The Association of Changes in Local Health Department Resources With Changes in State-Level Health Outcomes

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We explored the association between changes in local health department (LHD) resource levels with changes in health outcomes via a retrospective cohort study. We measured changes in expenditures and staffing reported by LHDs on the 1997 and 2005 National Association of County and City Health Officials surveys and assessed changes in state-level health outcomes with the America’s Health Rankings reports for those years. We used pairwise correlation and multivariate regression to analyze the association of changes in LHD resources with changes in health outcomes.

Increases in LHD expenditures were significantly associated with decreases in infectious disease morbidity at the state level ($P=0.037$), and increases in staffing were significantly associated with decreases in cardiovascular disease mortality ($P=0.014$), controlling for other factors. (Am J Public Health. 2011;101:609–615. doi:10.2105/AJPH.2009.177451)

THE ULTIMATE AIM OF LOCAL health departments (LHDs) is to improve the quality of life for the communities they serve—a part of the larger mission of public health, which is “the fulfillment of society’s interest in assuring the conditions in which people can be healthy.”$^{6,7}$ Since the Institute of Medicine’s 1988 report, The Future of Public Health, there have been numerous studies that have described and measured the performance of LHDs, the characteristics associated with performance, and whether and how such performance affects health.$^{2}$ Studies have most often described associations of performance with LHD size, jurisdictional size, and funding: LHDs with larger staffs, serving populations greater than 50,000 persons, and with higher funding per capita were more often higher performing.$^{3–4,44}$ Higher performing LHDs also had greater community interaction, a director with higher academic degrees, and leadership functioning within a management team.$^{9,10,13}$

Only 4 published studies have attempted to link LHD characteristics, activities, or performance to health outcomes.$^{9,10,13,16,17}$ All of these studies are limited by their cross-sectional design. One study has examined the longitudinal relationship between LHD inputs and health outcomes, showing significant associations between changes in local public health spending and infant mortality and deaths attributable to cardiovascular disease (CVD), diabetes, and cancer at the county level.$^{18}$ We focused on the relationship between changes in LHD inputs (financial resources, staffing), aggregated to the state, and changes in state-level health measures (smoking and obesity prevalence, infectious disease morbidity, infant mortality, cancer and CVD mortality, and premature death). Aggregating LHD inputs to a state level not only allows the opportunity to explore the impact of LHDs’ combined resources but also reduces the complexities inherent in studies.
that have compared LHDs to one another, always a challenging task with the very large differences in LHD size, functions, and jurisdictions.

Conceptual and logic models pertaining to public health in general posit that an increase in inputs leads to enhanced capacity to provide the essential public health services, which, in turn, leads to improved public health performance and, ultimately, to improvements in community health status. The health measures included in this study were selected on the basis of amenability to public health interventions for which logic models may be specified. The primary and secondary prevention methods that may lead to improvements in these health measures—e.g., community-based efforts to enhance physical activity opportunities to reduce CVD and targeted immunization campaigns to reduce vaccine-preventable diseases—are interventions that are commonly led by LHDs.

The relative paucity of empirical evidence that supports such logic models for LHDs remains a challenge for public health. This serves as rationale for our study, the goal of which is to identify LHD inputs that may ultimately lead to health improvements. We investigated the association between LHD inputs—aggregated to the state—and health outcomes at the state level. This association has relevance both in community health status and, ultimately, to improvements in health outcomes at the state level.

METHODS

We examined 2 data sets to determine the extent to which changes in LHD inputs are associated with changes in health measures: surveys of LHDs by the National Association of County and City Health Officials (NACCHO) and America’s Health Rankings (AHR), produced by the United Health Foundation.

We utilized LHD expenditures, staffing, and jurisdictional population data from field surveys conducted by NACCHO in 1997 and 2005. Completed surveys were returned for 2492 of the 2832 (88%) identified LHDs in 1997 and 2300 of the 2864 (80%) identified in 2005. A total of 1924 LHDs reported in both 1997 and 2005.

Local health departments reported actual total expenditures for the most recent fiscal year before the survey; 1997 expenditures were adjusted to 2005 dollars. The method of adjustment follows the model proposed by Mays and Smith, with spending measures adjusted to represent 2005 dollars by using a weighted average of the general Consumer Price Index (CPI) and the medical care CPI. Local health departments reported the total number of full-time equivalents (FTEs) employed by their agency. We aggregated local health department expenditures, FTEs, and jurisdictional populations to the state level. We calculated changes in LHD expenditures and FTEs per capita between 1997 and 2005 on the basis of both proportional change and absolute change between these 2 points in time.

We derived state-level health measures from the AHR reports, which have been produced annually since 1990. We included 7 health measures in this study: smoking and obesity prevalence, infectious disease morbidity, infant mortality, mortality from CVD and cancer, and years of potential life lost (YPLL). America’s Health Rankings derives data for these health measures from other secondary sources as described subsequently.

Smoking prevalence is a measure of the percentage of the population aged 18 years and older that has smoked at least 100 cigarettes and currently smokes tobacco products regularly. Obesity prevalence is a measure of the percentage of the population estimated to be obese, defined as having a body mass index of 30.0 kg/m² or higher. The source of data for smoking and obesity is the Behavioral Risk Factor Surveillance System.

Infectious disease morbidity includes the 3-year average occurrences of AIDS, tuberculosis, and hepatitis (A and B), as representative of all infectious diseases, per 100,000 population, as reported by state health departments in the Morbidity and Mortality Weekly Report from the Centers for Disease Control and Prevention (CDC).

Infant mortality is the rate of infant deaths per 1000 live births in a year. Cardiovascular deaths were measured by using a 3-year average, age-adjusted death rate (per 100,000 population) attributable to heart disease, strokes, and other forms of CVD. Cancer deaths were measured by using a 3-year average, age-adjusted death rate (per 100,000 population) attributable to cancer. YPLL measures the loss of productive life because of death before age 75 years. The source of data for these measures of mortality was the US National Center for Health Statistics.

Data Management

To improve comparability between the 1997 and 2005 data, we only included the 1924 LHDs that reported in both surveys in the initial data set. We removed LHDs that did not report expenditure data for both years, reducing the data set to 1852 LHDs in 1997 and 1856 LHDs in 2005. Four states were excluded: Rhode Island, because it has no LHDs; Hawaii and Alaska, because they both had only 1 LHD report expenditure for 2005 and no reported expenditures for 1997; and Mississippi, because the state reported by county-level LHDs in 1997 and multicounty districts in 2005.

We aggregated LHDs’ jurisdictional populations by state. We excluded states that had less than 40% of their actual total population represented, for either 1997 or 2005, from further data analysis. This removed an additional 4 states: Maine, New Hampshire, New Mexico, and South Dakota. The final data set included data from 1843 LHDs in 1997 and 1845 LHDs in 2005, covering 42 states, with a 97% match for LHDs with usable data for both 1997 and 2005. For the 42 states that were retained, the actual state population represented in 1997...
ranged from 40.8% to 96.5%, with a mean of 78.7% and a median of 81.3%. For 2005, the range of actual state population represented was 40.6% to 100%, with a mean of 83.6% and a median of 85.9%. Total aggregated data for the 42 states represented 78.4% of the US population for 1997 and 82.9% of the US population for 2005. The number of state data represented was 40.6% to 100%, with a mean of 83.6% and a median of 81.3%. For 2005, the range of actual state population ranged from 40.8% to 96.5%, with a mean of 78.7% and a median of 78.4%. The number of states included in the 1998 AHR report. We determined changes for each of the 7 health measures between the 1998 and 2008 AHR reports by calculating proportional and absolute changes between the 2 points in time.

### Data Analysis
Changes in LHD expenditures and staffing per capita, aggregated to the state level, served as independent variables, and changes in the 7 health measures from AHR served as dependent variables. We assessed the association between the changes in specific dependent variables with the changes in independent variables with the Spearman rank correlation, and with multivariate regression. To analyze data, we used Stata version 10 (StataCorp LP, College Station, TX). Control variables in the regression models included factors known to influence health at the community level: high-school graduation (percentage of the population aged older than 25 years that has graduated), health insurance (percentage with health insurance), poverty (percentage below federal poverty line), racial composition (percentage of population that is non-White), and age structure.

### RESULTS

Results are presented by changes in independent variables, changes in dependent variables, and the association between these changes.

#### Changes in Independent Variables
State-level mean expenditures per capita (Table 1) also fell between 1997 and 2005. The number of FTEs per capita ranged from 2.31 (per 10,000 population) in Vermont to 10.46 in Arizona in 2005. Only 12 states experienced an increase in FTEs per capita between 1997 and 2005.

#### Changes in Dependent Variables
The changes in the dependent variables between the 1998 and 2008 AHR reports are shown in Table 2. Overall, rates for all health measures declined between 1998 and 2008, with 1 exception: obesity prevalence increased. All 42 states showed declines in infectious disease morbidity and CVD mortality, with all but 1 state also showing declines in smoking prevalence and cancer mortality. Changes in infant mortality and premature deaths (YPLL) showed a mix of states with declining and increasing rates, with the majority of states still showing a decline. Obesity prevalence increased in all 42 states by a mean change of almost 58%.

#### Pairwise Correlations of Independent and Dependent Variables
With the measures of proportional change, there were statistically significant negative associations.

### Table 1—Overall 1997 and 2005 Aggregated LHD Expenditures per Capita and FTEs per Capita, and State-Level Proportional and Absolute Changes Between 1997 and 2005: 42 US States

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Composite IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditures per capita</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997 overall</td>
<td>$44.13</td>
<td>$34.24</td>
<td>$29.80</td>
<td>$8.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 overall</td>
<td>$42.17</td>
<td>$34.30</td>
<td>$23.92</td>
<td>$7.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportional change, %</td>
<td>2.57</td>
<td>-1.72</td>
<td>27.35</td>
<td>-57.28</td>
<td>71.33</td>
<td>25.17</td>
</tr>
<tr>
<td>Absolute change</td>
<td>-1.96</td>
<td>-0.71</td>
<td>21.74</td>
<td>-84.87</td>
<td>59.79</td>
<td>9.96</td>
</tr>
<tr>
<td>FTEs per capita (×10,000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997 overall</td>
<td>6.12</td>
<td>5.73</td>
<td>2.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 overall</td>
<td>5.12</td>
<td>4.66</td>
<td>1.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportional change, %</td>
<td>-11.48</td>
<td>-16.47</td>
<td>26.66</td>
<td>-64.22</td>
<td>83.76</td>
<td>28.02</td>
</tr>
<tr>
<td>Absolute change</td>
<td>-1.00</td>
<td>-0.80</td>
<td>2.01</td>
<td>-8.12</td>
<td>3.95</td>
<td>1.74</td>
</tr>
</tbody>
</table>

Notes: FTE = full-time-equivalent employee; IQR = interquartile range; LHD = local health department. *For negative numbers, greatest decrease, 1998-2008. **Greatest increase.
between changes in expenditures per capita and infectious disease morbidity ($r = -0.3407; P = .0272$) and CVD deaths ($r = -0.3723; P = .015$) and between FTEs per capita and CVD deaths ($r = -0.3689; P = .016$; Table 3). The correlations that used absolute change showed a significant inverse relationship between FTEs per capita and CVD deaths ($r = -0.3482; P = .024$). For the majority of these correlations, the results were consistent in direction and significance between using proportional change and absolute change.

**Multiple Linear Regression**

As shown in Table 4, an increase in expenditures per capita was statistically significantly associated with a decrease in infectious disease morbidity ($t = -2.17; P = .037$). For each 10 percentage point increase in expenditures per capita, infectious disease morbidity declined by 1.82 percentage points. An increase in FTEs per capita was statistically significantly associated with a decrease in CVD mortality ($t = -2.59; P = .014$). For each 10 percentage point increase in FTEs per capita, CVD mortality declined by 0.65 percentage points.

For states that experienced an increase in expenditures per capita, spending increased an average of 24.7%, which would have resulted in a decrease in infectious disease morbidity by 4.50 percentage points—a 7.0% reduction in infectious disease morbidity that is associated with the increase in LHD spending. For states that showed an increase in FTEs per capita, staffing increased an average of 21.4%, which would have resulted in a decrease in CVD mortality by 1.39 percentage points—a 6.6% reduction in CVD mortality associated with the increase in LHD staffing.

**DISCUSSION**

The primary findings of this study revealed that an increase in LHD expenditures per capita was associated with a decrease in infectious disease morbidity at the state level, and an increase in FTEs per capita was associated with a decrease in CVD deaths.

Although these results point to an association between LHD inputs and state health outcomes, the mechanisms linking LHD services or activities to such inputs and outcomes can only be inferred.

The finding of an association between LHD expenditures and improvements in infectious disease mortality is consistent with cross-sectional studies that have identified positive correlations between absolute LHD expenditures as well as expenditures per capita with LHD performance or effectiveness. Mays and Smith provide the only evidence to date that changes in expenditures per capita are correlated with changes in health outcomes, with the strongest associations between LHD spending and infant mortality and CVD deaths; mortality from influenza changed in the expected direction but did not reach statistical significance.

The association between changes in FTEs per capita and changes in CVD deaths is consistent with cross-sectional studies that have found positive correlations between the number of FTEs and LHD performance and effectiveness and with studies that have specifically examined FTEs per capita. None of these studies measured longitudinal changes in FTEs per capita, and no study directly correlates FTEs per capita with health outcomes.

If our results suggest that increases in LHD inputs may contribute to improvements in health outcomes, then what are the possible pathways? In the 2005 *Profile of Local Health Departments*,

**TABLE 2—Changes in Dependent Variables From America’s Health Rankings Reports Between 1998 and 2008: 42 US States**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportional change (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking prevalence</td>
<td>-14.58</td>
<td>-14.31</td>
<td>7.83</td>
<td>-29.41</td>
<td>4.87</td>
<td>11.95</td>
</tr>
<tr>
<td>Obesity prevalence</td>
<td>57.65</td>
<td>54.53</td>
<td>16.55</td>
<td>29.24</td>
<td>108.06</td>
<td>15.71</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>-58.76</td>
<td>-57.68</td>
<td>14.74</td>
<td>-96.41</td>
<td>-29.23</td>
<td>25.05</td>
</tr>
<tr>
<td>Infant mortality</td>
<td>-9.05</td>
<td>-10.13</td>
<td>10.87</td>
<td>-34.21</td>
<td>20.00</td>
<td>13.17</td>
</tr>
<tr>
<td>Cardiovascular disease deaths</td>
<td>-17.72</td>
<td>-18.16</td>
<td>4.49</td>
<td>-28.25</td>
<td>-4.66</td>
<td>5.36</td>
</tr>
<tr>
<td>Years of potential life lost</td>
<td>-5.08</td>
<td>-4.86</td>
<td>8.29</td>
<td>-28.34</td>
<td>14.02</td>
<td>11.59</td>
</tr>
</tbody>
</table>

**Absolute change**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking prevalence</td>
<td>-3.41</td>
<td>-3.25</td>
<td>1.90</td>
<td>-7.70</td>
<td>1.20</td>
<td>2.20</td>
</tr>
<tr>
<td>Obesity prevalence</td>
<td>9.50</td>
<td>9.45</td>
<td>2.11</td>
<td>6.00</td>
<td>14.30</td>
<td>2.50</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>-24.96</td>
<td>-21.02</td>
<td>16.60</td>
<td>-67.05</td>
<td>-4.79</td>
<td>26.30</td>
</tr>
<tr>
<td>Infant mortality</td>
<td>-0.68</td>
<td>-0.80</td>
<td>0.83</td>
<td>-2.60</td>
<td>1.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Years of potential life lost</td>
<td>-385.80</td>
<td>-370.95</td>
<td>684.85</td>
<td>-2462.70</td>
<td>1160.40</td>
<td>806.70</td>
</tr>
</tbody>
</table>

**Note.** IQR = interquartile range.  
bGreatest increase.
NACCHO provided a comparison between LHD activities reported in the 1993 survey and responses to similar questions in the 2005 survey. This comparison showed an increase in communicable disease surveillance and epidemiological investigations, which could provide a pathway to a decrease in infectious disease cases.

This may also link to the single area for which there has been a substantial increase in public health preparedness funds through their state agencies, at an average amount of $0.99 per capita, for a median of $35,000 per LHD. Fifty-one percent of LHDs reported hiring additional FTEs by using funding from the CDC cooperative agreement.

The evidence supporting a pathway between LHD inputs and improvements in CVD deaths that goes through LHD services or activities is limited and indirect at best. Cardiovascular diseases remain the leading cause of death in the United States, even though overall heart disease death rates have been declining since 1968. In a recent study exploring the reasons for this decline, Ford et al. determined that 47% of the decline in the coronary heart disease death rate was attributable to improved medical therapies, and 44% of the decline was attributable to risk factor modifications—including reductions in total cholesterol, systolic blood pressure, smoking prevalence, and physical inactivity.29

Local health departments may influence risk factor modifications through clinical preventive services as well as through population-directed activities. A primary risk factor for CVD is tobacco use, and the NACCHO comparison of LHD services and activities over time shows that tobacco use prevention activities increased; however, chronic disease surveillance remained static, screening services for high blood pressure and diabetes fell, and the provision of comprehensive primary care decreased by more than 50%. If the general movement away from clinical service provision was met with a concomitant increase in population-focused activities—such as through health assessment, planning, and policymaking—this may provide a pathway between LHD inputs and CVD mortality reduction. Although the evidence base for community activities is limited, direct evidence suggests an association between increased public health preparedness funds and decreases in infectious disease cases.


<table>
<thead>
<tr>
<th>Health Measures</th>
<th>LHD Inputs</th>
<th>Proportional Change</th>
<th>Absolute Change</th>
<th>Expenditures per Capita, r (P)</th>
<th>FTEs per Capita, r (P)</th>
<th>Expenditures per Capita, r (P)</th>
<th>FTEs per Capita, r (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Obesity</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>NS</td>
<td>NS</td>
<td>-0.3407 (.027)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Infant mortality</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>-0.2735 (.08)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Cardiovascular deaths</td>
<td>NS</td>
<td>-0.3482 (.024)</td>
<td>-0.3723 (.015)</td>
<td>NS</td>
<td>-0.3689 (.016)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Cancer deaths</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Years of potential life lost</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Notes. FTE = full-time-equivalent employee; IQR = interquartile range; LHD = local health department; NS = not significant at P < .05. All correlations calculated with the Spearman rank coefficient.

### TABLE 4—Multiple Linear Regression Results for Changes in Infectious Diseases With Changes in Expenditures per Capita, and for Changes in Cardiovascular Disease Deaths With Changes in FTEs per Capita: 42 US States

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (SE)</th>
<th>95% CI</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in infectious diseases with changes in expenditures per capitaa</td>
<td>-0.18226 (0.08384)</td>
<td>-0.3524, -0.01206</td>
<td>-2.17</td>
<td>.037</td>
</tr>
<tr>
<td>Changes in cardiovascular diseases with changes in expenditures per capitaa</td>
<td>-0.06504 (0.02515)</td>
<td>-0.1161, -0.01398</td>
<td>-2.59</td>
<td>.014</td>
</tr>
</tbody>
</table>

Notes. CI = confidence interval; FTE = full-time-equivalent employee.

aAdjusted R^2 = 0.3873; F(6,35) = 5.32; P < .001.

bAdjusted R^2 = 0.3612; F(6,35) = 4.86; P = .001.
improving, this study did not attempt to explore such pathways. There were no statistically significant findings in the regression models for the other health measures—smoking and obesity prevalence, infant mortality, cancer mortality, and premature death. These measures may be less amenable to change with LHD interventions; the timeframe for detecting change may have been too short; there may be fewer LHD services specifically addressing these health measures; and there may be no true effect of LHD inputs on these health measures. The preponderance of both bivariate and multivariate analyses that yielded nonsignificant results may also be a reflection of low power because of the relatively small sample size (n=42 states).

Although there is a growing body of literature that links LHD inputs to performance, finding any association between LHD inputs and health outcomes, whether through cross-sectional or longitudinal studies, has been a methodological challenge. Only recently, with the ability to link repeated measures of LHD inputs through the NACCHO surveys, have investigators had access to data that allow for such studies.

Limitations

There are several limitations to this study and its findings. First, the association of changes in LHD inputs with changes in health outcomes does not prove cause and effect, and reverse causation, or endogeneity, cannot be ruled out. Second, we used proportional and absolute change between 2 points in time and did not consider the changes that may have occurred within the time period. Third, there is a potential ecologic fallacy in that the health outcome changes that took place may have been experienced by subpopulations other than those represented by the LHDs that were included in the analyses. Fourth, the timeframe covered by this study may be too short to detect real associations that may be detectable if studied over a longer period.

Fifth, although statistically significant, the coefficient for FTEs per capita in the regression model (−0.06504) indicates that the expected percentage decrease in CVD deaths given a 1 percentage point increase in FTEs per capita is relatively low. State and local health departments are frequently mandated by law to establish infectious disease control programs, whereas services to prevent or treat CVDs are more frequently optional. This creates a greater sensitivity for health outcomes that connect to activities for which LHDs exert more control—thus, there is a greater likelihood that the association of changes in LHD staffing and CVDs is spurious in contrast to the stronger, more robust association between LHD spending and infectious diseases. Sixth, this study did not consider state and federal public health spending that does not get included in the LHD expenditures measure, yet may still affect LHD functions, performance, and health outcomes.

Implications for Future Study

Our findings suggest at least 3 avenues for further study. First, there is the opportunity to carry out natural experiments, with the results of this study forming a baseline for later analyses. Since 2005, federal funding for state and local preparedness has been cut more than 25%, and states are no longer receiving any supplemental funding for pandemic influenza preparedness. If expenditures per capita are linked to infectious disease morbidity through activities previously supported by such funding, future slowing of gains made—or even a reversal in infectious disease morbidity—may provide further evidence of the association between LHD inputs and health outcomes as well as the possible pathway.

Second, exploring statewide initiatives may help to explain the pathway between LHD inputs and health outcomes. It may be very instructive to examine—through documents and key informant interviews—whether states that improved in rankings and had increases in public health expenditures and FTEs implemented specific activities in response to early AHR reports.

Third, repeating the methodologies in this study with earlier and later NACCHO surveys will extend the timeframe for studying changes in LHD inputs and outputs.

Finally, all of these avenues for further study would be greatly enhanced if LHDs used a consistent, uniform chart of accounts, improving comparability. Collecting consistent state-level data, using the Association of State and Territorial Health Officials’ 2009 State Public Health Survey as a starting point, will likewise be of great benefit to future research in this field.

Conclusions

In keeping with what Turnock and Handler have suggested, our purpose was to “to measure [LHD] inputs, processes, outputs, and outcomes in ways that allow for changes [emphasis added] in one to be linked with another.” Our findings suggest that improvements in public health resources at the local level may contribute to improved health outcomes at the state level. Although it was not possible to identify changes in LHD services or activities that could provide a clear pathway between inputs and outcomes, there are opportunities to use the findings from this study to further strengthen the empirical base for what LHDs should be funded to do.

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P.C. Erwin originated the study and led the data analysis and writing. S.B. Greene and M.V. Davis assisted with the study.
design and the writing. G. P. Mays and T. C. Ricketts assisted with data analysis and writing.

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Human Participant Protection

This study made use of secondary data only, available to the public, and did not require institutional review board approval through the University of Tennessee.

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