing self-assessment results.

The FDOH supports and maintains the Community Health Assessment Resource Tool Set (CHARTS), which is an online and publicly available resource providing access to data regarding community health status, population and social characteristics, and health indicators to inform health improvement activities. The system also provides a range of disease rates based on state mandated reporting of notifiable diseases (Charts, 2016). CHARTS was accessed to download county-level enteric disease rates per 100,000 population, corresponding to the year each EH program conducted their self-assessment. The most prevalent enteric diseases were selected, which included campylobacteriosis, cryptosporidiosis, giardiasis, salmonellosis, and shigellosis.

Previous public health performance, systems, and services research included a variety of organizational characteristic variables considered to potentially impact performance (Scutchfield et al. 2004; Bhandari et al. 2010; Meyer, Davis & Mays, 2012). Additionally, increased food safety program organizational capacity regarding staff size, experience, and budgets has shown association with decreased incidence of foodborne illness (Zablotsky Kufel et al., 2011). The study included organizational characteristics, related to those used in previous research, as potential confounding variables. The selected organizational characteristics were important because of their potential relationship with EH program performance. The FDOH provided information about EH program organizational characteristics including budgets, the number of full-time equivalents (FTE), and the number of various EH services rendered between June 1, 2014, and May 30, 2015. These data were used to calculate budget per capita, along with FTE and volume of services per 100,000 population. The volume of services variable represented an aggregate number of food, drinking water, and pool inspections and complaint responses conducted within the one-year period. County-level figures for population per square mile and percent living in poverty were obtained from the U.S. Census American Fact Finder and included in the dataset to represent the populations served by the EH programs (American Fact Finder, n.d.).

EH program performance self-assessment results, enteric disease rates, and organizational characteristics were combined in a spreadsheet and organized by county. Disease rates and organizational characteristic values were averaged for the two programs that completed a joint assessment. There were three missing values for EH program full-time equivalents and budgets variables, representing less than five percent of all values. Two EH programs did not report the year when they conducted the self-assessment. Those EH programs were paired with 2014 enteric disease rates considering most self-assessments were carried out during that year. Three EH programs shared a budget and reported the same total amount. The value was divided into thirds, and those values were included in the dataset for each of the programs.

Table 1. The 10 Essential Environmental Public Health Services (EEPHS)

EEPHS	Description
1	**Monitor** environmental and health status to identify and solve community environmental health problems
2	**Diagnose** and investigate environmental health problems and health hazards in the community
3	Inform, **educate**, and empower people and communities about environmental health issues
4	**Mobilize** community partnerships to identify and solve environmental health problems
5	Develop **policies** and plans that support individual and community environmental health efforts
6	**Enforce** laws and regulations that protect health and ensure safety
7	**Link** people to needed environmental health services and ensure the provision of environmental health services when otherwise unavailable
8	Assure a competent environmental health **workforce**
9	**Evaluate** the effectiveness, accessibility, and quality of personal and population based environmental health services
10	**Research** for new insights and innovative solutions to environmental health problems and issues

Note.
EEPHS = Essential Environmental Public Health Service. Boldface indicates the key word representing each essential service. Reproduced from "Environmental Public Health Performance Standards: Version 2.0," Centers for Disease Control and Prevention, 2014.

Data Analysis

Previous public health research recognized the importance of analyzing the performance of each essential service (Mays et al., 2006). This study followed this finding by conducting analyses for each EEPHS rather than a composite result for all essential services. Kendall's tau-b correlation tested the relationships between the 10 EEPHS and five enteric disease rates. These results helped make variable selections for multivariate regression analysis. Organizational characteristics were included in the study as potential confounding variables. Kendall's tau-b also was calculated among the organizational characteristics to prevent the possibility of multicollinearity by selecting appropriate independent variables in the regression analysis. Associations were considered strong when $T_b > .500$ (Laerd Statistics, 2016).

Poisson regression analysis is a common method chosen for analyzing dependent variables representing count data (Laerd Statistics, 2013). Negative binomial regression is an alternative to Poisson regression when over-dispersion of the dependent variable occurs (Gardner, Mulvey & Shaw, 1995; Byers, Allore, Gill & Peduzzi, 2003). Poisson regression would have been an appropriate fit for the enteric disease rate variables serving as dependent variables; however, negative binomial regression was selected for this study as the disease rate variables did not exhibit Poisson distribution and were overdispersed with variance higher than mean values.

Previous research considered public health performance and organizational variables as independent variables and health outcomes as dependent (Ingram et al., 2012; Zablotsky Kufel et al., 2011). Accordingly, the regression models were constructed with enteric disease rates as the dependent variable and one EEPHS with organizational characteristics as independent variables. The regression analysis examined the relationship between the disease rates and performance with organizational characteristics as potential confounders. The models calculated incidence rate ratios (IRR) to show changes in the incidence of the enteric diseases as a potential effect of an independent variable in presence of others. The log of county population was included as an offset to control for population size, and dependent variable values were rounded to whole numbers for analysis. Analyses were performed in 2016 and 2017 using SPSS Version 24, Armonk, NY.

RESULTS

Descriptive

Table 2 shows descriptive statistics for all study variables. EEPHS 2 diagnose (μ = 88%, SD = 12.0), EEPHS 3 educate (μ = 81%, SD = 16.1), and EEPHS 6 enforce (μ = 79%, SD = 20.6) had the highest mean results and were within the optimal level of activity. The mean performance results for all other essential services were within the activity level categorized as significant: EEPHS 8 workforce (μ = 73%, SD = 16.5), EEPHS 4 mobilize (μ = 73%, SD = 18.9), EEPHS 5 policies (μ = 71%, SD = 14.1), EEPHS 7 link (μ = 65%, SD = 23.9), EEPHS 9 evaluate (μ = 64%, SD = 22.5), EEPHS 10 research (μ = 62%, 27.8), and EEPHS 1 monitor (μ = 56%, SD = 25.2).

Salmonellosis had the highest incidence with a mean of 36.7 cases per 100,000. Campylobacteriosis showed a mean of 12.1 cases per 100,000, followed by cryptosporidiosis (μ = 8.9), giardiasis (μ = 6.7), and shigellosis (μ = 5.5). These mean rates were above the 2014 national rates per 100,000 population for cryptosporidiosis (2.7), giardiasis (5.8), salmonellosis (16.1) and below for shigellosis (6.5). National level campylobacteriosis rates were not reported (Adams et al., 2016). EH program budgets per capita ranged from $1.13 – $12.76 with mean $4.81, while mean FTEs per 100,000 were 6.6 with a range of 1.9 – 24.4. EH programs provided a mean of 747.1 services per 100,000 with a range of 178.1 – 5,962.4. The mean percentage of the population living in poverty was 18.9 with a range of 8.2 – 31.7, and mean county population per square mile was 327.8 persons with a range of 10.0 – 3,347.5. The percentage of the population living in poverty was slightly above the national percentage of 15.5 (American Fact Finder, n.d.).

Correlation Analysis

Four pairs of essential services and enteric diseases showed statistically significant relationships ($p < .05$) with weak ($T_b \leq .500$) positive correlation. Cryptosporidiosis was associated with EEPHS 2 diagnose ($T_b = .195$, $p = .027$) and EEPHS 8 workforce ($T_b = .234$, $p = .006$). Salmonellosis was associated with EEPHS 4 mobilize ($T_b = .179$, $p = .042$) and EEPHS 6 enforce ($T_b = .201$, $p = .020$). All other pairs of EEPHS and enteric diseases showed weak correlation with no statistical significance (Table 3).

Table 4 shows correlation results among the organizational characteristic variables. Correlation between all variable pairings was statistically significant ($p < .05$). A strong correlation ($T_b > .500$) existed among EH program budget per capita, FTEs per 100,000, and services per 100,000, while percent living in poverty and population per square mile showed a weak correlation between these two variables and all others. Correlation results were used to select appropriate independent variables for

the regression models. Services per 100,000 was selected as an independent variable while excluding budget per capita and FTEs per 100,000 because of the high magnitude of correlation among these three variables. Additionally, percent living in poverty and population per square mile were included as independent variables as there was no indication of strong correlation with the other organizational characteristics. The essential services showing a statistically significant association with either cryptosporidiosis or salmonellosis also served as independent variables with the organizational characteristics services provided per 100,000 population, percent living in poverty, and population per square mile.

Table 2. Descriptive Statistics for 67 Florida County Environmental Health Program Performance Self-assessment Results, Enteric Disease Rates, and Organizational Characteristics

Variable	Mean (μ)	SD	Median	Range
Monitor	56	25.2	58.5	3 – 98
Diagnose	88	12.0	90.5	60 – 100
Educate	81	16.1	87.5	32 – 100
Mobilize	73	18.9	75.0	13 – 100
Policies	71	14.1	67.0	48 – 100
Enforce	79	20.6	83.0	22 – 100
Link	65	23.9	67.0	12 – 100
Workforce	73	16.5	73.0	37 – 100
Evaluation	64	22.5	64.5	25 – 100
Research	62	27.8	66.0	9 – 100
Campylobacteriosis	12.1	6.4	11.0	0 – 31.7
Cryptosporidiosis	8.9	13.3	4.4	0 – 91.7
Giardiasis	6.7	6.5	5.5	0 – 42.6
Salmonellosis	36.7	24.3	32.9	7.8 – 196.9
Shigellosis	5.5	6.3	3.3	0 – 26.3
Budget per capita	4.81	2.2	4.57	1.13 – 12.76
FTEs per 100,000	6.6	4.3	5.5	1.9 – 24.4
Services per 100,000	747.1	4.3	5.5	178.1 – 5962.4
% Living in poverty	18.9	5.6	18.2	8.2 – 31.7
Population per square mile	327.8	514.8	165.9	10.0 – 3347.5

Note.
FTE = full-time equivalents.
EEPHS values are reported as percentages and diseases are per 100,000 population.

Table 3. Kendall's Tau-b Correlation among 67 Florida County Environmental Health Program Performance Self-assessment Results and Enteric Disease Rates

EEPHS	Campylobacte-riosis		Cryptosporidio-sis		Giardiasis		Salmonellosis		Shigellosis	
	T_b	p	T_b	p	T_b	p	T_b	p	T_b	p
Monitor	-.108	.207	.046	.594	-.087	.308	.016	.851	.059	.497
Diagnose	.025	.776	.195	**.027**	-.090	.302	.080	.361	.016	.858
Educate	.037	.665	.058	.505	.015	.859	.058	.499	.103	.238
Mobilize	-.023	.793	.097	.275	-.070	.431	.179	**.042**	.027	.762
Policies	-.044	.606	.022	.798	-.064	.460	.031	.718	-.020	.819
Enforce	-.077	.938	.101	.248	-.124	.155	.201	**.020**	-.036	.679
Link	.128	.137	.156	.072	-.047	.586	.096	.262	-.054	.540
Workforce	-.032	.706	.234	**.006**	-.089	.297	.070	.409	-.052	.548
Evaluate	.038	.657	.094	.278	-.042	.629	.105	.224	-.089	.313
Research	.017	.842	.048	.582	-.029	.735	.114	.185	-.062	.479

Note.
EEPHS = Essential Environmental Public Health Service. Boldface indicates statistical significance ($p < .05$). Table format was adapted from "Local Public Health System Performance and Community Health Outcomes," by R. C. Ingram, D. Scutchfield, R. Charnigo, & M. C. Riddell, 2012, *American Journal of Preventive Medicine*, *42*, p. 218. Copyright 2012 by the *American Journal of Preventive Medicine*.

Table 4. Kendall's Tau-b Correlation among 67 Florida County Environmental Health Program Organizational Characteristics

	Budget per capita		FTE per 100,000		% Living in poverty		Population per square mile	
	T_b	p	T_b	p	T_b	p	T_b	p
Budget per capita								
FTEs per 100,000	.648	**.001**						
% Living in poverty	.261	**.003**	.276	**.001**				
Population per square mile	-.415	**.001**	-.391	**.001**	-.390	**.001**		
Services provided per 100,000	.648	**.001**	1.00	**.001**	.276	**.001**	-.391	**.001**

Note.
FTE = full-time equivalents. Boldface indicates statistical significance ($p < .05$).

Multivariate Regression

Table 5 and Table 6 show the negative binomial regression results. Two regression models were produced for both cryptosporidiosis and salmonellosis as dependent variables and an EEPHS with three organizational characteristics as independent variables. The models were constructed with one performance variable to test the relationship between each particular EEPHS and enteric disease without the presence of another EEPHS. The models showed statistical significance jointly for all the variables ($p < .05$). EEPHS 2 diagnose ($p = .04$) and EEPHS 4 mobilize ($p = .00$) showed a statistically significant relationship with cryptosporidiosis and salmonellosis, respectively. Percent living in poverty and population per square mile had statistically significant relationships ($p < .05$) in all models. The first cryptosporidiosis model indicated that a unit increase for EEPHS 2 diagnose may have decreased incidence by 3.0%, while a unit increase in EEPHS 4 mobilize may have meant a 2.0% decrease in the incidence of salmonellosis.

DISCUSSION

Correlation analysis revealed statistically significant association between two EEPHS and cryptosporidiosis and salmonellosis, although the correlations were weak. Regression analysis with organizational characteristics as independent variables and potential confounders showed statistically significant associations between one EEPHS and cryptosporidiosis and salmonellosis. All IRR values for EEPHS variables were relatively close to 1.00, which indicated minimal potential for those independent variables to change disease incidence. However, there was an indication that improved performance of certain EEPHS may have changed enteric disease incidence. Considering these results, FDOH EH programs might benefit from improving their performance of EEPHS 2 diagnose and EEPHS 4 mobilize to address cryptosporidiosis and salmonellosis, respectively. These results may present implications for EH practice and policy by encouraging closer consideration of performance and its impact on health outcomes.

Correlation analyses showed a significant association between cryptosporidiosis, primarily a waterborne illness, and EEPHS 2 that reflects surveillance and investigation activities. Regression analysis indicated that increases in the performance of this EEPHS may have decreased cryptosporidiosis incidence in the presence of organizational characteristics. EH programs with stronger surveillance and investigation of waterborne diseases, namely cryptosporidiosis, could potentially impact the incidence of this disease. FDOH EH programs are responsible for public swimming pool inspections and permitting, and may benefit from a closer examination of improved performance and its impact on prevention of cryptosporidiosis. FDOH EH

programs share services related to drinking water safety with the Florida Department of Environmental Protection. It may be beneficial to maintain strong collaboration among the two agencies to increase surveillance and investigation efforts to prevent cryptosporidiosis and other waterborne diseases.

Correlation analysis results also indicated statistically significant relationships between salmonellosis and EEPHS 4 about mobilizing partnerships along with EEPHS 6 addressing enforcement of laws and regulations. Regression analysis showed a potential for increased performance of both EEPHS to decrease the incidence of salmonellosis, although only the association with EEPHS 4 was statistically significant. As a common foodborne illness, the prevalence of this disease can be impacted by legislation and regulatory inspections of food service establishments (Patel et al., 2010). FDOH EH programs enforce regulations through routine inspections of facilities such as institutional food establishments and other types including daycares, while another state agency has regulatory responsibility for inspecting restaurants and commercial food operations. Partnership building among agencies with a stake in food safety may prove especially important given the statistically significant relationship between EEPHS 4 concerning the mobilization of community partnerships and salmonellosis rates.

Table 5. Negative Binomial Regression Results for Cryptosporidiosis Rates

Independent variable	Coefficient	p-value	Incidence Rate Ratio (95% CI)	Change in incidence (%)
Model 1				
Diagnose	-.027	**.04**	.97 (.95, 1.00)	-3.0
% Living in poverty	.068	**.01**	1.07 (1.02, 1.13)	+7.0
Population per square mile	-.002	**.00**	1.00 (1.00, 1.00)	0
Services provided per 100,000	.000	.11	1.00 (1.00, 1.00)	0
Model 2				
Workforce	.005	.62	1.01 (.99, 1.03)	+1.0
% Living in poverty	.073	**.01**	1.08 (1.02, 1.14)	+8.0
Population per square mile	-.002	**.00**	1.00 (1.00, 1.00)	0
Services provided per 100,000	.000	.43	1.00 (1.00, 1.00)	0

Note.
Boldface indicates statistical significance ($p < .05$). Model 1 likelihood ratio chi square = 66.6, $p = .00$; Model 2 likelihood ratio chi square = 62.33, $p = .00$.

Table 6. Negative Binomial Regression Results for Salmonellosis Rates

Independent variable	Coefficient	p-value	Incidence Rate Ratio (95% CI)	Change in incidence (%)
Model 1				
Mobilize	-.021	**.00**	.98 (.97, .99)	-2.0
% Living in poverty	.130	**.00**	1.14 (1.09, 1.20)	+14.0
Population per square mile	-.001	**.00**	1.00 (1.00, 1.00)	0
Services provided per 100,000	-9.285E-5	.57	1.00 (1.00, 1.00)	0
Model 2				
Enforce	-.011	.09	.99 (.98, 1.00)	-1.0
% Living in poverty	.14	**.00**	1.15 (1.10, 1.21)	+15.0
Population per square mile	-.001	**.00**	1.00 (1.00, 1.00)	0
Services provided per 100,000	-2.691E-5	.87	1.00 (1.00, 1.00)	0

Note.
Model 1 likelihood ratio chi square = 96.34, p = .00; Model 2 likelihood ratio chi square = 90.29, p = .00.

Organizational characteristics likely confounded the relationships between performance and enteric disease rates; however, the relationships among these variables are likely impacted by many extraneous variables beyond the scope of the EH programs' missions, services, and the organizational characteristics addressed by this study. For example, a conceptual model for public health performance identified macro context including socioeconomic and political factors that can impact a public health system (Handler et al. 2001). Assessing performance of individual EH programmatic areas such as food safety and incidence of diseases originating from an identified source may strengthen the ability to control for the many possible confounding factors impacting enteric disease rates. For example, Zablotsky Kufel et al. (2011) examined local food safety program capacity and its impact on foodborne illness, using data derived from foodborne disease outbreak reporting and surveillance systems.

Performance improvement is a priority for public health and is encouraged by the relatively recent release of the Public Health Accreditation Board's national voluntary accreditation process for health departments (Scutchfield et al., 2009; Riley, Bender & Lownik, 2012; Chen et al., 2015). Public health departments and EH programs have used self-assessment results to inform the implementation performance improvement efforts using methods, such as the Plan-Do-Check-Act process, with intentions of addressing identified gaps in performance (Dilley, Bekemeier, Harris, 2012; Gerding & Price, 2012; Gerding et al., 2016). As a component of these improvement activities or a standalone effort, FDOH EH programs might benefit from evaluating performance improvement efforts by considering impacts to prevailing community concerns and important health outcomes specific to their respective counties.

Assessing EH program impact with health outcomes and environmental indicators versus process-oriented measures is inherently difficult. A study of local EH programs in California illustrated the tendency to use process measures, customer satisfaction, and absence of complaints as common measures of success (Dyjack, Case, Marlow, Soret &

Montgomery, 2007). Identifying and tracking environmental indicators ranging from contaminants and health impacts is critical for surveillance and generating data to inform EH practice (Malecki, Resnick & Burke, 2008). FDOH EH programs may consider the use of environmental indicators concerning health hazards, issues, and exposures as effective outcomes for measuring the impact of EH program performance in addressing community health needs. The Florida CHARTS system provides access to data on various health outcomes and EH indicators such as air quality and unsatisfactory inspection results (CHARTS, 2016). FDOH EH programs have the opportunity to leverage CHARTS to obtain data and incorporate various indicators into performance improvement activities. Additionally, community EH assessments could supply relevant data or identify indicators for performance improvement and identification of service delivery needs. For example, frameworks such as the Protocol for Assessing Community Excellence in Environmental Health (PACE EH) support efforts to identify factors adversely impacting health and the environment. FDOH EH programs have successfully implemented PACE EH to determine and address community-based environmental health issues (Hubbard, 2006; Harduar-Morano, Price, Parker & Blackmore, 2008).

EH programs sometimes factor community need into decisions about the delivery of services and activities (Dyjack, Case, Marlow, Soret & Montgomery, 2007; Resnick et al., 2009). The Florida public health system is classified as having a shared governance structure that facilitates coordination of operations, activities, and resources between the state level department of health and county health departments. This situation may contribute to consistency in EH program services delivered across the state; however, each county potentially faces different community health challenges or issues creating specific service needs. At a national level, this is likely the case for all county health departments and their EH programs, and there may be value in understanding the criteria used to determine priorities and inform decision-making about service delivery. Enteric disease rates may be one of those factors, yet EH programs routinely respond to broader issues that involve community-based concerns, environmental hazards, and exposures that might relate more closely to performance.

The EH services delivery system is complex and consists of multiple agencies and organizations (IOM, 1988; NEHA, 1993; Resnick, Zablotsky, Janus, Maggy & Burke, 2009). In most communities, agencies other than county health department EH programs also provide services with the intention of promoting healthy environments and preventing environment-related disease. Identifying partner organizations and understanding their contributions to the public health system is recognized as an important factor for public health services and systems research (Thomas, Corso & Monroe, 2015). EH programs in Florida share some responsibilities for food safety and drinking water quality services with other governmental agencies. Several of the FDOH EH program self-assessments included representatives from health department programs other than EH and partner agencies within their communities. Whereas this could have affected assessment results, it may be a major consideration to include partners when examining EH program performance and its impact on environment-related disease.

The results of this study indicated that county health departments' environmental health program performance of certain EEPHS may be associated with environment-related disease rates and could potentially impact the incidence of select enteric diseases. The EnvPHPS provide a framework for conducting performance self-assessments that might produce important results for planning and implementing performance improvement efforts to address environment-related diseases. Specifically, consideration may be given to improving the performance of EEPHS 2 diagnose and EEPHS 4 mobilize with intentions of addressing the incidence of cryptosporidiosis and salmonellosis. Continued efforts to assess EH program performance and its impact on environment-related disease could reveal critical information to increase the efficiency and effectiveness of the EH services delivery system.

Limitations

This study was subject to limitations. First, analysis of secondary data and lack of control over data collection could introduce biases. Standardized guidance for conducting EnvPHPS performance self-assessments is publicly available online and easily accessible, although inconsistencies in interpretation of assessment measures may have occurred.

Additionally, wide variation in EH program organizational characteristics, such as budgets and staffing levels, may have impacted the consistency of performance self-assessment results. Representation and inclusion of different health department programs and agencies in the self-assessments could have led to varying views and perspectives that influenced consensus responses about performance.

The small number of observations was a limitation; however, researchers have noted strengths in using study populations of health departments in only one

state and its potential to decrease the level of variation in organizational characteristics (Roper & Mays, 2000; Chen et al., 2012). Previous research has also examined EH program performance and capacity at county health departments in one state (Bohan, 2007; Zablotsky Kufel et al., 2011). Florida has a shared governance structure with state and local influences over operations. The fact that all health departments fall under the FDOH umbrella may increase homogeneity, as there are similarities in EH program services and priorities. However, the study results are not likely generalizable to other health departments because this study represented Florida's unique setting for public health and EH.

Possible inaccuracies in enteric disease reporting may be another limitation. Misdiagnosis or undiagnosed illnesses could affect the enteric disease rates used for this study. Also, there is an inherent lag in the detection and recognition of disease rates, which could limit the ability of an EH program to adjust performance to decrease the incidence. Furthermore, confounding variables and factors were likely to have impacted the results.

EH program performance self-assessments may not have considered the full impact of other agency contributions to the EH system and impact on preventing or controlling enteric diseases. For example, FDOH EH programs share responsibilities for the provision of some food safety and drinking water services with other agencies. This situation could impact the ability to directly link FDOH EH program performance assessment results to enteric disease rates. The performance, services, and impact of all agencies, as an EH system, should be better understood to accurately examine the ability of health department EH programs to have a direct bearing on health outcomes.

IMPLICATIONS FOR PUBLIC HEALTH PRACTICE

This study used a unique approach to examining relationships between EH program performance and environment-related disease. It produced results that contributed to the current understanding of EH program performance and could provide information for FDOH EH programs engaging in performance improvement efforts. The identified associations between performance of certain EEPHS and enteric disease rates, along with the potential to decrease disease incidence, may provide support for continued performance assessment and improvement efforts. FDOH EH programs might consider closely examining their performance of EEPHS 2 regarding surveillance and investigation activities and EEPHS 4 mobilizing partnerships and the potential to impact the incidence of enteric diseases, particularly cryptosporidiosis and salmonellosis.

The methodology employed may serve as a framework for other studies intended to examine EH program performance and its impact on community health outcomes or environmental indicators. Future research might consider the performance of specific EH program areas and disease known to occur from a related source whether water, food, or vector-borne diseases. Additional research might also include longitudinal studies to examine performance improvement and its impact on environment-related disease rates over time and determining the plausibility of certain indicators such as environmental contaminants or even critical inspection violations to serve as proxies for health outcomes. Continued efforts to describe the impact of EH programs on reducing environment-related disease and improving health outcomes could strengthen the Florida and national EH services delivery system and improve health status.

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