

# The NHLBI—UnitedHealth Global Health Centers of Excellence Program



## Assessment of Impact of Federal Funding Through a Social Network Analysis

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Global collaborations in research are bringing new challenges and opportunities for investigators to combat noncommunicable diseases in low- and middle-income countries. In addition, funders are identifying creative new ways to fund global health research, form new research networks, and leverage team members' strengths.

In June 2009, the National Heart, Lung, and Blood Institute joined UnitedHealth Group to create the National Heart, Lung, and Blood Institute—UnitedHealth Global Health Centers of Excellence Program by funding a total of 11 Centers of Excellence in low- and middle-income countries (Table 1). The National Heart, Lung, and Blood Institute solely funded 3 contracts, UnitedHealth Group solely funded 2 contracts, and they jointly funded 6 contracts, for a total of 11 contracts in 10 countries.

The aims of this network were to: 1) conduct research in noncommunicable cardiovascular and pulmonary diseases; 2) build capacity; and 3) enable research training of early-stage career investigators at individual Centers of Excellence. Each Center of Excellence subcontracted with an academic institution in a high-income country that participated in the Fogarty International Clinical Research Scholars and Fellows Program to serve as a Developed Country Partner. The Developed Country Partner's role was to serve as an adviser and mentor to the Center of Excellence staff. The National Heart, Lung, and Blood Institute also issued a contract to Westat for an Administrative Coordinating Center to coordinate the activities of the network, build cohesion, cultivate and leverage team members' strengths, provide communications forums, and foster collaboration and team science [1].

### GROWING INTEREST IN TEAM SCIENCE

Team science is gaining acceptance as a bona fide framework for effective collaborative research. For the past 6 decades, investigators have been collaborating with colleagues using a collaborative research approach known as "team science" because scientific knowledge and methods have become more complex and advanced [2]. Team science has evolved out of necessity, given the explosion of data and the specialization that make it virtually impossible for 1 individual to be all knowing about a scientific endeavor, and there is more emphasis on global generalization of research findings.

### CENTERS OF EXCELLENCE PROGRAM AND HOW THE ADMINISTRATIVE COORDINATING CENTER FOSTERED GLOBAL COLLABORATION

In the remainder of this article, we offer a brief overview of 1 component of the Centers of Excellence Program and how the Administrative Coordinating Center applied the tenets of team science from the National Institutes of Health's *Collaboration & Team Science: A Field Guide* [3] to successfully deliver outcomes of collaborations in epidemiology.

Across the network projects, 45 common variables were identified and harmonized, with the intent of answering questions regarding noncommunicable cardiovascular and pulmonary diseases that may not otherwise be answered by any single research activity. These were harmonized into a single dataset, data dictionary, and master frequency table, as described elsewhere [1].

The challenge was to transform a group of cardiovascular and pulmonary disease researchers with no prior relationship into a functionally effective team. The Appendix illustrates how the Administrative Coordinating Center staff used the team science tenets of leadership, team evolution, trust, shared vision, communication, team dynamic strengthening, recognition and credit, and system leveraging and navigation to foster the Centers of Excellence Epidemiology Subcommittee as an integrated research team.

Successes resulting from the implementation of these team science tenets included creating a data-sharing agreement; identifying 45 common variables; developing and prioritizing research questions; Centers of Excellence principal investigators' accepting the Administrative Coordinating Center data manager's harmonization structure; forming 8 writing teams with 6 manuscripts; determining the process for authorship; and having Administrative Coordinating Center staff members provide statistical and literature review support.

Despite the challenges of having 18 Epidemiology Subcommittee team members in Africa, Asia, and Latin America, delayed communication due to varying time zones and technology connectivity issues, and competing priorities for many of the Centers of Excellence principal investigators, the Epidemiology Subcommittee was very gratifying. Not only were investigators invited to submit collaborative manuscripts to the issue of *Global Heart*

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**TABLE 1.** Funded contracts by organization

National Heart, Lung, and Blood Institute—funded contracts	UnitedHealth Group—funded contracts	Joint National Heart, Lung, and Blood Institute/UnitedHealth Group—funded contracts
Institute for Clinical Effectiveness and Health Policy, Buenos Aires, Argentina	University Hospital Farhat Hached, Sousse, Tunisia	International Centre for Diarrhoeal Disease Research, Dhaka, Bangladesh
Moi University School of Medicine, Eldoret, Kenya	Center for Health Promotion in Northern Mexico, Hermosillo, Mexico	George Institute for Global Health, Beijing, China
Universidad Peruana Cayetano Heredia, Lima, Peru		Institute of Nutrition of Central America and Panama, Guatemala City, Guatemala
		St. John’s Research Institute, Bangalore, India
		Public Health Foundation of India, New Delhi, India
		University of Cape Town, Cape Town, South Africa

devoted to noncommunicable diseases, but many of the Centers of Excellence principal investigators have obtained funding to continue collaborating and have continued informally as a network. This would not have been possible without federal funding from the National Heart, Lung, and Blood Institute and private funding from UnitedHealth Group.

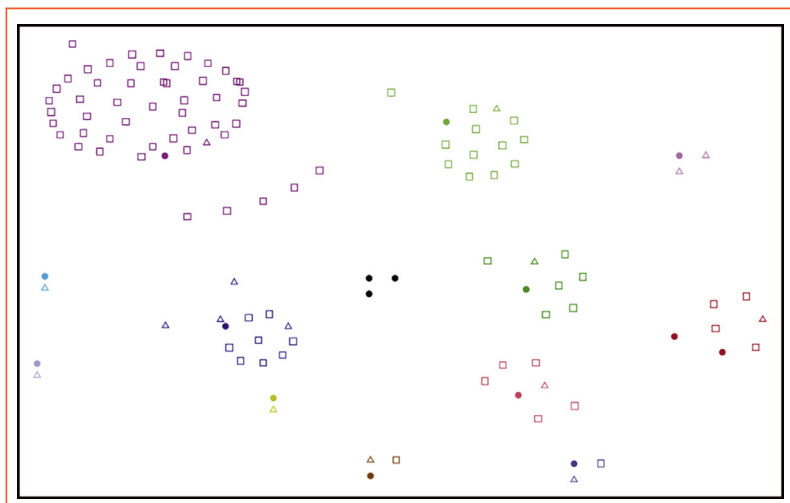
**SOCIAL NETWORK ANALYSIS**

One approach to demonstrate the impact of collaboration with federal support is social network analysis. Social

network analysis describes the relationships and interplay (ties) among a set of institutions (nodes). These nodes can be tied together through relationships, such as professional collaborations. The Centers of Excellence Program includes Centers of Excellence and their subsites and Developed Country Partners, with the support of the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat, all of which act as nodes in the Centers of Excellence network. Collaborations on research projects and administrative support tie these nodes together, producing a network of institutions connected by collaborative and supportive partnerships.

The Centers of Excellence network began as a set of 128 nodes, and the Centers of Excellence and subsites, Developed Country Partners, and partners became connected through collaborative research projects over the 5 years of the Centers of Excellence Program. Figure 1 shows these nodes before the program’s implementation. Node color varies for each location, with the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat depicted in black. Node shape also varies by role, with the Centers of Excellence, the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat denoted with circles, subsites with squares, and Developed Country Partners with triangles. No ties are depicted in Figure 1, because research collaborations were not yet formed.

During the Centers of Excellence Program, relationships were created through the 24 collaborative research projects. On any given project, each collaborating node was connected. For example, a project involving 2 collaborators comprised 1 tie between collaborating nodes, a project involving 3 collaborators comprised 3 ties among collaborating nodes, a project involving 4 collaborators comprised 6 ties among collaborating nodes, and so forth.



**FIGURE 1.** Network graph before the Centers of Excellence Program was formed. ○ = National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat (black), Centers of Excellence (various colors); □ = subsites (vary by color); △ = Developed Country Partners (vary by color).

**TABLE 2.** Location characteristics

Location	Centers of Excellence, Developed Country Partners, and Subsites	Centers of Excellence	Developed Country Partners	Subsites	Hosted Research Projects	Hosted Collaborative Research Projects	Number of Collaborating Components (Range)	Number of Collaborating Locations
Argentina	7	2	1	4	2	2	4–6	1
Bangladesh	2	1	1	0	5	0	0	2
China	8	1	1	6	2	2	4–7	1
Guatemala	13	1	4	8	7	5	2–10	3
Bangalore	61	1	1	59	3	3	5–43	0
New Delhi	14	1	1	12	3	3	2–13	1
Kenya	3	1	2	0	6	4	2–3	2
Peru	7	1	1	5	3	3	3–5	2
South Africa	2	1	1	0	2	1	5	3
<b>Total*</b>	<b>128</b>	<b>13</b>	<b>17</b>	<b>95</b>	<b>34</b>	<b>24</b>	<b>2–43</b>	

\*Additionally includes 2 UnitedHealth Group Centers of Excellence, the pilot site, and the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat.

Additionally, the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat were tied to one another and to every Center of Excellence.

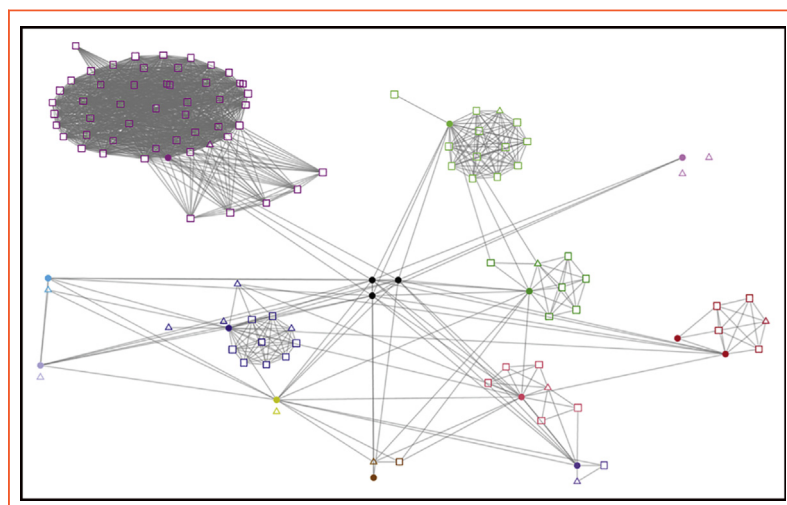
Properties of this network are shown in Table 2, both overall and for each of the 9 Centers of Excellence (excluding the 2 contracts funded solely by UnitedHealth Group). Each location comprises Centers of Excellence and subsites and Developed Country Partners as nodes. Locations hosted 34 research projects, 24 of which were collaborative and involved more than 1 distinct node. Collaborations ranged in size from only 2 nodes (such as in Guatemala, New Delhi, and Kenya) to 43 nodes (in Bangalore). Collaborations were not limited to single locations, and in 8 of the 9 locations, at least 1 project involved a collaborator from a different location.

The network graph depicting these connections is shown in Figure 2. As in the pre-collaboration network (Fig. 1), node color varies for each location, with the 3 sponsoring partners (the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat) depicted in black, and node shape varies by role (Centers of Excellence and sponsoring partners as circles, Developed Country Partners as triangles, and subsites as squares). A few nodes remain unconnected to any other node; these represent Developed Country Partners and subsites that did not participate in collaborative research projects. Network graphs featuring only the nodes within specific locations and the sponsoring partners are shown in Figures 3 and 4 for Guatemala and Kenya, respectively.

Table 3 summarizes the full network depicted in Figure 2. Within-site ties for each location represent the number of pairwise (2 corresponding organizations or sites that are associated) collaborations for research projects housed within that location, while the total number of ties additionally includes cross-site connections, as well as relationships with the sponsoring partners and the 2 UnitedHealth Group locations and pilot site. Some pairs of nodes collaborated on multiple research projects, and Table 3 distinguishes between duplicated and unique ties.

Density calculates the proportion of all possible ties that are included in the network. For example, in the full network, collaborations represent 15.2% of all possible pairwise ties between nodes. The initial goals of the Centers of Excellence Program were to support individual Centers of Excellence in low- and middle-income countries, and collaborative research became a focus later in the program. Thus, 15.2% of possible collaborations represent an unplanned benefit of the Centers of Excellence Program.

Average distance calculates the mean number of ties that create a path connecting any 2 nodes. In the full network, the average number of collaborative ties required to connect 2 components is 2.890. Average distance is driven down by the presence of Westat, the National Heart, Lung, and Blood Institute, and UnitedHealth Group, each



**FIGURE 2.** Network graph after the Centers of Excellence Program was formed. ○ = National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat (black), Centers of Excellence (various colors); □ = subsites (vary by color); △ = Developed Country Partners (vary by color).

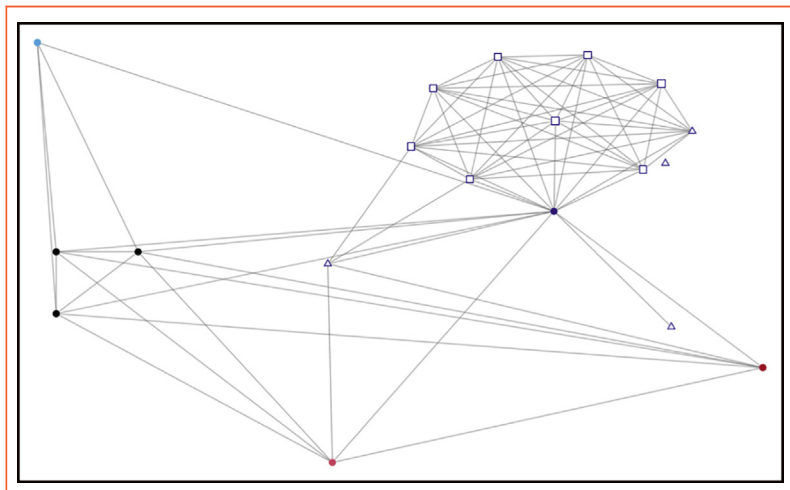


FIGURE 3. Network graph of nodes within and connected to Guatemala.

of which is connected to every Center of Excellence. In addition, most Centers of Excellence are connected to other Centers of Excellence through cross-site collaborations, further reducing the number of ties connecting sites. This relatively short distance given the segmented nature of the network indicates the influence of cross-site collaborations in bringing subsites closer together and can facilitate future cross-site collaborations by placing potential new connections within close reach.

**CONCLUSIONS**

Team science enabled collaborations to emerge in this work that, in turn, fostered more dynamic research. Before the Centers of Excellence Program was created,

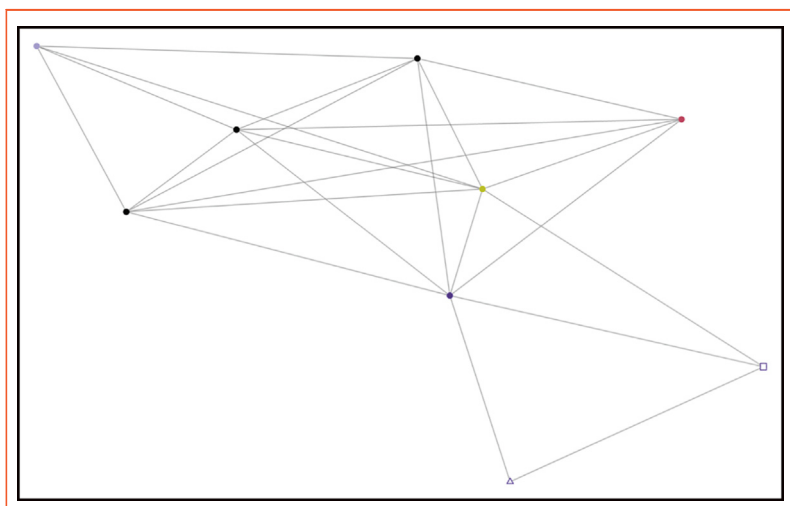


FIGURE 4. Network graph of nodes within and connected to Kenya.

TABLE 3. Network description, overall and by location

Location	Within-Site		Density (%)	Average Distance
	Within-Site Ties	Unique Ties		
Argentina	21	18	85.7	0.980
Bangladesh	0	0	—	—
China	24	23	82.1	1.031
Guatemala	54	49	74.2	1.153
Bangalore	1,033	978	83.2	1.145
New Delhi	85	79	86.8	1.051
Kenya	6	3	100.0	0.667
Peru	19	15	71.4	1.102
South Africa	2	2	100.0	0.500
Total*	1,320 (includes cross-site ties)	1,238 (includes cross-site ties)	15.2	2.890

\*Additionally includes 2 UnitedHealth Group Centers of Excellence, the pilot site, and the National Heart, Lung, and Blood Institute, UnitedHealth Group, and Westat.

none of the sites had collaborated. When the Centers of Excellence Program was formed, collaborations emerged as Centers of Excellence principal investigators, through team science, determined common interests. Although the initial goal of the Centers of Excellence Program was to conduct individual research using federal funds (from the National Heart, Lung, and Blood Institute), the collaborations that emerged were a value-added benefit.

Teamwork resulted in efficacious manuscripts that offer globally applicable data to answer critical research questions. This result would not have been possible without the funding from the National Heart, Lung, and Blood Institute, which established the social and professional networks that nurtured professional collaboration. Most of these professional relationships have endured, such as the formation of Global Research Against Non-communicable Diseases South, which carries on research globally related to noncommunicable cardiovascular and pulmonary diseases.

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## APPENDIX

Team science tenet	ACC action to foster an integrated Epidemiology Subcommittee research team.
Leadership	Leadership was positional but quickly emerged from team members with annual rotation.
Team's evolution	Tuckman's model of team stages allowed the ACC staff to recognize the team's stage to plan activities to move to the next stage.
Trust	Trust was fostered as team members had recognized compatible goals related to reducing the burden of noncommunicable cardiovascular and pulmonary diseases; roles and responsibilities were negotiated and accepted by all team members.
Shared vision	Team members shared primary outcomes of research activities and how these could contribute to a richer database from which research questions could be answered.
Communication	"Culturally sensitive/neutral communication": convened meetings/calls at best predetermined times globally with agendas; promoted respectful dialogue and debate, focusing on concepts, methodologies rather than the person, with the outcome of improving the research; engaged in active listening; practiced anticipatory and creative problem solving.
Strengthen team dynamic	Respectful, supportive environment that promoted strengths of team members; all agreed the team was stronger than any one team member and all shared in the team's success; members have formed another network since the contract concluded.
Recognition and credit	Decision criteria for authorship and credit established more inclusive than exclusive collaboration, acknowledging team members contributions to the research outcome.
Navigate and leverage systems	Social network analysis demonstrates the progress of the team beginning as separate entities and developing collaborative relationships for research endeavors beyond the scope of the network.
ACC, Administrative Coordinating Center.	