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What Can Appalachian Pediatric Networks Do to Improve Disaster Preparedness and Health Outcomes? Examining Characteristics of Pediatric Networks in the United States to Identify Differences between Appalachian and Non-Appalachian Collaborations

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Abstract

Introduction: Living in the Appalachian Region of the United States (US) has been linked with poorer pediatric health outcomes, particularly for children in low income families living in rural areas.

Purpose: We endeavored to describe the characteristics of the Appalachian and non- Appalachian pediatric emergency networks in the US and to determine if pediatric healthcare networks in the Appalachia differ from networks elsewhere in the U.S. according to size, whether they were inter- or intra-state, and intensity of collaboration.

Methods: Data were collected using a two-stage survey process. The first survey was used to identify networks. The second survey assessed disaster preparedness capabilities and achievements of each identified network, degree of fund sharing, and the intensity and formality of information sharing among network partners. Networks were separated into Appalachia or non-Appalachia networks based on state location.

Results: Appalachian networks were more likely to be interstate and operating at the highest stage of network development compared to non-Appalachian networks, but were less likely to share funding among network partners.

Conclusion: Despite consistently insufficient pediatric capacity and repeated calls for collaboration among pediatric care providers, only three out of seventeen identified pediatric networks were operating in Appalachia. Operating in Appalachia was associated with less fund sharing, although Appalachian networks were more likely to have achieved the highest stage of network development. Developing new pediatric networks and increasing the intensity of collaboration (i.e., increased levels of fund sharing) among existing networks may improve disaster preparedness, network operations, collaboration, and health outcomes in Appalachian states.

Keywords: Disaster preparedness, Rural disparities, Pediatric networks, Appalachian

Introduction

The Appalachian region of the United States, made up of 420 counties in thirteen states spanning from southern New York to northern Mississippi, is home to an estimated 25 million people [1]. Living in Appalachia has been linked with poorer pediatric health outcomes, particularly for children in low income families living in rural areas. Problems accessing appropriate pediatric care is a nationwide problem; across the country, most children who sought care in emergency departments (69.0%) received care in Emergency Departments (EDs) averaging fewer than 15 pediatric patients per day [2]. For Appalachian families, limited access due to insufficient pediatric capacity is compounded by access factors including increased travel distances to obtain care, poverty, and lack of insurance [3].

Problems related to access and capacity limitations of pediatric healthcare organizations are compounded during disasters. The Institute of Medicine (IOM) reported that only six percent of the emergency departments in the US have all the necessary supplies, facilities, or personnel to deal with pediatric emergencies [4]. In addition, the American Academy of Pediatrics (AAP) Committee on Pediatric Emergency Medicine identified pediatric ED overcrowding as a significant constraint to providing adequate pediatric emergency care in general and a significant constraint during disaster response [5-7].

Developing networks of healthcare organizations can increase surge (as in a temporary increased demand for services) and non-surge pediatric capacity. Collaborative networks would benefit rural Appalachian communities and would allow them be better equipped for the increasing frequency and intensity of hazardous events.

Background

The short-supply of resources and children's hospitals routinely operating at or near capacity combine to produce little available reserves for even a modest surge of inpatients [8,9]. In addition to their critical role during disasters, networks of pediatric care providers are urgently important to the health and wellbeing of communities before and after disasters occur.

Several agencies and organizations have devoted research or other efforts and resources to the topic of disaster-related regional

and networks. For example, in its 2010 report to the President, the National Commission on Children and Disasters (NCDD) recommended that "resources for a formal regionalized pediatric system of care to support surge capacity during and after a disaster" should be provided [10]. This recommendation was made earlier by the IOM in 2006 [4] and independently corroborated by a peer-reviewed paper published in the same year [11]. Further, the AAP, the Office of the Assistant Secretary for Preparedness and Response (ASPR) Hospital Preparedness Program (HPP), and the IOM have focused webinars and workshop presentations on the topic of regional collaborations and networks. There is significant evidence of the need for the formation of regional collaborations and networks of providers for pediatric surge. As Krug and colleagues note "enhanced partnerships between pediatricians and state or local health department representatives would likely result in improved pediatric preparedness planning" [12].

Despite the evidence of need, formal regional networks have been slow to develop perhaps because they are difficult to organize, develop, and manage, and there may be numerous legal, infrastructural, and operations barriers to their formation and maintenance [13]. Even with the inherent difficulties, there are a number of nascent and informal networks in various stages of development and fewer formally established regional pediatric surge networks; however, beyond networks for routine care, such as trauma, perinatal, and referral collaborations, little is known concerning the development, characteristics and effectiveness of these networks. Therefore, conducting an inventory and analysis of US networks and other collaborative efforts to address pediatric surge capacity is an important step towards achieving pediatric preparedness. Further, such an inventory will provide guidance for improving existing networks and support the creation of new networks.

Network Rationale

Forming coalitions among organizations has become an expectation of public health agencies at the local, state, and national levels [14]. Indeed, partnering and community involvement are essential in the Public Health Accreditation Board (PHAB) process for state, local and tribal public health accreditation [15]. "Mobilizing community partnerships" is one of the essential public health services defined by the IOM [16], and the National Public Health Performance Standards includes the use of partnership strategies as a performance measure [17].

With the passage of the Pandemic and All-Hazards Preparedness Act (PAHPA, Public Law No. 109-417) in 2006, the Congress authorized the HPP. The program is managed by the ASPR in the U.S. Department of Health and Human Services. The HPP has placed considerable emphasis on the formation of health care coalitions through its funding efforts. Rambhia and colleagues [18] reported that more than 90.0% of hospitals participating in the survey were involved in a coalition or network as a result of HPP funding. It is noteworthy that the HPP program applies to all hospitals and is not specific to pediatric specialty hospital or pediatric-focused networks. Toner and colleagues [19] concluded that although the HPP program has contributed to major advancements in individual hospital preparedness and the furtherance of health care coalitions, health care coalitions remain in the early stages of development and are insufficient to effectively respond to widespread catastrophic events.

Network Theory and Research

Research on factors that promote inter-organizational collaboration is extensive [20-23]. Inter-organizational collaboration in its most advanced stage results in networks – nonhierarchical collections of legally separate organizations interacting for exchange, concerted action, and joint production [24,25]. Networks are sets of collaborative relationships [26], between a lead collaborator and member collaborators [26-30]. Multiple organizations participating in inter-organizational relationships established by each lead collaborator has been labeled an "organizational set" by Evan [28] and affirmed by Whetten [31].

Density and Intensity: Two structural properties of inter-organizational collaboration have been defined as density and intensity [24, 31,32]. Density is the proportion of all possible linkages within an organizational set [32]. Intensity is the frequency of interaction within an interorganizational set [32]. Essentially, density and intensity of collaboration, are measures of the richness of the collaboration efforts.

Network Development Stage: Networks typically evolve through three Stages: Stage 1 - exchange networks, the sharing of information among participants; Stage 2 - action networks, mutual goal setting and collective action; and Stage 3 - formal networks, long-term formal linkages with memoranda of understanding, memoranda of agreement, and contracts [24, 31-33]. The Stage of network development generally reflects the mutual interdependence within the organizational set and the maturity of the collaborative efforts.

Purpose

Given the need for the well-functioning networks of pediatric providers before, during, and after disasters, and the unique vulnerability of the Appalachia region, the goal of the study was to describe collaboration among the pediatric healthcare networks in the Appalachia region compared to such networks outside the region. This study investigated pediatric healthcare networks in the Appalachia region to determine if they differ from networks elsewhere in the US in terms of locus (inter- or intra-state), density (measured by number of network members), intensity (measured by collaborative goal achievement), fund sharing, and stage of network development.

Methods

Data were collected using a two-stage survey process. The first survey (Survey I) was distributed by the AAP disaster preparedness initiatives staff to AAP members and public health representatives in the field and identified networks or groups of collaborators (response rate of 53.0% with 111 complete responses from 209 attempted or partial completions; 69.0% of respondents were involved in at least one network). The second survey (Survey II) was sent to the eighty-two Survey I respondents who had identified at least one collaborative network, were based in the U.S., and had agreed to participate in Survey II. Survey II asked about network size, achievement of disaster preparedness goals, frequency and formality of information sharing, and fund sharing among network members (response rate of 62.0% with 51 responses). Consistent with our study goal, we analyzed with descriptive statistics, i.e. mean. Due to the small sample size, we did not use tests for statistical differences.

Density was measured by the number of partnerships a network possessed; with fewer than 4 partnerships categorized as low density, 4-10 partnerships as medium, and 11 or more as high density (average was 7). Intensity measured the extent to which identified networks achieved each of 15 preparedness goals using a four-point scale, with 1 meaning "does not yet address" and 4 meaning "addresses to a significant extent." Each network could achieve a score in the range of 15 (a score of 1 on each item) to 60 (a score of 4 on each item). Networks classified as "low" if they scored less than 32, "medium" if they scored between 33-47, and "high" if scored higher than 47. The median score was 41.

Networks were also evaluated based on their stage of development (ranging from 1 to 3) as outlined in previous research [24]. The first stage is the sharing of information – i.e. sharing of disaster surge protocols. The second stage is mutual goal setting and collective action – i.e. networks agree upon and word toward mutual goals for each hospital in the network. The third and final stage is the creation of a formal network via long term linkages – i.e. creation and agreement of formal contractual agreements. Information sharing was measured

using a fivepoint scale with 1 "not at all" and 5 meaning "to a great extent."; degree of formality was assessed with a yes or no question regarding network members had formal agreements or contracts in place. Networks were considered to be in stage 1 if they scored 3 or less for information sharing, stage 2 if scored greater than 3 for information sharing but did not have formal agreements or contracts in place, and stage 3 if they scored greater than three for information sharing and had formal agreements or contracts in place.

Results

Networks were separated into Appalachian or non-Appalachian networks based on state location. The Kentucky Coalition, Southeastern Regional Pediatric Disaster Surge Network, and the Ohio Coalition were considered Appalachian networks and the remaining networks were considered non-Appalachian. Figure 1 below is a map showing the location of each identified network.

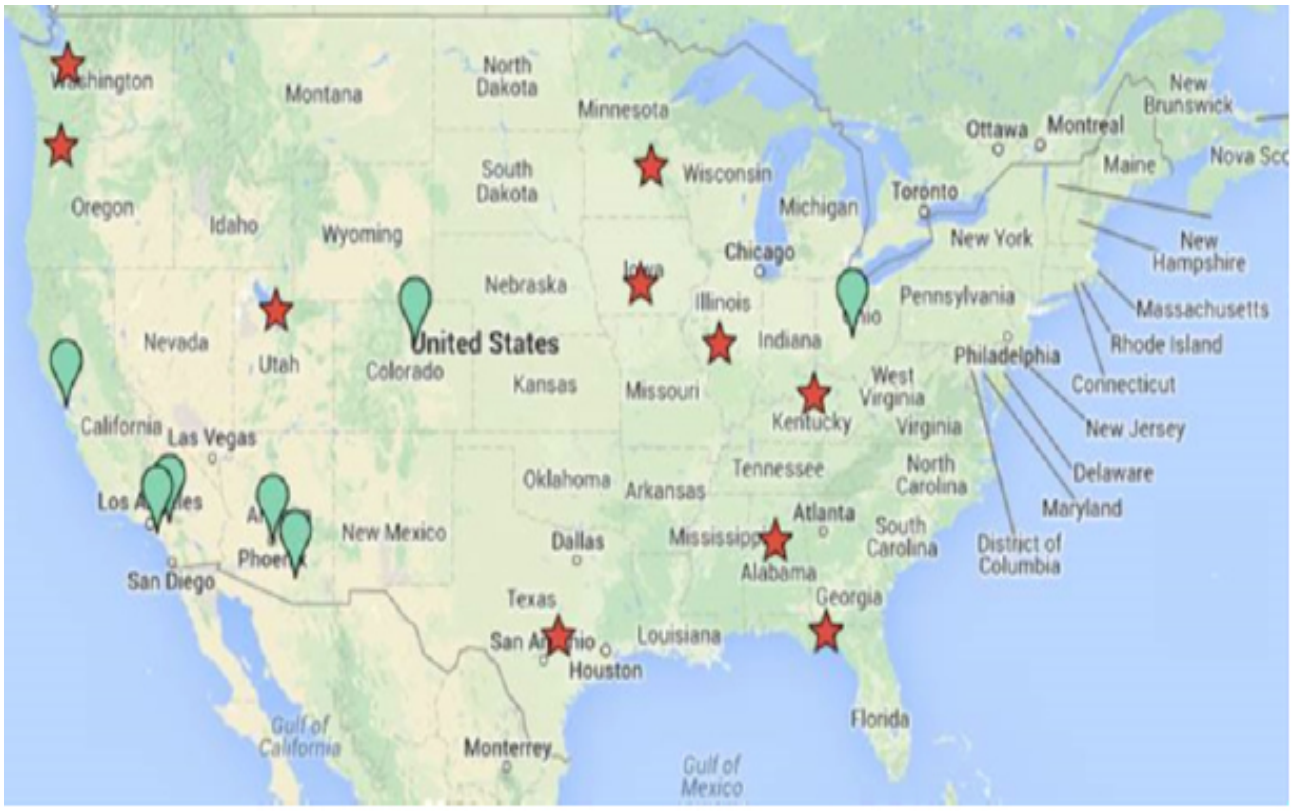

Figure 1. Map of Network Locations

Among interstate networks, five (50.0%) were in stage three of network development, three (30.0%) were in stage two; one was in stage 1 (10.0%) (stage of network development data was missing for one interstate network). Among intrastate networks, two (29.0%) were in stage 3 and five (71.0%) were in stage 2. Each network's stage of development, density, and intensity scores are presented in Table 1.

Coalition Label	Stage of Network Development	Density of Collaboration	Intensity of Collaboration
Interstate Networks			
Florida Children's Preparedness Coalition	2	High	Medium
Illinois Coalition	3	Medium	High
Iowa Coalition	3	Medium	Medium
Kentucky Coalition*	3	High	Medium
Minnesota Coalition	2	Medium	Low
Mountain States Pediatric Disaster Surge Coalition	1	High	Medium
Oregon Coalition	No Data	High	Low
Southeastern Regional Pediatric Disaster Surge Network*	3	Medium	Medium

Table. 1 to be Cont.....

Texas Coalition	3	Medium	Medium
Washington State Coalition	2	Low	High
Intrastate Networks			
Arizona Healthcare Coalition Southeastern	3	Medium	High
Colorado Coalition	3	High	Medium
Coyote Crisis Collaborative	2	Medium	Low
Ohio Coalition*	2	Low	Low
San Bernardino (CA) County Coalition	2	Medium	Medium
San Francisco Coalition	2	Low	Medium
Southern California Coalition	2	Medium	Medium

*Indicates the network is primarily located in the Appalachian region

Table 1. Network Names, Stage of Network Development, Density, and Intensity of Collaboration

Ten interstate (59.0% of identified networks) and seven intrastate networks (41.0% of identified networks) were identified via the second survey, with interstate defined as network collaborations that existing in more than one state (i.e. multiple hospitals in multiple states to form one network) and intrastate defined as network collaborations within a single state (i.e. multiple hospitals in one state to form one network). Two Appalachian networks (Kentucky Coalition and the Southeastern Regional Pediatric Disaster Surge Network) were interstate and the other (the Ohio Coalition) was intrastate. Below, Table 2 displays the percentage of selfreported fund-sharing ranging from "not at all" to a "great extent" for each network.

Network Label	Not at All	A Little	Some	A Lot	Great Extent
Interstate Networks					
Florida Children's Preparedness Coalition	100.0%	0.0%	0.0%	0.0%	0.0%
Illinois Coalition	80.0%	20.0%	0.0%	0.0%	0.0%
Iowa Coalition	40.0%	0.0%	0.0%	0.0%	60.0%
Kentucky Coalition*	25.0%	38.0%	13.0%	13.0%	13.0%
Minnesota Coalition	67.0%	0.0%	0.0%	0.0%	33.0%
Mountain States Pediatric Disaster Surge Coalition	89.0%	0.0%	0.0%	0.0%	11.0%
Oregon Coalition	No Data				
Southeastern Regional Pediatric Disaster Surge Network*	100.0%	0.0%	0.0%	0.0%	0.0%
Texas Coalition	0.0%	0.0%	0.0%	25.0%	75.0%
Washington State Coalition	0.0%	0.0%	100.0%	0.0%	0.0%
Intrastate Networks					
Arizona Healthcare Coalition Southeastern	100.0%	0.0%	0.0%	0.0%	0.0%
Colorado Coalition	88.0%	12.0%	0.0%	0.0%	0.0%
Coyote Crisis Collaborative	100.0%	0.0%	0.0%	0.0%	0.0%
Ohio Coalition*	100.0%	0.0%	0.0%	0.0%	0.0%
San Bernardino (CA) County Coalition	67.0%	0.0%	33.0%	0.0%	0.0%
San Francisco Coalition	34.0%	33.0%	33.0%	0.0%	0.0%
Southern California Coalition	61.0%	13.0%	13.0%	13.0%	1.0%

*Indicates the network is primarily located in the Appalachian region

Table 2. Network Fund Sharing

Three of the 17 networks were located in the Appalachia region – Kentucky Coalition, Southeastern Regional Pediatric Disaster Surge Network, and the Ohio Coalition. Appalachian (2/3) and non-Appalachian networks (8/14) were more likely to be interstate networks than intrastate networks. The Appalachian networks were equally as likely to be high (1/3), medium (1/3), or low density (1/3); non-Appalachian networks were most likely to be medium density (8/14) and least likely to be low density (2/14). Appalachian networks were

more likely to be medium intensity (2/3); non-Appalachian networks were most likely to be medium intensity (8/14); 3/14 were high and 3/14 were low intensity. Appalachian networks were most likely to be in stage 3 of network development (2/3); non-Appalachian networks were most likely to be in stage 2 (7/13) and least likely to be in stage 1 (1/13). Only one Appalachian network, the Kentucky Coalition, reported any fund sharing; in contrast, 10/13 non-Appalachian networks reporting at least some fund sharing.

Discussion

Operating in Appalachia was associated with less fund sharing among networks, although Appalachian networks were more likely to have achieved the highest stage of network development. Overall, increased network intensity (particularly increased levels of fund sharing) among pediatric networks may improve network operations and collaboration and subsequently the health of individuals who live in Appalachian states. The results suggest that the majority of pediatric networks do not engage in any fund sharing at all. This lack of high-level collaboration may lead to increased risk of adverse and poor health outcomes for the vulnerable pediatric population during a hazardous event. Collaborative efforts such as networks are valuable because they provide both surge and non-surge pediatric capacity.

Conclusion

Pediatric networks in Appalachia can improve coordination among health providers in the Appalachian region via increased evidenced based organizational changes that higher levels of collaboration and creation of strategies centered on preparedness, emergency operations, and medical surge. Because rural hospitals and care providers must often operate with fewer resources, struggle with higher per capita costs, and fewer service providers per capita [3] it is imperative that more networks are created and sustained. The few Appalachian networks identified in our survey are doing important work in an underserved and disadvantaged region. Further studies should evaluate barriers to high density and intensity networks and determine ways to facilitate pediatric healthcare network development in Appalachia.

Conflict of interest: The author has declared no conflict of interest.

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