Research Brief

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New methods and measures to assess the impact of the economic recession on public health outcomes: Study implications

The question of how investments in public health affect community health outcomes has garnered attention as public health programs compete for scarce resources. A research team at the University of North Carolina at Chapel Hill, in collaboration with public health practitioners, has completed a study examining the association between investments in local public health and community health outcomes in North Carolina. The aims of the study were to:
1) Assess the relationship between the public health spending and the provision of public health services at the local level in the context of the economic recession,
2) Assess the relationship between public health spending, staffing and services and community health outcomes in the context of the economic recession, and
3) Develop and examine the feasibility and responsiveness of new measures of community health indicators to respond to changes in public health capacity (e.g., spending, staffing).

Previous research briefs provide detailed findings from the analyses of each of these aims.[i] This report provides a summary of the key findings of the study, and discusses the implications of the results for policy, practice, and future research.

Methods

This retrospective study was conducted to examine the effects of NC local health department (LHDs) investments on community outcomes over the time period from 2005 - 2010. Specifically, we were interested in the effects of changes in spending related to the economic recession; thus data were grouped into two time periods reflecting before and after the 2008 economic recession (2005-2007, and 2008-2010). We combined different data sources in North Carolina in order to study the variation and effects of LHD spending, staffing and services on morbidity and mortality. Details of the data sources, measures and analytic processes are described below.

LHD spending and services data were obtained from the National Association of County and City Health Officials (NACCHO) profile survey data from years 2005 and 2008. Spending was analyzed using a per capita expenditure measure constructed from the total reported LHD expenditures and the county, or service region population. A comparison between NACCHO profile survey data and North Carolina data from state expenditure reports validated the accuracy of the NACCHO data with respect to total public health spending. Services provided by LHDs were grouped into six categories: clinical preventive services, medical treatment, specialty care services, population based services, regulatory and licensing services, and environmental services. Within each category of service, we assessed the proportion of specific services in the category that were provided or contracted for by the LHD. In addition, we examined the provision of selected individual services with selected outcomes to further understand potential mechanisms for observed relationships.

Mortality data were obtained from aggregated mortality files from the Centers for Disease Control and Prevention (CDC) supplemented by de-identified raw

NC Vital Statistics available from the Odum Institute[ii]. Five cause-specific mortality rates were examined: heart disease, diabetes, cancer, pneumonia and influenza, and infant mortality. Age-adjusted rates per 100,000 population were used for each cause of death except infant mortality, which was calculated as the number of deaths for children under age 1 per 1000 live births. Rates were calculated separately for each of the 2 time periods.

Morbidity outcomes were examined for a number of conditions, using hospitalization data and outpatient data, separately and combined. In this study we measured screening for breast, cervical and colorectal cancer, hospitalization rates for pneumonia, hospitalization rates for heart disease and North Carolina reportable diseases. Morbidity data were obtained using ICD-9 CM Diagnosis Codes from the Integrated Cancer Information and Surveillance System (ICISS). The ICISS program links the NC Central Cancer Registry data to Medicare, Medicaid, private insurance plans, and other state-level health and demographic datasets. This novel, linked data resource includes 5.5 million unique individuals representing the diversity of the state population. To assure we captured claims for unique individuals, we examined beneficiary data from three mutually exclusive groups based on age and payer: 1) age 65 and older in the 100% Medicare sample, 2) those younger than age 65 in the 100% Medicaid sample, and 3) those younger than 65 represented in the private payer data. Persons younger than age 65 not represented in the ICISS data are beneficiaries covered by non-participating insurers and the uninsured. To quantify these two missed populations a synthetic population estimate was created by linking the ICISS enrollment data with county level demographic measures and individual level health care information from the Census Bureau's Small Area Health Insurance Estimates[iii]. Using these population-based measures, disease rates of the missing privately insured individuals were estimated from the included ICISS population. County level hospitalization rates using this approach were validated against the State Inpatient Data from NC Division of Public Health (DPH).

Analyses were conducted to assess the relationship between changes in spending, the effect of those changes on the provision of services, and the association between changes in provision of services and the effect of those changes on morbidity and mortality. Multilevel models with random intercepts for LHDs were used to assess the associations in the two time points, controlling for community characteristics identified from previous literature as important factors in explaining variations in community health outcomes. We included the following county level variables from the Area Resource File (ARF) as covariates: number of public clinics per 10,000 population, percent of population female, unemployment rate, percent of population non-white, percent of population age 65+, total population, percent college graduates, percent of population who were non-English speakers, number of physicians per 100,000 population, number of hospital beds per 100,000 population, percent of population living in poverty, percent of population uninsured, and urban/rural indicator. Because local communities experienced the impact of the economic recession differently, we used geospatial analysis to identify geographic areas in the state at higher and lower risk.

Findings

Variation in spending, staffing and services between 2005-2008

Spending in North Carolina LHDs increased between 2005 and 2008 from $74 per capita to $87 per capita. Although spending increased on average, overall level of staffing in LHDs decreased from an average of 110 FTEs in 2005 to 107 FTEs in 2008. Ten local health departments, however, experienced a decrease in the amount of spending during this time period, and 37 LHDs experienced a decrease in staffing, suggesting that impacts from the economic recession varied across local health departments. In addition, the latest year of spending data used in this study was 2008; thus any impacts from the recession on spending after that year were not included in this analysis.

The extent of services provided by NC LHDs varied by the category of service. Clinical preventive services, such as family planning, prenatal care, and well-child visits, were the most extensively provided category of services, with LHDs on average, providing or contracting for nearly all (90%) of the potential services in this category. Specialty care services, such as speech and hearing for children with special health care needs, were the least likely to be offered, with LHDs providing on average only 30% of the potential services in this category. The overall level of services provided by LHDs changed very little from 2005 to 2008. However, about a quarter of LHDs reduced the number of services offered in 2008.

Community health outcome: mortality

Age-adjusted mortality rates for heart disease, cancer, diabetes, pneumonia/influenza and infant mortality fell between 2005 and 2008 in the jurisdictions served by more than two-thirds of the LHDs. The burden of mortality, however, varied by location over the three-year time period. Excess infant mortality was observed in eastern areas of NC. Although our time window of 3 years is shorter than the 5-year window typically used to account for small numbers of infant deaths at the county level, the pattern of elevated infant mortality rates in the eastern region of NC we observed has been previously noted.[iv]

Increases in spending were associated with increased provision of medical treatment services and specialty care services ($p < 0.05$) such as speech and hearing for children with special health care needs. No associations were observed between changes in spending and provision of other types of services

Analyses examining the effect of changes in the provision of specific types of services revealed a significant association between an increase in the provision of women and children's services and a decrease in infant mortality rates ($p < 0.05$). These services included: family planning, prenatal care, obstetric services and WIC services. No other associations were observed between services and other mortality outcomes, although given the short study period, it is unlikely that we could have detected change in conditions taking longer to develop.

Community health indicators: hospitalization and morbidity rates using administrative data

Using the health insurance claims we measured morbidity at the community level and found significant variation across LHDs and over time. We also found that provision of primary care services was associated with higher rates of cancer testing, and the provision of regulatory or licensing activities was associated with a decline in reportable diseases. To better understand if the morbidity was localized in specific geographic areas of the state we applied geographic information system (GIS) mapping. First, we mapped the age-adjusted morbidity rates and second, conducted cluster analysis both before and after adjusting for person and contextual factors. Our geographic analyses indicated that much of the community level variation in rates of heart disease hospitalization was explained by the contextual variables (such as urban status, educational and income rates, etc.). However, there were still several areas of the state which had excess morbidity relative to the adjacent counties which also had high rates of disease and a similar contextual environment. Analyses of heart disease hospitalizations demonstrated that total public health spending, percent of the population who were college educated, number of public health clinics, and urban status were all significantly associated with lower morbidity, while percent of the population over 65 or non-white were associated with higher morbidity.

Analyses of STDs revealed the contextual variables in the model were much less important in explaining the variation observed. Only the percent of the population that was nonwhite was significantly associated with STD morbidity. This may be a reflection of a more random spatial distribution of these contextual variables relative to the outcome or unmeasured confounding. By appropriately accounting for the distribution of the disease across the state, we still identified areas of excess morbidity, as well as areas which appear to have lower rates relative to neighboring jurisdictions.

In summary, our study shows that spending, staffing and services vary widely across communities, and increases in spending impacts LHD staff and services provided to a community. Furthermore, staffing and services do affect community health outcomes. In this study, subsequent increases in staff and maternal and child services were associated with a reduction in infant mortality (1-2 infant deaths per 1000 live births). This confirms previous studies which demonstrate the association between local public health funding and community health. In our analyses we showed that administrative data can be used to measure community morbidity and examine geographic disparities for targeting intervention to improve community health. It is worth noting that in our study we controlled for community characteristics including demographic characteristics of the population served and medical care related resources. However, it is possible that some unmeasured characteristic may be contributing to the observed relationships.

Policy and Practice Implications

Our study documented wide variation in per capita public health spending. Determining the necessary level of spending needed to achieve desired morbidity and mortality outcomes (i.e. develop spending benchmarks) is an important next step in understanding the level of public health investment

needed. It is important to collect and analyze this information for informed decision-making. While we can collect data the same way within a state, data is not systematically collected nationally. As a result, we are unable to answer these important policy and public health practice questions.

We also encountered issues related to reporting levels of public health spending and outcomes. Sensitivity is needed in reporting data for counties with higher per capita expenditures and poor health outcomes in the current political context. It is unclear whether LHDs with higher expenditures should be expected to have better health outcomes. For example, LHDs may have higher expenditures if they serve more rural communities, or older populations with greater health needs (socioeconomic, environmental, etc.) Ruralness is important in that there is a fixed cost in most cases to running a health department, and if the health department does not serve large numbers of people, per capita costs may be higher (i.e. limited economies of scale). The cost of delivering public health services is influenced by a number of variables, including the demographic and health characteristics of the population and the presence (or lack) of other health services.

The economic recession and the transforming health landscape is significantly impacting communities with regard to LHD funding and provision of services. Spending data used in this study was collected early in the recession; further studies are needed to document lags in reduced spending and staffing as the recession continued. Moreover, some LHDs in NC have already begun to eliminate services. In many communities, public health spending is driven by the delivery of clinical services in a local health department. If public health continues to decrease clinical service delivery this will likely result in a loss of revenue for the public health sector. There is also concern that with fewer local health departments offering primary care, people with Medicaid as their source of payment will fail to get the necessary preventive health screenings, such as breast and cervical cancer screening, without the wraparound services, such as outreach, case management and follow-up, traditionally provided by LHDs. The need for safety-net services is likely to grow over time given that the post-recession recovery disproportionately has benefitted those with higher incomes and the ACA will strain the safety net as millions of previously uninsured compete with traditional Medicaid participants for outpatient and inpatient care.

Public health spending is important for overall community health even as clinical services are restructured. By working together more closely, public health and primary care may achieve their own goals while also having a greater impact on the health of populations compared to working independently. In order to protect some of our most vulnerable populations, it is vital to support funding for local public health and strengthen partnerships between public health and health care delivery organizations.

Recommendations

Our findings provide support for the work that LHDs are doing to improve health in their communities. While it is not possible to directly attribute the improved health outcomes to LHD services, the fact that the association was observed for improved health outcomes of infant mortality, reduced hospitalizations for heart disease, and increased cancer test use with corresponding increases in the specific services designed to improve those outcomes, and not for other, unrelated services, lends support to the conclusion that LHD services play a role in improving community health outcomes.

We need to continue to build the evidence, however, that investments in public health result in improvements in community health. The findings from our study add to the existing body of research, but more is needed. New measures and methods are needed to help public health practitioners describe morbidity and mortality at the community level and demonstrate effectiveness. In our study we found that morbidity measures and new methods for mapping hold promise. We need to learn to use these new data sources and methods to build the case for public health investments.

For the field of public health systems and services research, geospatial information studies may help us better identify and study areas of 'low' relative burden of disease compared to neighboring jurisdictions while also accounting for all the other environmental influences. In other words, we may be able to identify 'where things are working', or 'not working'. We can identify clusters and significant variation by combining model adjusted rates with geospatial modeling.

Furthermore, geospatial methods can also be applied to contrast behavioral and environmental risk factors and identify areas of significantly high or low risk. Mapping age-adjusted incidence rates may obscure important underlying correlations, or areas of

high relative burden of disease. A better understanding of the broader environmental context can help inform and tailor interventions for a specific area.

For example, an educational intervention for cancer screening may be most efficacious by identifying the areas with the highest risk relative to an area where people have insurance, but low screening rates. This is in direct contrast to an area with high risk and low screening rates - but where individuals lack insurance to pay for screening or have poor access. Crude mapping and targeting areas of low screening or high risk of disease ignores the underlying mediating factors of insurance, poverty, or access to care. In a time of decreasing resources, we must better target interventions and more objectively demonstrate effectiveness and return on investment.

Our findings also demonstrate a need for better data systems, such as aggregated insurance claims data that provide a useful tool for assessing the population burden of disease. This may be especially important for diseases which are not consistently or systematically reported to public health agencies. Secondary data collected for other purposes such as administrative (claims) data or Electronic Medical Record (EMR) data may become increasingly useful and available to public health systems research as advances and investments in data infrastructure and standardization continue.

It is challenging, though, to identify outcomes according to those sensitive to public health interventions. Illnesses are typically reported based on the organism and not the method of infection (etiology vs. manifestation may explain lack of signal that we see or variation). Our study attempted to create a construct of public health response and service, but outcomes are reported by organism and not intervention. In addition, there are currently no informatics standards for data interoperability between clinical services and public health, making it difficult to associate a single public health service with a single outcome. Thus, it remains challenging for public health to demonstrate return on investment for a single service, particularly with respect to infectious disease. One possibility is to consider using e-codes for infectious diseases which would better describe what factors in the environment were instrumental to transmission of the infectious disease and supplement organism data (ICD-10).

Finally, at the state level, reference standardization, like HL7 which provide a framework (and related standards) for the exchange, integration, sharing, and retrieval of electronic health information, is needed so that all reporting entities agree to report under a data standard. These standards would define how information is packaged and communicated from one party to another, setting the language, structure and data types required for seamless integration between systems.

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Footnotes

[i] Three research briefs about this project are available online:
http://sph.unc.edu/files/2013/11/nciph-MeasuringOutcomes_8-2013revised.pdf

http://sph.unc.edu/files/2014/09/nciph-assessing-roi-3.pdf

https://sph.unc.edu/files/2015/03/nciph-measuring-outcomes.pdf

[ii] http://arc.irss.unc.edu/dvn/dv/NCVITAL

[iii] https://www.census.gov/did/www/sahie/

[iv] Infant death rates by perinatal region and county of residence, NC 2011, 2012 and 5-year totals 2008-2012. NC State Center for Health Statistics, Raleigh, NC. Available: http://www.schs.state.nc.us/schs/deaths/ims/2012/PCRandCountyRates.pdf, accessed 7/28/2014.