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PERSPECTIVE

Strengthening Digital Health Technology Capacity in Navajo Communities to Help Counter the COVID-19 Pandemic

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Access to affordable, quality health care is a dominant issue in Native American communities throughout the United States. Health disparities are often at play with economic, environmental, and social determinants of health. Poverty, inadequate housing, poor infrastructure and poor health literacy interact synergistically to create health inequity. Native Americans' life expectancy is 5.5 years less than that of all other races in the United States (1). Compounding socioeconomic conditions that promote the spread of infection, the coexisting conditions of diabetes, hypertension, and obesity and household air pollution (2, 3) are associated with increased coronavirus disease 2019 (COVID-19) morbidity and mortality. The national COVID-19 pandemic has cast a magnifying glass on these social and health disparities within the Navajo Nation.

In May of 2020, the Navajo Nation (population of 173,000) had the highest number of COVID-19 cases per capita in the United States. By August, the disease had killed more people per capita than in any U.S. state (4, 5). As of the most recent lockdown on November 20, 2020, there were 8,140 COVID-19 cases per 100,000 people and 618 deaths in the Navajo Nation. The Southwest reservation's 27,000 square miles extend into New Mexico, Arizona, and Utah. Despite the low population density, physical distancing is often difficult because of multigenerational housing, cultural practices, and frequent travel over vast distances to more populated areas for water, groceries, and health care. Community participation is an important aspect of traditional gatherings and spiritual ceremonies. In New Mexico intensive care units, it has been common to have multiple family members with COVID-19 in adjacent rooms.

Up to 40% of households on the Navajo Nation lack running water; 30% do not have electricity (6). There is limited access to telephone services and reliable broadband (high-speed) internet is uncommon. These telecommunication deficiencies challenge patient education, emergency response, and critical services. Its provision has the potential to dramatically improve health outcomes in the Navajo Nation.

The Indian Health Service (IHS), an agency within the U.S. Department of Health and Human Services, provides health care to members of federally recognized tribes, including the Navajo Nation. The IHS is obligated to provide financial resources as a result of federal relationships that include treaties that exchanged land for health care and education. Chronic underfunding of the IHS has complex reasons and has been a persistent barrier to implementing a large-scale telehealth infrastructure.

The 2018 Broadband Deployment Report describes quality internet capability as sufficient to create and relay high-quality voice, data, and video. Broadband is defined by law as 10 megabits per second (Mbps) downstream (download speed) and 1 Mbps upstream (upload speed). The percentage of Native Americans experiencing year-to-year increases in Mbps wireless mobile network capacity has remained flat at 64% (7). Videoconferencing applications such as Zoom and Skype require 3–8 Mbps. Over 1.2 million people on tribal lands lack basic mobile Long-Term Evolution (a standard for faster data transfer speeds and capacity) broadband speeds of 10 Mbps/3 Mbps. Fixed terrestrial speeds of 10 Mbps/3 Mbps are significantly behind those in urban areas.

In a July 8, 2020, testimony to the U.S. House of Representatives Committee on

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Energy and Commerce, President of the Navajo Nation, Jonathan Nez, identified these broadband challenges as deepening the digital divide and exacerbating institutional inequities in many areas, including the prevention of critical public health announcements and limiting emergency healthcare command operation responses. Furthermore, because half of the 110 Navajo communities lack any broadband access and as per the Rural Digital Opportunity Fund, underserved census blocks failing to meet the Federal Communications Commission minimum speeds of 25 Mbps for downloads and 3 Mbps for uploads were demonstrated over a vast portion of the Navajo Nation (8, 9) (Figure 1).

Tele-education for Communities

In live town halls, Navajo community members have expressed concern regarding their lack of internet to access real-time information and culturally appropriate education on COVID-19. Tele-education could supplement the great asset of Navajo community health workers' efforts and improve language barriers by providing resources such as certified Navajo medical interpreters to translate medical information efficiently and accurately. Many Navajo communities rely on tribally run radio signals to disseminate information in the traditional language. Complexities of the virulence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and necessary preventive measures are frequently lost in translation. Webinars or brief spots on hand washing, social distancing, and patient education could be enacted with better videoconference capabilities.

Tele–Traditional Medicine

Traditional Navajo healers are working to integrate within modern tribal health systems while adhering to physical distancing. Telehealth allows them to interact with patients via live videoconferencing. Although traditional healers have been integrated within the Navajo IHS, many traditional medicine practitioners need greater assistance with internet service, Wi-Fi hotspots or telecommunication supplies (i.e., phone, laptop). Some traditional healers are conducting prayers by phone or Face Time, acknowledging the necessity of physical distancing and the need to integrate traditional ways with technology. In conversation with one of the authors (M.B., a Navajo physician), a traditional Navajo medicine man expressed interest in these opportunities if they would benefit patients (M. Bahe, B.A., oral communication, May 1, 2020).

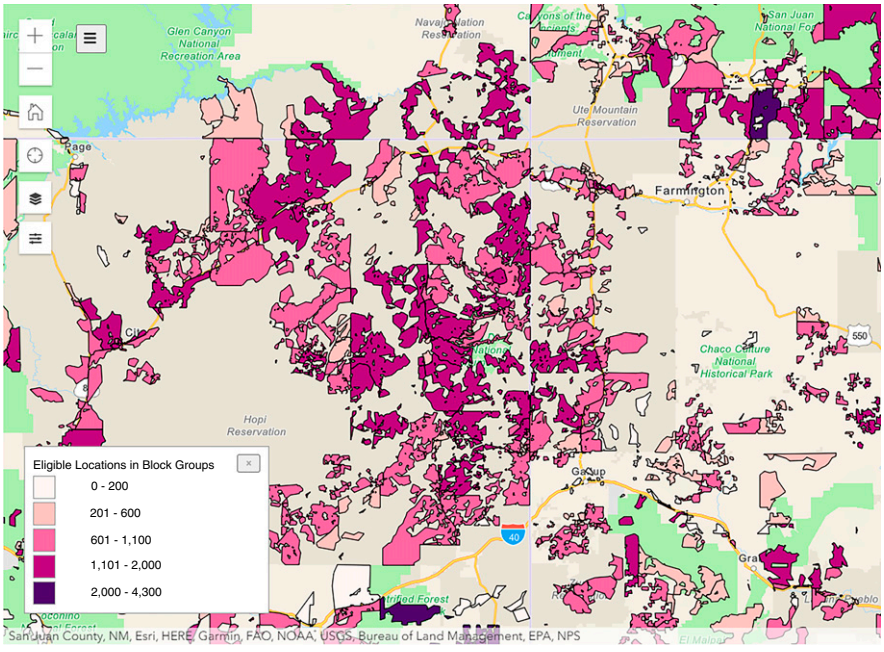


Figure 1. Underserved census blocks on the Navajo Nation that fail to reach the Federal Communications Commission minimum of 25/3 megabits per second and have Rural Digital Opportunity Fund eligibility. Adapted by permission from Reference 9.

Tele-education and Telementoring for Healthcare Providers

The pandemic has created a dilemma for health care in the Navajo Nation. The number of patients requiring care has increased, whereas primary care and specialist practices have shut down. Innovative solutions are needed to support quality rural multidisciplinary healthcare teams. The Project ECHO (Extension for Community Health Outcomes) program at the University of New Mexico provides longitudinal telementoring to multidisciplinary providers caring for patients with COVID-19 on tribal lands, using an interactive structured curriculum (10). Providers attend voluntarily, regardless of whether they present a case, to view didactics, partake in case discussions, contribute insights from their practices, and learn from expert panels and their peers. Providers benefit from access to experts at the hub or spoke sites between sessions by e-mail or telephone.

The ECHO model uses technology such as multipoint videoconferencing and the internet to leverage scarce mentoring resources, a disease-management model proven to improve outcomes in other diseases by reducing variation in processes of care and sharing best practices, a case-based learning technique, and an internet-based database to monitor outcomes (11).

Since March of 2020, the Tele-ECHO COVID-19 program has provided structured, long-term telementoring, differing from traditional telemedicine in that providers typically assume short-term care of individual patients. Unlike traditional didactic lectures or webinars, the model provides real-time, interactive discussion of cases with expert panels. The discussions are contextualized following learning theoretical principles, such as deliberate practice, social cognitive theory, and situated learning, and communities of practice.

This creation of a virtual community of practice emphasizes reciprocity, which promotes trust and respect by acknowledging

Table 1. Proposed COVID-19 Congressional bills affecting Native Americans

H.R.6800: The HEROES Act
Sponsor: Rep. Nita M. Lowey (D-NY-17)
Passed by the house on May 15, 2020
Provides payments to tribal governments and includes funds to increase broadband service
This bill responds to the COVID-19 outbreak and its impact on the economy, public health, state and local governments, individuals, and businesses.
Among other things, the bill
- Provides FY2020 emergency supplemental appropriations to federal agencies;
- Provides payments and other assistance to state, local, tribal, and territorial governments;
- Provides additional direct payments of up to $1,200 per individual;
- Expands paid sick days, family and medical leave, unemployment compensation, nutrition and food assistance programs, housing assistance, and payments to farmers;
- Modifies and expands the Paycheck Protection Program, which provides loans and grants to small businesses and nonprofit organizations;
- Establishes a fund to award grants for employers to provide pandemic premium pay for essential workers;
- Expands several tax credits and deductions;
- Provides funding and establishes requirements for COVID-19 testing and contact tracing;
- Eliminates cost-sharing for COVID-19 treatments;
- Extends and expands the moratorium on certain evictions and foreclosures; and
- Requires employers to develop and implement infectious disease exposure control plans.

The bill also modifies or expands a wide range of other programs and policies, including those regarding
- Medicare and Medicaid,
- Health insurance,
- Broadband service,
- Medical product supplies,
- Immigration,
- Student loans and financial aid,
- The federal workforce,
- Prisons,
- Veterans' benefits,
- Consumer protection requirements,
- The U.S. postal service,
- Federal elections,
- Aviation and railroad workers, and
- Pension and retirement plans.

Senate received on May 20, 2020
May 21, 2020: placed on Senate legislative calendar under read the first time
Committee on small business and entrepreneurship hearings held on July 23, 2020

H.R.6819: COVID-19 Designation of Immediate Special Authority of Spectrum for Tribes' Emergency Response in Indian Country Act or the COVID-19 DISASTER in Indian Country Act
Sponsor: Rep. Debra Haaland (D-NM); also introduced by Rep. Tom Cole (R-OK)
Introduced on May 12, 2020, referred to: House Committee on Energy and Commerce
Directs the Federal Communications Commission to grant Indian tribes emergency special temporary authority of available spectrum on tribal lands so they can immediately deploy broadband networks during this pandemic. Funds grants for the immediate deployment of temporary wireless broadband service on tribal lands and Hawaiian home lands, to provide emergency special temporary authority to use electromagnetic spectrum for the provision of wireless broadband service on tribal lands and Hawaiian home lands, and for other purposes

S.3666: COVID-19 Designation of Immediate Special Authority of Spectrum for Tribes' Emergency Response in Indian Country Act or the COVID-19 DISASTER in Indian Country Act (Senate version)
Sponsor: Sen. Heinrich, Martin (D-NM)
Introduced on May 7, 2020, referred to: Committee on Indian Affairs

H.R.6585: Equitable Data Collection and Disclosure on COVID-19 Act
Sponsor: Rep. Robin L. Kelly (D-IL-2)
Introduced on April 21, 2020, referred to: Committees on Energy and Commerce; Natural Resources
April 27, 2020, referred to: Subcommittee for Indigenous Peoples of the United States
Establishes the commission on ensuring health equity during the COVID-19 public health emergency; adds reporting requirements for certain demographic data related to COVID-19.
1. Determine approaches to using data to reduce demographic disparities in COVID-19 prevalence and outcomes.
2. Submit findings and recommendations to Congress on a specified timeline until the end of the public health emergency.

During the public health emergency, the CDC and the Centers for Medicare and Medicaid services must publish, and update daily, data on COVID-19 testing, treatment, and outcomes that is disaggregated by race, ethnicity, and other demographic characteristics on the CDC website. The IHS shall consult with tribes with respect to COVID-19 data collection and reporting. The DHHS must make a summary of final statistics related to COVID-19 publicly available and report specified information to Congress within 60 d of the end of the public health emergency.

S.3850: Equitable Data Collection and Disclosure on COVID-19 Act
Sponsor: Sen. Elizabeth Warren (D-MA)
Introduced on June 1, 2020, referred to: Committee on Health, Education, Labor, and Pensions

H.R.7077: Community Solutions for COVID-19 Act
Sponsor: Rep. Robin L. Kelly (D-IL-2)

(Continued)

Table 1. *(Continued)*

Introduced on June 1, 2020, referred to: Committee on Energy and Commerce
Provides funding for the CDC to award grants to nongovernmental entities for programs to reduce or eliminate disparities related to COVID-19. Eligible entities must have experience working to address issues related to health equity among those disproportionally impacted by adverse health outcomes. Grant funds may be used to improve access to testing, treatment, and other services with respect to COVID-19 and for other purposes.
S.3877: Community Solutions for COVID-19 Act
Sponsor: Sen. Cory A. Booker (D-NJ)
Introduced on June 3, 2020; referred to: Committee on Health, Education, Labor, and Pensions
H.R.6772: Tribal COVID-19 Disaster Assistance Cost Share Relief Act
Sponsor: Rep. Ben Ray Lujan (D-NM)
Introduced on May 8, 2020, referred to House Committee on Transportation and Infrastructure
May 11, 2020, referred to: Subcommittee on Economic Development, Public Buildings, and Emergency Management
Waives the cost share requirement for Indian tribes receiving disaster assistance relating to COVID-19, and for other purposes.
S.3622: Indian Tribal Government Coronavirus (COVID-19) Disaster Assistance Cost Share Relief Act
Sponsor: Sen. Martin Heinrich (D-NM)
Introduced May 6, 2020, referred to: Committee on Senate Homeland Security and Governmental Affairs

Definition of abbreviations: CDC = Centers for Disease Control and Prevention; COVID-19 = coronavirus disease 2019; DHHS = Department of Health and Human Services; D-IL-2 = Democrat representing second district of Illinois; D-MA = Democrat representing Massachusetts; D-NJ = Democrat representing New Jersey; D-NM = Democrat representing New Mexico; D-NY-17 = Democrat representing the 17th district of New York; FY2020 = 2020 fiscal year; H.R. = House of Representatives bill; HEROES = Health and Economic Recovery Omnibus Emergency Solutions; IHS = Indian Health Service; Rep. = Representative; R-OK = Republican representing Oklahoma; S. = Senate bill; Sen. = Senator.

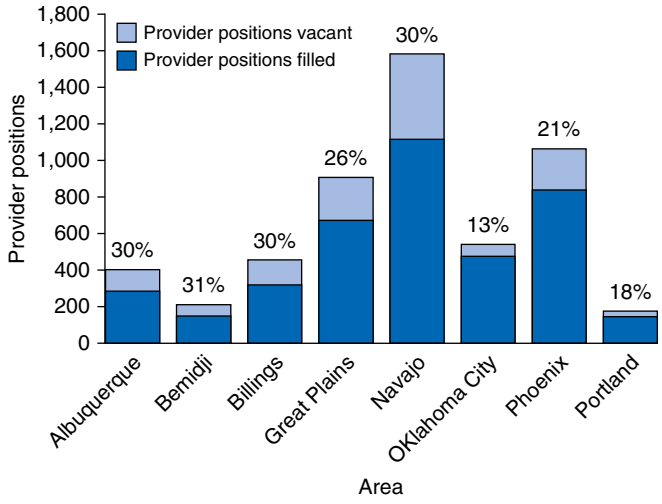
that each participant brings unique expertise. Although access to the program is limited by lack of telecommunication capacity, it has the potential to revolutionize health care in the Navajo Nation.

Home-based Point-of-Care Testing

Current COVID-19 test-based surveillance does not effectively capture medically vulnerable rural populations in the Southwest. Home-based testing would fill a critical gap for Navajo communities (12). Rapid home-based serological and antigen tests, similar to fingerstick glucose tests and home pregnancy tests, will be accessible soon. Smartphone-based devices containing a cartridge-housed microfluidic chip that uses isothermal amplification of viral nucleic acids from nasal swab samples, detected using the smartphone camera, may soon be available. Self-test kits may be combined with prepaid mail-back, mobile app–based, or telemedicine interpretation approaches. The Food and Drug Administration has granted emergency clearance for an at-home nasal self-swab kit (Pixel; LabCorp), which includes mail-back to the company for conducting the polymerase chain reaction assay and online access to results (13). Policy interventions are needed to minimize financial barriers and improve access to postal services on the vast Navajo Nation, which currently has only 11 post offices. The need to drive long distances to these services creates ongoing challenges to embracing these new technologies.

Home-based Telemonitoring

Home-based telemonitoring may include real-time, audio–video messaging tools that connect providers with patients. Remote tools such as blood pressure monitors, Bluetooth-enabled digital scales, Fitbits and other wearable devices can relay biometric information. Data can be paired with individual symptom reports collected via smartphone apps or electronic health records. Technology-based apps can be used to monitor the pandemic and aid contact tracing. For example, smart thermometers, which collect aggregated deidentified (crowdsourced) data online whenever a user takes someone's temperature, or interacts with the app to self-report symptoms, have provided early evidence of imminent hotspots. The Centers for Disease Control and Prevention previously



Source: GAO analysis of Indian Health Service (IHS) data. | GAO-18-580

Figure 2. Number of provider positions and vacancy rates by Indian Health Service area as of November 2017. Providers included physicians, nurses, nurse practitioners, certified registered nurse anesthetists, certified nurse midwives, physician assistants, dentists, and pharmacists. Reprinted by permission from Reference 1. GAO = Government Accountability Office.

reported an extremely close match with the Kinsa smart thermometer (Kinsa Inc.) and influenza data (R^2 of 0.96) (14). Google released an open online resource that aggregates anonymized location-tracking data from mobile devices to share large-scale mobility trends, such as the percentage change in visit volume for churches or casinos. Use of contact-tracing apps and Global Positioning System–tracking telephone bracelets may be helpful as connectivity improves in the Navajo Nation.

Additional Technological Challenges

Home-Delivery Technology

Delivery of home goods, including medications from commercial or government services, has been hampered by lack of a physical address for many Navajo people, as well as by long distances between locations. Google Maps and the nonprofit Rural Utah project collaborated to create "Plus Codes," six-digit numbers based on latitude and longitude coordinates. The codes also facilitate access by first responders. The National Guard and countless volunteers have delivered food and water to regional centers using this approach.

Cold-Chain Technology

SARS-CoV-2 vaccination programs will require a robust cold-chain supply, a delivery system that maintains the integrity of biologically active, temperature-sensitive vaccines from manufacture to administration. Medical cold-chain requirements present unique challenges due to health risks, complexity, governance, and potential product recall (15). Temperature concerns could slow the rollout of new vaccines on the Navajo Nation, such as those requiring −20°C to −70°C, exacerbating vaccine inequities. Internet-based models that integrate the multifaceted aspects of the process have been described. In China's Shandong Province, an animal vaccine program used the system "Internet of Things" to coordinate temperature-sensing technology, radiofrequency identification technology and network communication to maintain the cold chain (16). Increased use of technology could improve the cold chain in the Navajo Nation through solar-powered (photovoltaic) refrigerators, cell phones for communication, and software resources to assist planning and management.

Federal Financing for Technology Upgrades

An early response to the pandemic was the Coronavirus Aid, Relief, and Economic Security (CARES) Act. Passed by Congress with overwhelming bipartisan support, it was signed into law on March 27, 2020. Congress recognized that lack of high-speed internet in tribal and rural areas impedes telemedicine, access to unemployment insurance, small business loans, and remote education. The CARES Act provided for a more than $23 million investment by the U.S. Department of Agriculture (Broadband ReConnect Program) in rural broadband across New Mexico, mostly in the central and southern parts of the state. Funds were appropriated via loans and grants for the costs of construction, improvement, or acquisitions of facilities and equipment needed to provide broadband service (17).

The Navajo Nation was allocated over $600 million from the CARES Act. Delays in funding, due to legal challenges, and refusal to release sensitive tribal information that Native communities needed to fight the disease may have resulted in increased illness and death (16). There has been widespread support in the Navajo Nation to use the funds to pay for critical infrastructure. A majority has been allocated for water projects, such as portable water storage, hand-washing stations, and shower units (18). The CARES Act fund simultaneously allocated financing for technology infrastructure, recognizing the importance of both projects to the Navajo people. Urgent requests were also made to use funds for personal protective equipment, food distribution, and disinfection of government offices. In August of 2020, the Navajo Nation allocated $32 million from the CARES Act to increase internet services, broadband expansion, and mobile towers. In October of 2020, another $18 million was allocated to provide more internet services to the Navajo Nation (19). Funding from the CARES Act was significant and welcome, but it only begins to address the challenges faced by the Navajo Nation. Additional Congressional bills pertinent to Native people have been submitted (Table 1) (20).

Conclusions

Despite its early interventions to decrease spread of SARS-CoV-2, the Navajo Nation has experienced vastly disproportionate illness and death. The pandemic has exposed the devastating impact of decades of inadequate services to Native Americans, services promised years ago in exchange for land. The IHS is chronically underfunded and understaffed, providing $4,078 per capita for health care, less than half of what is spent on federal health care for non–Native Americans ($9,726); in the general U.S. population, $13,185 is spent per Medicare beneficiary (21). There is a 30% provider vacancy rate within the Navajo Nation (Figure 2), affecting patient access, quality of care, and employee morale (1). Although there are several initiatives to increase the number of clinicians, including collaborative efforts among the American Thoracic Society, the American College of Chest Physicians, and PA Consulting (Clinician Matching Network) (22), many are temporary patches. Long-term solutions will take time and considerable funding. A promising realistic approach is to dramatically increase telehealth capacity (23). Despite challenges imposed by the pandemic, its devastating effects, and a bipartisan, bicameral Congressional letter to the Federal Communications Commission (24) to extend the tribal broadband application deadline (2.5-GHz Rural Tribal Priority Window), the window to apply for broadband expansion closed in early September of 2020, highlighting the difficulty for tribes to apply for broadband funding (25).

In keeping with prior challenges to interventions in the Navajo Nation, an approach such as community-based participatory research (CBPR) would foster culturally appropriate programs that acknowledge local customs and cultural nuances. CBPR is essential for identifying the most effective manner to build technological infrastructure within Native communities (5). Collaboration with community stakeholders and tribal and/or federal programs would allow telehealth and tele-education to occur in a manner comfortable for community members. It would foster culturally appropriate programs that acknowledge local customs and cultural nuances. CBPR would facilitate ownership of telehealth and allow sustainability, with long-term value being placed on its role in sharing knowledge. In addition to addressing critical determinants of health, closing the digital divide is a key component of achieving health equity for the Navajo Nation. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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