

# Public health delivery systems and the provision of maternal and child health preventive services

**Keywords:** hispanics, LHD, PHD, MCH, NLSPHA, joint production, prenatal, obstetric, NACCHO, tobacco use

## Introduction

Despite major advances in medical care, critical threats to maternal, infant, and child health exist in the United States.<sup>1</sup> Among the nation's most pressing challenges are reducing infant mortality, which in 2015 remained higher among non-white Hispanics, 5.22 deaths per 1,000 live births, and non-Hispanic blacks, 11.11 deaths per 1,000 live, compared to non-Hispanic whites, 4.93 per 1,000 live births.<sup>1</sup> One approach for addressing the pressing challenge of reducing the infant mortality rate is optimizing the health of the mother prior to and during pregnancy to create the best opportunity for a fetus to develop in a healthy manner.<sup>2</sup> Despite the emerging need to improve maternal and infant health, budget cuts to local health department's (LHD) have forced a reduction or elimination of preventive programs and services aimed to promote healthy women and infants.<sup>3</sup> In 2011, 57% of LHDs reduced or eliminated at least one program and 21% were maternal child health programs.<sup>3</sup> In early 2014, 28 percent of LHDs across the nation reported additional cuts to their budgets, which limits their ability to address the health needs especially among the most vulnerable populations, women and children.<sup>3</sup> To minimize the effects of program and service cuts, LHDs have begun to collaborate with other agencies to increase the reach of maternal and child health services. However, LHDs have faced many challenges in developing and sustaining collaborative capacity over the last decade.<sup>3</sup> One challenge is how to develop and maintain collaborations in light of changes over time including changes in relationships through joint production, core membership, and number of collaborators (i.e. partnerships). One possible approach to addressing the challenge may be to study the changes of LHD collaborative capacity and joint production (i.e. ability to perform services with other organizations) to enhance and coordinate services targeted at assuring healthy women, infants, and children through public health delivery systems (PHDS). PHDS include public and private organizations that contribute to the delivery of public health services for a given population. The inter-organizational theory is useful for studying collaborative efforts of PHDS by addressing change and examining how organizations work together.<sup>4,5</sup> It suggests that studying and understanding PHDS may lead to a more comprehensive and coordinated approach to addressing complex issues beyond a single organization's domain.<sup>4,6</sup> Additionally, the theory suggests that defining a useful foundation for understanding and mobilizing PHDS enhances the ability to address a range of public health issues, such as infant mortality. By working together, PHDS may be able to provide a comprehensive coordinated approach and useful foundation to increase the reach of maternal and infant services and ultimately reduce infant mortality. The existing literature provides some evidence of the benefit of PHDS. For example, a recent study found that PHDS varied widely in organizational structure but offer a broader scope of services and engage with a wider range of organizations.<sup>7</sup> Another study found that partnerships among public health systems were a partial mediator between resources and service provision.<sup>8</sup> In a mediating role, these partnerships reduce differences

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in service provision among rural, suburban, and urban LHDs.<sup>9</sup> A social network analysis study found an association between central and dense PHDS and improved health status.<sup>10</sup> Also, a few studies have suggested that joint production, or collaboration through PHDS, is motivated by cost reduction and resource scarcity.<sup>11,12</sup> Taken together, these studies suggest that joint production is a strategic way of gaining access to crucial knowledge while developing fast, effective, and efficient means for acquiring the appropriate skills and resources needed to deliver services to communities of need. Research has focused mainly on collaboration processes, interactions, and health outcomes and less on how the changes in partnerships and joint production over time may influence their ability to deliver superior maternal and child health (MCH) services. It is important to understand that PHDS joint production cannot be measured by partnerships alone but there is a need to understand the mutual responsibilities and benefits of working collaboratively to deliver maternal and child health services. We used two measures of social network analysis, density and centrality, to understand the relationship between PHDS partnership and joint production and maternal and child service provisions and over time. Density is the number of delivery systems partners and centrality is the number of organizations that jointly produce services. Therefore, we hypothesized that joint production among a large number of PHDS partners is associated with a broader larger scope of maternal and child health services. The current study tests this hypothesis by examining PHDS partnerships and joint production, defined by density and centrality, association with MCH preventive services.

## Methods

We used a longitudinal retrospective cohort research design to examine the association of structural changes in PHDS and MCH services. We used social network analysis measures to characterize PHDS partnerships and joint production in four categories of change, high levels of joint production and a limited number of partners, high levels of joint production and a large number of partners, limited joint production and number of partners, and limited joint production and a

large number of partners. We also used a one-way analysis of variance to examine the association of PHDS partnerships and joint production changes and the provision of MCH preventive services.

## Data sources and samples

We used survey data from two waves (2006 and 2012) of the National Longitudinal Study of Public Health Agencies (NLSHPA), which was conducted to identify organizational and operational characteristics of PHDS.<sup>10</sup> The NLSHPA asked LHD directors to indicate the 20 public health activities performed in their jurisdiction and the type of organizations, other than the LHDs, that contributed to each of those activities. LHDs were members of the public health delivery system, serving populations of at least 100,000 people in all but four states. We obtained additional data to further characterize the LHDs, the population they serve, and the communities in which they are located from the 2005 and 2010 National Association of County and City Health Officers Profile Studies<sup>3</sup> and the 2006, and 2011 Area Resource Files.<sup>11</sup> We included all LHDs that responded to both waves of the NLSHPA in the sample for this study (N=239).

## Measures

We used data from the 2006 and 2012 National Longitudinal Study of Public Health Agencies (NLSHPA) to examine the association of changes in PHDS partnerships and joint production and MCH preventive services overtime. MCH services included clinical and non-clinical preventive services that promote healthy maternal behaviors. The study examined the characteristics of PHDS that experienced changes in partnership and joint production from 2006 to 2012. Social network analysis measures, density and centrality, were calculated for each of the 239 public health delivery systems. Degree centrality (i.e. joint production) describes the degree of PHDS coordination.<sup>12</sup> It is calculated by summing the number of connections that a particular organization has with all other organizations and dividing by the total number of organizations in the delivery system then subtracting one.<sup>13</sup> For this study, we used the number of organizations reported by LHDs on the NLSHPA to determine PHDS degree centrality. Degree centrality values can range from 0 to 1, with a higher value representing a more centralized PHDS.<sup>12</sup> Next, we calculated PHDS density, which is the number of partners (or ties) an organization has divided by the number of possible partners (the number of organizations in the PHDS).<sup>12</sup> Density values range from 0 to 1, with higher values indicating dense networks and lower values indicating sparse networks.<sup>12</sup> First, PHDS density and degree centrality were calculated to identify the number of organizations in each public health system and joint production in the public health delivery system. Next, the analysis assessed the variation among differences in PHDS joint production and partnerships from 2006 to 2012 using diffuse and contracting PHDS as the reference group (Table 1). To demonstrate variation in PHDS joint production and partnerships, each of the PHDS was classified according to four categories of change (Table 1). The categories are joint production and limited partners, joint production and a large number of partners, limited joint production and number of partners, and limited joint production and a large number of partners. Then PHDS were stratified based on whether or not the system migrated from one category to another from 2006 and 2012. Next, statistical analysis was performed using SAS 9.2. Differences between groups were assessed by one-way analysis of variance (ANOVA).<sup>13,14</sup> P values of <0.05 were considered significant. We examined changes in the provision of MCH preventive services, local health department characteristics, and population characteristics.

**Table 1** Public health delivery systems partnerships and joint production

PHDS (2006-2012)	N	(%)
Limited partners and high levels of joint production	98	41%
Large number of partners and high levels of joint production	31	14%
Limited partners and joint production	105	44%
Large number partners and limited joint production	5	2%

**Note:** the percentage is calculated based on the number of delivery system (PHDS) partners and joint production in each category. PHDS partnerships and joint production was examined from 2006 to 2012.

## Results

Similarities and differences among PHDS. PHDS were more likely to have a large number of partners in 2006 (17 percent) compared to 2012 (14 percent). PHDS joint production decreased slightly in 2012 (14 percent) compared to 2006 (15 percent). Next, PHDS were more likely to have limited joint production and partners (44 percent) and high levels of joint production and limited numbers of partners (41 percent). A small number of PHDS had high levels joint production and a large number of partners (14 percent). The remaining PHDS had a limited joint production and a large number of partners (2 percent). These findings suggest most PHDS reduced their number of partners from 2006-2012. Delivery systems, among LHDs and other organizations, are essential for developing and promoting sustainable programs that target the needs of the community.<sup>15</sup> Table 2 shows MCH service delivery, population characteristics, and LHDs characteristics are very similar across these four categories. Specifically, there were no statistical differences in clinic MCH services (i.e. prenatal and obstetric) across the four categories of change. PHDS with high levels of joint production and a large number of partners provided a statistically significantly lower amount of STD clinical services compared to PHDS with limited joint production and partners. PHDS with limited joint production and a large number of partners provided a statistically significantly higher amount of STD clinical services compared to PHDS with limited joint production and partners. Non-clinical preventive MCH services were also statistically different across the four categories of change. PHDS with high levels of joint production and a large number of partners offer a significantly increased amount of injury prevention services compared to PHDS with limited joint production and partnerships. Also, PHDS with limited joint production and a large number of partners offer more STD treatment services as well as serve a population of less uninsured and a higher income per capita than PHDS with limited joint production and partnerships. In addition, PHDS with high levels of joint production and a limited partnerships offer a larger scope of cardiovascular disease screenings, tobacco control services, and adult immunizations compared to PHDS with limited joint production and partnerships. Overall, PHDS with high levels of joint production and a limited partnerships offer a broader scope of MCH preventive services compared to PHDS with limited joint production and partnerships. The findings suggest joint production among PHDS is associated with an increase in the provision of MCH preventive and the PHDS likelihood to meet the needs of the community by reducing infant mortality. These results demonstrate the importance of classifying PHDS joint production and partnerships and examining MCH preventive services to highlight how changes in joint production and partnerships are associated with the provision of MCH preventive services.

**Table 2** Quantitative characteristics of public health delivery systems partnerships and joint production

Variables	Partners (-) and joint production (-) (n=105)		Partners (+) and joint production (+) (n=31)		Partners (+) and joint production (-) (n=5)		Partners (-) and joint production (+) (n=98)	
Scope of maternal and child preventive services	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
<b>Clinical</b>								
Prenatal care	0.43	-0.49	48.00%	-0.5	0.5	-0.58	0.43	-0.49
Obstetrics	0.01	-0.1	-	-	-	-	0.01	-0.11
STD treatment	0.94		0.80**	-0.8	**		0.92	
<b>Non-Clinical</b>								
Well-Child Visit (WIC)	0.02	-0.14	-	-	-	-	0.03	-0.17
Cardiovascular Disease Screening	0.32	-0.46	41.00%	-0.5	0-Jan	-0.57	.47**	-0.5
Diabetes screening	0.43	-0.49	57.00%	-0.5	0.5	-0.57	0.47	-0.5
Tobacco Control	0.73		0.75*	0.75	0.75		.84*	
Injury prevention	0.47	-0.5	0.71**	-0.46	0.5	-0.57	0.58	-0.49
Childhood immunization	0.98	-0.1	0.97	-0.18				0
Adult Immunizations	0.08		0.97	-0.18	1-Jan		.93**	-0.24
STD screening	0.04				0.25		0.05	
<b>Population Characteristics</b>								
Percent of Non-White	0.28	-0.18	0.3	-0.19	0.36	0.22	0.26	-0.15
Number of Uninsured	15.66	-4.72	14.21		13.23*		15.79	-5.67
Income Per Capita	33,377.86		34,255		53,415*	-0.96	45,262.28	
Population	373,363.02		699,425		2,884,341		422,444	
<b>Local health departments characteristics</b>								
Full-Time Employee	59.47	-84.94	49.22	-28.19	45.06	-25.04	52.26	-32.41
Expenditures Per Capita (log)	3.72	-0.87	3.67	-0.76	3.76	-0.7	3.84	-0.69

**Note:** LHD, local health department

For 1998, the number of LHDs was, 315, 232 for 2006, and 239 for 2012.

\*P<.05; \*\*P<.01.

## Discussion

There was a significant difference in the provision of vital MCH services between groups. Specifically, PHDS with high levels of joint production were significantly more likely to offer a larger scope of MCH preventive services (i.e. injury prevention services, tobacco control, and STDs) compared to PHDS with limited joint production. Injury is the leading cause of death among children ages 1 to 5.<sup>16</sup> Smoking during pregnancy has been linked to sudden infant death syndrome, low birth weight, preterm birth, and other birth defects. STDs can be transferred to the fetus or newborn; gonorrhea and chlamydia have been linked to infant blindness.<sup>17,18</sup> The Healthy People 2020 goal for maternal age and pregnant women to adopt healthy behaviors

such as tobacco cessation, effective use of contraceptives to reduce the transmission of STDs, a reduction in injuries, healthy nutrition and exercise which leads to reduction in cardiovascular disease, and proper immunization are more likely to be reached by PHDS with high levels of joint production.<sup>1</sup> Additionally, PHDS with limited joint production and a large number partnerships (2 percent) offered a larger scope of STD treatment services and served a population with a lower number of uninsured and a larger income per capita compared to PHDS with limited joint production and partnerships. Although the number of PHDS with limited joint production and a large number partnerships is limited, the findings suggest these PHDS may not have a high demand for MCH preventive services because they serve a population with a higher insured rate and larger income

per capita compared to the other three groups. PHDS with limited joint production and partnerships may only offer a limited number of MCH preventive services to meet the needs of the community.

## Conclusion and limitations

This study offers important contributions to the literature; however, there are important limitations that affected the external validity, particularly generalizability. First, the sample size is small. The quantitative data only examines 239 LHDs (<10%) across the nation's 2,565 LHDs that participate in the 2010 NACCHO profile study. However, the findings in this study are similar to those in a recent NACCHO report that indicated larger systems with full capacity offer a larger scope of services.<sup>19</sup> Second, density and centrality are not the only social network measures that can be used to examine PHDS joint production and partnerships. However, density and centrality are complementary measures. Density describes the general level of cohesion, and degree centrality describes the extent to which the cohesion is organized (joint production) around a particular focus point (maternal and child health).<sup>20</sup> Further research is needed to assess their use in the examination of PHDS and the systems' capacity or approaches to meeting population needs. Third, the measurements of centrality and density are two aspects of measuring joint production and partnerships in one aspect of improving stakeholders' knowledge of the collaborations and the characteristics of these collaborations.<sup>17</sup> However, these network measures provide a wealth of information about the partners.<sup>16</sup> Fourth, LHDs were members of the public health systems, serving populations of at least 100,000 people. The NLSPHA does not examine rural agencies where communities may depend more on MCH services. However, rural LHDs face significant challenges in providing adequate maternal and infant health care due to unequal distribution of resources.<sup>18</sup> Lastly, the scope of maternal and child services are limited to services that encourage healthy behaviors for maternal age and pregnant women. However, early identification of unhealthy behaviors, such as tobacco use, unsafe sex, and inadequate nutrition and unhealthy weight among women, may prevent infant death or disability and enable children to reach their full potential.<sup>19</sup> More research is needed to evaluate the effectiveness of these delivery systems and maternal and child health outcomes.

## Implications

The recent LHD budget cuts have resulted in a cut or elimination of essential public health services and programs.<sup>21</sup> A NACCHO study indicated that maternal and child services and programs are among the most vulnerable to LHD cuts.<sup>20</sup> Previous studies have suggested that public health partnerships put the well-being of a community into greater focus with overall goals to improve health outcomes despite budget cuts.<sup>21-23</sup> While previous studies have focused on the public health partnerships among PHDS and budget cuts, limited research has been done to characterize and examine changes in PHDS joint production and partnerships, and determine how these factors are associated with the delivery of public health services to improve health outcomes. The empirical method used in this study characterizes and examines PHDS joint production and partnerships association with the provision of MCH services and programs provided in each PHDS category. The study findings suggest that PHDS partnerships and joint production are associated with the provision of MCH services and programs. Our study's findings illustrate the complexities of PHDS and PHDS partnership and joint production association with

MCH services and programs. It is likely that the limited knowledge about PHDS joint production may limit the LHD's ability to provide essential public health services and programs. Research is needed to determine the level of joint production and partnerships among PHDS needed to improve MCH outcomes and reduce variation in PHDS joint production and partnerships overtime that may negatively impact MCH outcomes.

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## Conflict of interest

The author declares no conflict of interest.

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