The Parkland Center for Clinical Innovation (PCCI), a health care analytics and R&D organization based in Dallas, has developed an innovative model of community governance and cooperation to impact the health and welfare of the county’s residents. The Dallas Connected Community of Care is an entity that — working with community-based organizations, local government leaders, and health care providers in the Dallas metroplex — has been able to quickly assemble data to help identify hotspot neighborhood locations where the Covid-19 virus is having a disproportional impact on the residents, many of whom are poor and underserved. With that information, they have created targeted communications to improve containment efforts through community-wide awareness and education messaging. By connecting local CBOs and faith-based organizations with public health workers and clinicians, effective contact tracing and care plan development has been achieved for high-risk individuals.

When a major disaster occurs — such as a tornado, earthquake, or pandemic such as Covid-19 — health care providers and community-based organizations (CBOs) are called upon to provide more rapid and extensive care and support to the community than otherwise is the norm. An established and fully operational Connected Community of Care (CCC) can provide a tremendous strategic and tactical advantage over non-connected peers.

The CCC Model: Governance and Goals

Since 2014, the Parkland Center for Clinical Innovation (PCCI), an independent nonprofit data science and innovation organization, has led an effort to bring together health care entities and large social-service, safety-net providers such as food banks, homeless shelters, and transportation service vendors, along with more than 100 smaller CBOs (e.g., food pantries, crisis centers, utility assistance centers) and area faith-based organizations to form the Dallas Connected Community
of Care (Dallas CCC). Over time, civic organizations such as the Community Council of Greater Dallas, the Dallas County Health and Human Services (DCHHS), and various academic institutions have begun to participate in various projects under the Dallas CCC umbrella. The Dallas CCC has established partnerships with health care systems (such as Parkland Health & Hospital System and Baylor Scott & White Health as well as clinical practices and other ancillary health care providers serving the metroplex. These health care provider partnerships have proved essential in building a comprehensive and functional network aimed at improving both the health and well-being of Dallas residents.

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Effective communication between and among such entities, which have a range of resources and staffing models, is essential to meet the needs of individuals in the community. We use the Pieces™ Connect (formerly Pieces Iris®) electronic information exchange and case management software platform (licensed through Pieces, Inc., a sister company that grew out of PCCI), which allows for real-time, two-way sharing of information pertaining to an individual’s social and health care needs, history, and preferences (Figure 1 and Figure 2).
Social Needs Summary Screen Provides Access to Client’s Status

The top panel of this figure illustrates a screenshot of the food insecurity assessment screen used in determining the level of SDOH need and the recommended referral course of action. The lower panel of the figure shows the current level of SDOH food need (the arrow pointing to the circled number 2) and the target progress goal for this individual (the arrow pointing to the number 3).

Source: Parkland Center for Clinical Innovation
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society
Referral Screen Identifies Client’s Use of External Partners

The screenshot illustrates the information that the software compiles and records related to each digital or paper referral made, including: 1) client’s name and date of referral, 2) the organization and program from which the referral was made; 3) the organization and location that the referral was made to; and 4) the specific SDOH need category to be addressed (in this case food). Case manager notes that accompany the referral provide additional details about the client and their social/clinical background.

Source: Parkland Center for Clinical Innovation
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society

This platform is the glue that holds together the physical network and provides one of the mechanisms to disseminate information from health care entities to social service entities at both the group and individual resident levels. It allows the individual community resident, via the CBO, to become better informed about important health issues, such as routine vaccinations or preventive care during a pandemic.

Unlike many of the current health care provider-centric models that support comprehensive care — such as Accountable Care Organizations (ACOs), Comprehensive Primary Care (CPC), CPC+, and Patient-Centered Medical Homes (PCMH) — the GCC model is not built around a single health care entity at its center. Rather, CCC brings together many different types of organizations, including health care providers, to form a comprehensive clinical and social care network (Figure 3).
According to Funders Forum on Accountable Health, there are currently 100 CCCs across the United States ranging in size from large entities in urban areas with more than 70 participants to small networks of fewer than 10 participants in more rural areas. These organizations may be called Accountable Health Communities (the CMS/CMMI model), Accountable Communities for Health (non-federal models), or other names but each CCC-like entity serves as a platform...
for cross-sector collaboration and shared vision and accountability to improve the health of a community.

At the heart of a CCC is a governance group made up of one or two Anchor Organizations, typically a major philanthropic organization or national social service organization such as the United Way, Salvation Army, etc., along with a small number of key stakeholder partner organizations (health care providers, faith-based organizations, local social support providers). These organizations form the nucleus of the CCC and are responsible for its legal structure, operational policies, and securing necessary funding. Below the level of partners are network participants, smaller social and health care providers, civic and educational entities that form the connected community itself.

The governance group is also tasked with bringing together the actual network of participating CBOs and health care providers and providing channels for clear and frequent two-way communication and logistical and technical support. While forming the governance group is essential to getting a CCC off the ground, the ongoing communication and support function (i.e., relationship building and maintenance) is one of the key elements, in addition to securing financial viability, that determines a CCC’s long-term sustainability.

Another distinguishing feature of CCCs is that they do not typically take or share risk with clinical providers or payers, nor do they have integral payment systems for reimbursing the provision of social services. Instead, each member of the network typically relies on their own sources of internal and external funding to support continued operations and participation in the network. Increasingly, CCC governance groups, either directly or indirectly through an external consultant, are seeking to raise funds on behalf of the network to support cross-sector infrastructure needs such as technology, advocacy, and business development. Others are working with national or state advocacy groups to advance policy and legislation that specifically funds the type of services offered by CCCs, but are not currently funded (e.g., rides to a provider visit, temporary shelter, utility assistance, or nutritious food). While a CCC could be structured to take on risk or make payments for certain types of services, CCCs, to date, have not done so, preferring to play the role of network facilitator rather than financial intermediary.

**CCC Action During the Pandemic**

The primary mission of the Dallas CCC has been focused on addressing residents’ social determinants of health (SDOH) issues through providing community resources (e.g., food assistance, housing, transportation, etc.) to improve the health and well-being of Dallas County’s 2.6 million residents, more than 14% of whom are persons in poverty.\(^5\) While this mission is even more critical to address the severe socioeconomic impact of the Covid-19 pandemic (especially on vulnerable residents), the work of the Dallas CCC has also evolved to include direct, targeted community outreach to help stem the rapid spread of the virus.

From the first days of the outbreak of Covid-19 in Dallas (a public health emergency for the county was declared on March 12, 2020), PCCI has been working with Parkland and DCHHS to help reliably identify and quantify the geographic location and incidence rates of positive Covid-19 cases within Dallas County. This problem was especially challenging when considering that many
of the residents are either homeless, home-insecure, or periodically move about within the county and surrounding counties. Working with data provided by DCHHS, the Dallas-Fort Worth Hospital Council, and CBOs, PCCI built a series of dynamic geocoded heatmaps that were able to identify — at the neighborhood/block level — the location of hotspots of positive Covid-19 cases (Figure 4).

FIGURE 4

Identifying Covid-19 Hot Spots in Dallas County to Facilitate Community Outreach

The graphic illustrates the prevalence of positive Covid-19 cases within Dallas County at the city level as of July 27, 2020. Higher prevalence rates are shown by darker shading within the heatmap while spread of the virus is shown by the expanded shading across the heatmap. Additional drill-down heatmaps (not shown) provide the ability to localize cases to the block (neighborhood) and street level to enable proximity mapping. Of note, the affluent University Park area shows few positive cases, while a largely poor Hispanic community that borders it to the northeast shows a high level of positive cases in a concentrated area.

These geocoded heatmaps provided the foundation for subsequent PCCI efforts to develop more precise models that established a point-of-care Proximity Index (PI) for neighborhood residents (Figure 5).
Proximity Index: Identifying Spatial Relationship of Confirmed Covid-19 Individuals in the Community to a Patient of Interest

The graphic illustrates a data-driven algorithm that was developed by PCCI to estimate the proximity (closeness) and density (concentration) of individuals in the community that tested positive for Covid-19 ($x_j$, blue dots) to another person of interest ($x_i$, red dot), where block groups represent neighborhoods or street-level locales. In this example, the person of interest is located from 0.013 to 0.015 miles from the three nearest confirmed Covid-19 individuals. While the current model assumes static individuals (such as members of a household or contiguous neighbors), analytic activities underway at PCCI are incorporating movement patterns to extend the model's applicability.

Note: Each $x_j$ blue dot represents one or more Covid-19–positive persons in that location. In this example, because $\text{Num Covid} = 5$, we know that each of the five blue dot represents one person. Each $x_i$ red dot represents a patient or patients within a family unit residing at that location for whom we are developing the proximity index.

Source: Parkland Center for Clinical Innovation
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society

In addition to flagging at-risk patients and populations, the model was also used by public health and civic leaders to establish locations for testing sites within the city of Dallas based on Covid-19 incidence and community need.

Impact of the CCC

The value of a CCC becomes clear when health care entities (both public and private) must work with the community to prevent the spread of disease or, where disease is already present, to identify, isolate, and treat individuals. Such is the case with Covid-19 containment and control efforts in Dallas. With the establishment of the hot-spotting and PI information, the next step was to get that information, along with general infection prevention protocols, in the hands of local CBOs to help raise awareness and slow the spread of the virus. Adjusting for population differences,
preliminary analysis of the value of these epidemiological tools is underway through a comparison of block groups where the tools were used versus neighborhoods where they were not.

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The value of the CCC communication network linking health care providers and CBOs cannot be overstated, as it represents a highly effective and efficient mechanism to disseminate leading practice information aimed directly at the high-risk populations. We have seen first-hand that written/graphic communications delivered to community residents in-person through familiar food pantries, homeless shelters, and places of worship are effective in getting the message into the hands of a vulnerable population. Based on direct observation in CBOs and feedback from both community residents and CBO staff, the reason for this heightened effectiveness appears to be a combination of the personal interaction and trusting relationships that exist between neighborhood residents and the CBO staff and the fact that the CBO staff can distribute leaflets and other printed educational materials directly to the neighborhood residents in their bags of food or with other social support services, increasing the likelihood that the materials will be read and (hopefully) acted on. Similarly, targeted messaging aimed at specific community residents who have tested positive for Covid-19 or are living in proximity to another individual previously diagnosed with Covid-19 are much more effective when communicated via CBOs. This increased effectiveness is based on the fact that many of these at-risk individuals frequent the same CBOs on a regular basis for essential services and these individuals know and trust the CBO staff delivering the information. From one-on-one conversations to displaying infographic posters and take-away educational leaflets, CBOs provide a ready avenue to communicate with at-risk individuals in the communities they serve.

Early work in Dallas County is beginning to help researchers understand the impact of the CCC in facilitating contact tracing. Begun slowly at first because of lack of available personnel and necessary identification protocols, the contact tracing process has been ramping up in Dallas County. In this case, the challenge is not simply identifying the location of positive Covid-19 cases but also having the ability to connect those cases to other individuals within the neighborhood or community who may have come in contact with the infected individual, all while working in an environment where individuals often move from one location to another within the community or in some cases to neighboring communities or counties. Having a well-established communication system at the local neighborhood level can be extremely helpful in identifying contacts and potential contacts. It is well-known that many individuals in impoverished, underserved neighborhoods are reluctant to speak with individuals they don’t know or trust, especially if those individuals are affiliated with government agencies, no matter how well-intentioned. Staff members at local faith-based organizations and CBOs frequented by these vulnerable residents are a highly knowledgeable resource for identifying inter-personal relationships and connecting with those individuals. In Dallas, CBOs, public health and civic staffers, as well as medical student
Looking Ahead

As states and local communities continue to experiment with and establish various forms of the CCC model to help address SDOH needs while improving communication and coordination among vulnerable individuals with chronic health conditions, consider the potential. While these early innovators are in their infancy and much has yet to be learned and documented about how to optimize these entities, imagine the role that CCCs can play in helping stem the tide of the Covid-19 pandemic and future pandemics by reducing mortality and morbidity of the virus among vulnerable populations in large urban inner cities or in more rural and/or under-developed communities. We encourage health care providers to begin exploring the idea of working with other key community stakeholders, especially those addressing the social determinant needs of its residents, to strategically and proactively establish a CCC. Even if a health care provider has good working relations with one or two CBOs, the CCC can improve the health and well-being of a community’s residents and serve as a critical resource in times of crisis by optimizing the integration, coordination, and collaboration of all elements of the network.

“While these early innovators are in their infancy and much has yet to be learned and documented about how to optimize these entities, imagine the role that CCCs can play in helping stem the tide of the Covid-19 pandemic and future pandemics by reducing mortality and morbidity of the virus among vulnerable populations in large urban inner cities or in more rural and/or under-developed communities.”

Keith C. Kosel, PhD, MHSA, MBA
Vice President, Parkland Center for Clinical Innovation

David B. Nash, MD, MBA
Founding Dean Emeritus, the Jefferson College of Population Health, and Professor of Health Policy, Thomas Jefferson University

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