Texas Advisory on Public Health Infrastructure Improvement

2020 Recommendations

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Overview: Texas Advisory on Public Health Infrastructure Improvement

The Texas Advisory on Public Health Infrastructure improvement was developed to recommend public health system changes that would improve Texas' ability to detect, prevent, respond to, and recover from a public health crisis. It should be recognized that Texas' public health response to COVID-19 pandemic has been exemplary; however, the crisis has brought to light opportunities for improvement in dealing with a pandemic. Communicable diseases, viruses or otherwise, do not respect boundaries and are agnostic to wealth status, race, religion, and political lines. They opportunistically march forward looking for susceptible hosts to infect, which can, on the one hand, wreak personal and family havoc and, on the other hand, consume health care resources, paralyze economies, and create a sense of insecurity. This report offers recommendations for consideration in the longer term "after the storm" to help mitigate against a future public health crisis and is not meant to address the acute and ongoing challenges of the COVID-19 pandemic that we are currently experiencing. However, lessons learned from the current pandemic and our response can and should inform analysis, discussion, policy changes that will create a system better positioned to effectively respond to future public health emergencies.

Overview: Texas Advisory on Public Health Infrastructure Improvement

Our Advisors provided their counsel in four areas for a high performing, responsive public health system for Texans: the workforce, data and technology, public health infrastructure, and ancillary recommendations. They addressed these topics with a critical focus on improvements in Texas' public policy and public health/population health practices looking ahead mid-term to long- term, months to years.

The Advisors focused their recommendations on mid and long-term system building and improvements that are enabled through the creation of dedicated funding streams.

> *"It is critical to the future health of Texas that we appropriately invest in public health to help prevent disease and to be able to respond swiftly and accurately to a public health crisis whether it be a pandemic or not. This requires a public health surge capacity, innovative ways of educating more public health professionals and the appropriate Information Technology infrastructure to be able to acquire reliable data, metrics and enhance communication among Departments of Public Health."*
>
> *Francisco G. Cigarroa, M.D. UT Health San Antonio*

Overview: Texas Advisory on Public Health Infrastructure Improvement

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Advisors:

- John M. Zerwas, M.D. Executive Vice Chancellor for Health Affairs, The University of Texas System
- Francisco Cigarroa, M.D. Director of University Transplant Center, UT Health San Antonio
- Mary Dale Peterson, M.D., MSHCA, FACHE, FASA, Executive Vice President and Chief Operating Officer of Driscoll Health System
- Nancy Dickey, M.D. Executive Director, Texas A&M Rural and Community Health Institute
- Elena Marks, President and Chief Executive Office, Episcopal Health Foundation
- Angela Evans, Dean, LBJ School of Public Affairs
- Jaime Wesolowski, President & Chief Executive Officer of Methodist Healthcare Ministries of South Texas, Inc.
- Edward B. Burger, PhD, President and Chief Executive Officer of St. David's Foundation
- Greg Hartman, Vice Chancellor for Strategic Initiatives for the Texas A&M University System and Senior Vice President of the Texas A&M University Health Science Center
- George Roberts, Chief Executive Officer, NET Health
- Georges Benjamin, M.D. Executive Director, American Public Health AssociatioN

Overview: Texas Advisory on Public Health Infrastructure Improvement

The Advisors started with a set of consensus **PRINCIPLES** to guide Texas' public health policies moving forward. These include:

1. A comprehensive public health system that is resilient, adequately resourced, and data driven.
2. A system that is devoted to disease prevention and health promotion and is equipped to detect, investigate, and predict emerging threats and retain agility and capacity to respond effectively, when needed.
3. Proactive public health practices that are science-driven with adequate funding, competent staff, and well executed coordination and communication throughout all phases of a public health emergency.
4. A Texas preparedness strategic plan that will result in sustainable strategic capacity to successfully respond to future public health emergencies and needs.
5. A Texas public health system with sustainable funding and capacity to optimize the use of data and technology across multiple platforms to support the public health system's ability to competently and effectively assess and protect the health of Texans.
6. A Texas public health system that does its work with health equity as a goal, engenders the public's trust, participation, confidence, security, and even pride as a public health crisis ensues, is responded to, and recedes.

Overview: Texas Advisory on Public Health Infrastructure Improvement

The US public health system is fragmented in both organization and funding, with significant variability at local, county, and state levels. Nationally, public health spending represents 2-3% of total health spending. The inadequate funding undermines the health of individuals and families and places national security and economic viability at risk. COVID-19 has amply demonstrated that we can no longer accept or afford public policy practices that react to, rather than prepare for, public health crises.

The Advisors recommend we create a plan, fund the plan, train to the plan, and maintain the plan.

The Advisors wish to thank Anita D'Souza and Cailyn Stewart for their tireless volunteer support and dedicated guidance in researching and writing this report.

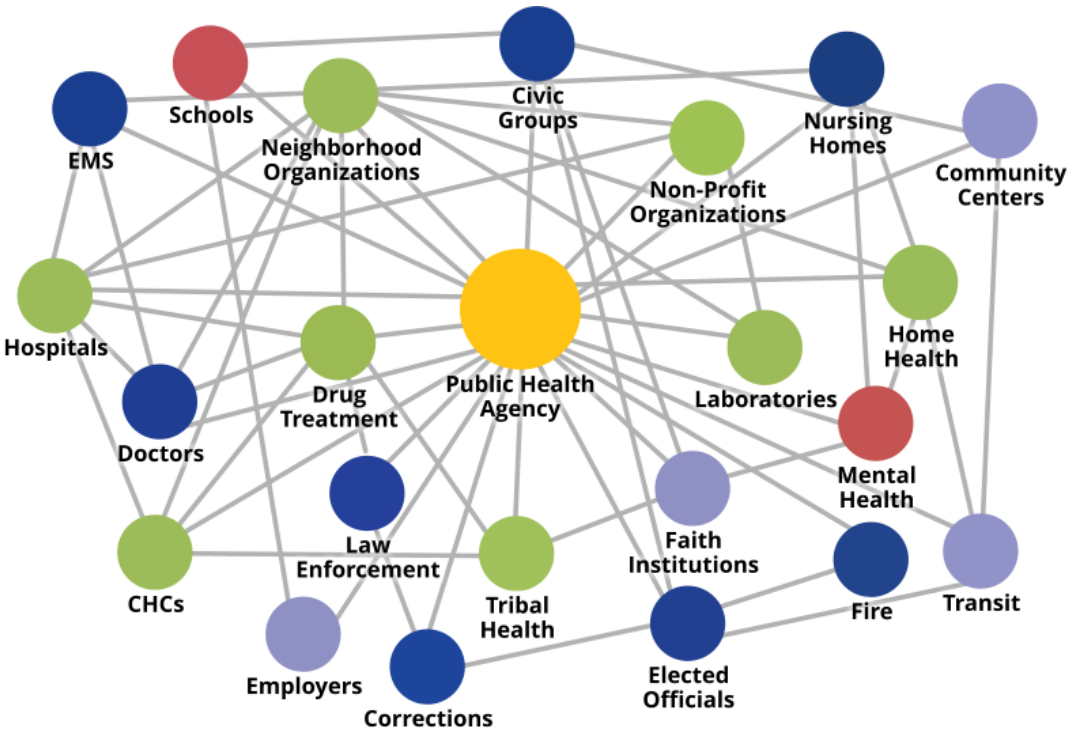
It is our intent and hope that these principles and recommendations are helpful to our state leadership.

Jon Comola, Founder, Wye River Group/
Texas Advisory on Public Health Infrastructure

> *"In Texas, we talk a lot about healthcare. But we don't talk enough about health. The poor health of many Texans, particularly Black and Hispanic Texans, and the disparate impact of Covid-19, are the product of social, economic, and behavioral conditions. This is where public health works—on the ground, in communities, with prevention-oriented, upstream strategies. When we invest in public health, we're investing in people, families, and communities."*
>
> *Elena M. Marks, President and CEO Episcopal Health Foundation*

Background

Public health systems are large interconnected systems that serve to protect the health of populations – particularly in times of public health crisis. In Texas, public health has to have the capacity to serve the public health needs of 29 million people living in urban, rural, and border communities.



Source: https://www.cdc.gov/publichealthgateway/publichealthservices/essentialhealthservices.html

Ten Essential Public Health Services recently revised by the Centers for Disease Control delineate the requirements of a complete public health system, which includes social determinants of health and preventive care.

Background

The 10 **CDC (Centers for Disease Control)** Essential Public Health Services (revised in 2020) are as follows:

1. Assess and monitor population health status, factors that influence health, and community needs and assets
2. Investigate, diagnose, and address health problems and hazards affecting the population
3. Communicate effectively to inform and educate people about health, factors that influence it, and how to improve it
4. Strengthen, support, and mobilize communities and partnerships to improve health
5. Create, champion, and implement policies, plans, and laws that impact health
6. Utilize legal and regulatory actions designed to improve and protect the public's health
7. Assure an effective system that enables equitable access to the individual services and care needed to be healthy
8. Build and support a diverse and skilled public health workforce
9. Improve and innovate public health functions through ongoing evaluation, research, and continuous quality improvement
10. Build and maintain a strong organizational infrastructure for public health

Background

The 10 **Texas** Essential Public Health Services codified in state law in Texas (originally developed in 1994) are as follows:

1. Monitor the health status of individuals in the community to identify community health problems
2. Diagnose and investigate community health problems and community health hazards
3. Inform, educate, and empower the community with respect to health issues
4. Mobilize community partnerships in identifying and solving community health problems
5. Develop policies and plans that support individual and community efforts to improve health
6. Enforce laws and rules that protect the public health and ensure safety in accordance with those laws and rules
7. Link individuals who have a need for community and personal health services to appropriate community and private providers
8. Ensure a competent workforce for the provision of essential public health services
9. Research new insights and innovative solutions to community health problems
10. Evaluate the effectiveness, accessibility, and quality of personal and population-based health services in a community.

In 1999, the Texas legislature passed HB 1444 (Representative Dianne Delisi and Senator Mike Moncrief) that defined and set a strategy for implementing the 10 essential public health services in Texas.
https://www.texashealthinstitute.org/uploads/1/3/5/3/13535548/ph_primer_2012_final.pdf

Background

"Disasters frequently have those famous silver linings. Clearly the learnings from the COVID 19 pandemic will have many lessons that will prepare us for future disaster conditions. Certainly, the availability of domestically produced PPE is at the forefront. Better state of the art IT such that decisions can be made in real time is essential to better public health response. Reassuring is the capability of our health care systems to absorb the surge of patients. And the ability of our research universities to quickly identify effective treatments has proven the value of this investment in higher education."

John Zerwas, MD Executive Vice Chancellor for Health Affairs, The University of Texas System

Executive Summary of Recommendations

Recommendation 1: **Improve the capacity of the public health workforce by increasing epidemiology capacity for communicable disease, noncommunicable disease (including mental health and substance abuse) and environmental factors; investigate the use of workforce extenders and educational training to work in public health.**

Recommendation 2: **Create & train surge capacity workforce. For example, use a certification program and workforce extenders.**

Recommendation 3: **Update existing Information Technology (IT) platforms and integrate new platforms to support state of the art data acquisition, data storage, and data management that optimize epidemiological analysis.**

Recommendation 4: **Leverage and integrate existing databases to increase the ability to conduct real-time data analysis.**

Recommendation 5: **Ensure equitable broadband access across the state.**

Recommendation 6: **Create a stable funding source for public health.**

Recommendation 7: **In times of public health emergencies, activate an incident command system to stand up a communications and collaboration infrastructure capable of informing the public, addressing dis- and mis-information, communicating with the field, and providing for coordination within/between health departments, clinical care systems, social services, schools and businesses.**

Recommendation 8: **Address local and regional variation of Public Health authorities in urban and rural areas by creating a quasi-governmental Council of Government (COG) type of multi-county resource pooling for data, services and programs and increase the number of accredited health departments including DSHS and not yet accredited local health departments.**

Recommendation 9: **Prepare for the future health related resource needs of Texans. For example, resources needed in mental health, post-covid19 complications, avoided care.**

Recommendation 10: **Build the system that can "know" in real time the health status of individuals to enable appropriate mobilization of health and health care resources.**

Recommendation 11: **Create an electronic passport/health record for epidemiological purposes.**

Workforce

Recommendation 1: **Improve the capacity of the public health workforce by increasing epidemiology capacity for communicable disease, noncommunicable disease (including mental health and substance abuse) and environmental factors; investigate the use of workforce extenders and educational training to work in public health.**

Public health functions require the efforts of many different types of professionals: public health physicians, tropical disease experts, HIV specialists, medical directors, management policy advisors, public health veterinarians, public health lawyers, and public health dentists, for example. This writing principally focuses on epidemiologists.

Epidemiology is the study of the distribution and determinants of health-related states and events in specified populations and the application of this study to the control of health problems (www.cdc.gov). Epidemiologists are to public health what cardiologists are to heart health. Texas has slightly more epidemiologists than the national average on a population basis (0.0252 per 1000 vs national average of 0.0226 per 1000 people), the distribution varies across the state with large areas of the state without this resource to help with disease outbreaks or other public health emergencies.

Six of the 25 most populated cities in the US are in Texas, but nearly half of the epidemiologists in Texas work in the Houston metro area.

> *"The arrival of the novel coronavirus 19 amplified the extant weaknesses our current public health care system. It revealed with brutal clarity the lack of access to adequate health care, especially among the most vulnerable; the disruption a pandemic can cause to care for non-pandemic, critical patients; the severe pressures on health care providers both in terms of emotional stress and overall capacity; and the consequences inconsistent and inaccurate communication. It also helped us see the value of data and evidence in making public health decisions, the power of networking and collaborations among care givers, and the role technology can play in health care delivery.*

Workforce

The real challenge now is to learn from these experiences: To fix failures and adopt successes to achieve a ready, robust, and accessible public health care system."

Dean Angela Evans, LBJ School of Public Affairs

Table 3: Epidemiologists in the public sector by Texas Region.

	Epidemiologists in Government
Texas Total	240
Austin-Round Rock	60
Dallas-Fort Worth-Arlington	40
Gulf Coast	60
Houston-The Woodlands-Sugar Land	60

Epidemiologists are crucial members of any pandemic prevention and response. There are other occupations that exercise skills similarly to the skills of epidemiologists including anthropologists, economists, environmental scientists, geographers, statisticians, health educators, nurses, actuaries, and numerous other professions. Many of these jobs collect and analyze data, study human behavior, use science, and problem-solve and should be part of a 'reserve pool'.

Workforce

Increasing the governmental public health epidemiology workforce in Texas requires recruitment and incentives along with more funding for training programs. More public sector positions need to be created and funded to better support the state's health department and local health departments in tracking and managing communicable disease activity. According to the U.S. Bureau of Labor Statistics (BLS) , epidemiologists require a master's degree in public health or any related field, and some have PhDs in medicine or epidemiology. The field of epidemiology is expected to grow at about 5%, which is average for all national occupation projections from 2018-2028 but, does not account for the rapid population growth projected for Texas. With a population projected at just under 35 million by 2030 and over 47 million by 2050, epidemiology positions must grow significantly to keep up with the population.

Workforce

Recommendation 2: **Create & train surge capacity workforce. For example, use a certification program and workforce extenders.**

> *"The pandemic has been a harsh reminder of the importance of bed capacity, surge staffing challenges and access to broadband. Even when rural hospitals had available beds and/or innovative solutions, they struggled with workforce and/or connecting patients. Rural Texas hospitals support these public health recommendations because every Texan matters and we can do better."*
>
> *John Henderson, CEO, TORCH*

Public health emergencies take many forms - they can occur as a result of a natural disaster like a hurricane or infectious disease outbreak or a man-made disaster such as a chemical spill. They can be limited by geography or time or be global, such as a pandemic. Public health emergencies can appear suddenly with little or no warning or they can build slowly over time. Each of these scenarios involves different skill sets and workforce requirements. Therefore, it is extremely difficult to precisely anticipate the size and qualifications of the workforce needed during any given public health emergency, and strategies to address surge capacity should be part of a long-term plan to address public health preparedness.

In health and healthcare, there are different facets to surge capacity – communicable disease investigation and contact tracing as well as hospital beds, ICU beds, and clinical care workforce. This recommendation focuses on public health surge capacity defined as the ability to implement core public health activities, such as risk communication, epidemiologic analysis, and contact tracing. (https://definitions.uslegal.com/p/public-health-surge-capacity/)

Workforce

During a severe outbreak, an epidemic, or a pandemic, these core responsibilities are the basis of all decisions made during a public health response, including communication to residents of the state or local community, allocation of resources within the state, and mitigating the effects of the crisis on the state. While certain activities require a highly technical skill set, such as epidemiological analysis, other public health activities require less technical skills for which training, such as contact tracing skills, can be provided.

Once core public health workforce and capacity as well as estimated public surge need in a worst case scenario is assessed, Texas should look at options to create a surge/reserve workforce that is available and can be activated to supplement existing assets and identify the public health training available or needed as well as the arrangements that might be operationalized (for example, telemarketing organizations and trained employees might be able to augment contact tracing related work). Currently, Texas Commissioner Dr. Hellerstedt reports that his agency contracts with various professionals locally to be able to control quality and have them available at the flip of a switch.

The US Military maintains a surge force that can mobilize in times of crises. This is a practice Texas should consider for civilians to help Texas be better prepared for public health crises in the future. A surge force or reserve could be trained to support front line public health and healthcare workers in contact tracing, testing, performing logistical support, food distribution and disinfection and provide relief to exhausted public health and medical staff. When not deployed, this reserve would be working their usual jobs in their communities. Maintaining a pool of trained reservists and keeping their skills current through periodic training would ensure that Texas has the personnel needed to successfully overcome the many challenges of a health crisis.

Our Advisors suggest we should expand the option of Bachelor of Arts in Public Health within more Texas universities and expand opportunities for students to be placed in experiential internships in health departments across the state.

Data and Technology

Recommendation 3: **Update existing Information Technology (IT) platforms and integrate new platforms to support 'state of the art' data acquisition, data storage, and data management that optimizes epidemiological analysis.**

Disease detection and investigation are the cornerstones of a public health response. Our Advisory members report that Texas experienced challenges during the current COVID- 19 outbreak caused by incompatible systems, changes in reporting requirements, and lags in reporting positive cases from labs resulting in missed opportunities for contact tracing. According to CDC, it involves the ongoing and systemic collection, analysis, and interpretation of health-related data for public health practice. Public health actions during a pandemic depend on timely and accurate detection and investigation along with flexible systems that can adapt as necessary.

Data that public health relies upon comes from a variety of sources: patients, health care system (electronic medical records), public health entities (including public health laboratories), clinical laboratories, pharmacies, schools. In Texas, public health entities encompass local health departments, local health units, and public health districts and their laboratories, if they have them.
Driving Public Health in the Fast Lane, Council of State and Territorial Epidemiologists, available at https://resources.cste.org/data-superhighway/mobile/index.html).

Data and Technology

The number of systems and the manner in which these systems collect, store, and transmit data affects the accuracy and timeliness of data available in a pandemic. Texas has made strides in syndromic detection and investigation. The Texas Department of State Health Services (DSHS), "in collaboration with local health departments across Texas and with Tarrant County Public health and Houston Health Department...has established a statewide syndromic network" that helps "identify emerging health threats and inform local decision-making while protecting individual's privacy." (https://www.dshs.texas.gov/mu/syndromic.aspx)

Timeliness and accuracy of data are paramount during a pandemic. Epidemiological analysis must be made on hour-to-hour or daily data in order to provide the most up-to-date information to public health and other emergency personnel, communities, policy makers, elected officials, and other decision makers. Texas should continue to improve on current data collection while considering optimal approaches.

Today, there are new technologies that are changing both the ability to collect data and the type of data that can be collected. Cell phone technology can provide multiple types of data: location data; activity data, self-reported data as to an individual's condition via apps.

One example of an app is AREA (Application for Rapid Epidemiology Assessment) supported by the Office of the Secretary of Defense and Defense Health Programs. AREA is a mobile application designed specifically for bio surveillance and health crisis resiliency. The app helps health workers identify and obtain the most critical information to assess and mitigate health risks; distribute these data in a secure and curated way, optimizing cross-organizational resource allocation. AREA provides situation awareness, comprehension, and projection of relevant on-the-ground information. The AREA app combines state-of-the-art social networking technology with algorithms for assessing risk and managing distributed resources. The app is designed for application in all phases of public health or humanitarian crisis management, from Early Detection/Onset to Response/Relief and Recovery/Transition.

In summary, quality data that can be collected in real time can support contact tracing systems, state public health systems, and help private health entities make better data-dependent decisions. In addition, schools, universities, and employers would also be able to make better decisions. Continued standardization and consolidation of data systems to streamline data input and availability and the introduction of new technologies is essential for the timely and robust epidemiological analysis required in pandemic situations.

Data and Technology

Recommendation 4: **Leverage and integrate existing databases to increase the ability to conduct real-time data analysis. (NOTE: We are researching this topic further and will be issuing a supplement this winter)**

> *"I am still in full COVID mode. We are still seeing huge numbers of cases in South Texas with an inadequate public health infrastructure to address. The State has come in to provide help but now I don't know where we are in the pandemic- 1,500 cases have been added in the last 2 days, but we aren't sure that those numbers are current. We are hearing that those are numbers from the State that are just now getting into our system, but don't know how far back it goes. So, there are 2 issues. Inadequate real time data systems as well as not having a trained reserve force to manage these surges."*
>
> *Mary Dale Peterson, M.D., MSHCA, FACHE, FASA, Executive Vice President and Chief Operating Officer of Driscoll Health System*

A rapidly evolving situation such as a pandemic involves both immediate and less time sensitive responses as well as the ability to revise and update responses, as new data and insights become available.

The value of traditional sources of data for public health considerations is clear. However, a large amount of electronic data is collected in and from other traditional and non-traditional sources that may be useful during a public health crisis such as a pandemic. Some real-time dataset examples are commercial laboratory feeds, pharmacy databases, consumer purchasing databases, databases containing self-reported information, databases documenting movement of individuals, wearable device data, and databases on internet searches. Insurance claims data are also useful but can often lag in time.

Having an understanding of real time data sets and resources and the ability to access relevant data quickly will ensure that Texas can detect and respond proactively in a data-driven manner to the next public health crisis and be able to tailor responses to unique community needs.

Data and Technology

Recommendation 5: **Ensure equitable broadband access across the state.**

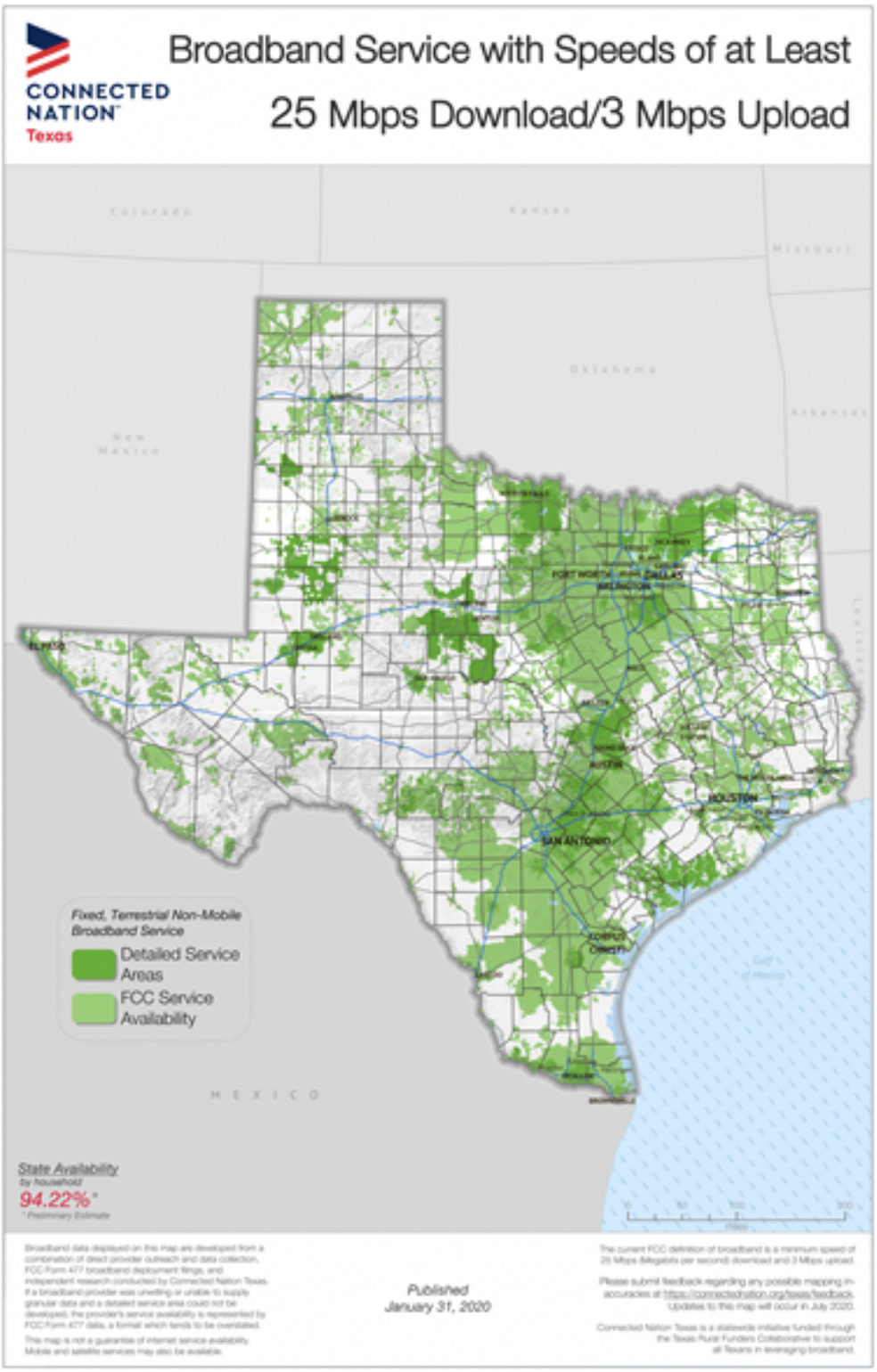
> *"The United States has benefitted extraordinarily from the construction and maintenance of the National system of Interstate and Defense Highways. Society has changed dramatically since the 1950's and it is beyond time that we do for broadband connectivity (and the people of the US) what Eisenhower did for transportation connectivity more than 5 decades ago."*
>
> *Nancy Dickey, Executive Director, A&M Rural and Community Health Institute*

Texas policy makers recognize the importance of ensuring all Texans have access to broadband. Passage of SB 14 in 2019 empowers Texas electric cooperatives to deploy broadband to the members they serve by allowing them to utilize their existing electricity easements. More can and should be done.

Whether it is working or studying from home or having access to telehealth during COVID - 19, rural Texans are particularly at risk. Before COVID - 19, rural Texas has experienced a significant decline in primary care physicians and therefore less access to medical care. Connectivity through telemedicine can help overcome reduced physical access to care.

Public health, health status, and connectivity are co-dependent. Internet connectivity is playing an increasingly important role in health, health care and public health. The use of telehealth to deliver healthcare, public health services and health education from a distance is changing clinical care and health related services and is dependent on broadband availability. Patient monitoring (particularly home-based cases) and contact tracing are examples of its benefits in the public health realm; whereas, patient monitoring, medication monitoring and follow up for chronic conditions and connecting providers are examples of its benefits in the clinical realm.

Data and Technology



Data and Technology

An estimated 24 million persons in the U.S. live in “digital deserts”, 19 million in rural areas. Access to broadband across Texas is a critically high priority particularly during a public health crisis but also during normal times. Connectivity has a direct impact on productivity gains, increased wages via sharpening skills, educational tools, information flow on local issues/civic engagement, entertainment and social networking/communication connectivity. During the current pandemic, schools in Texas are relying on broadband to conduct classes and likewise employers rely on this as well for work at home during lock-downs and quarantine. An estimated 34.4% or 1.8 million Texans in rural, suburban, and urban households do not have broadband.

Given broadband’s role as a moderating determinant of health, digitally isolated communities may risk worse health outcomes due to limited access for educational and economic opportunities and limited access to high- quality health services. To achieve equitable broadband access in Texas , it is imperative that we understand how our laws and policies governing telehealth and broadband access affect health outcomes. https://mediad.pu

Public Health Infrastructure

Recommendation 6: **Create a stable funding source for Public health.**

> *"COVID-19 has shown the nation the value of a robust public health system and the need for strategic and sustained investments in public health. The health and economic wellbeing of the nation depends on it."*
>
> *Georges C. Benjamin, MD, MACP, FACEP(E), FNAPA, Hon FRSPH, Hon FFPH, Executive Director, American Public Health Association*

In the U.S., 97 cents of every health dollar go to medical care and only 3 cents to public health! Many argue that the imbalance needs rebalancing.

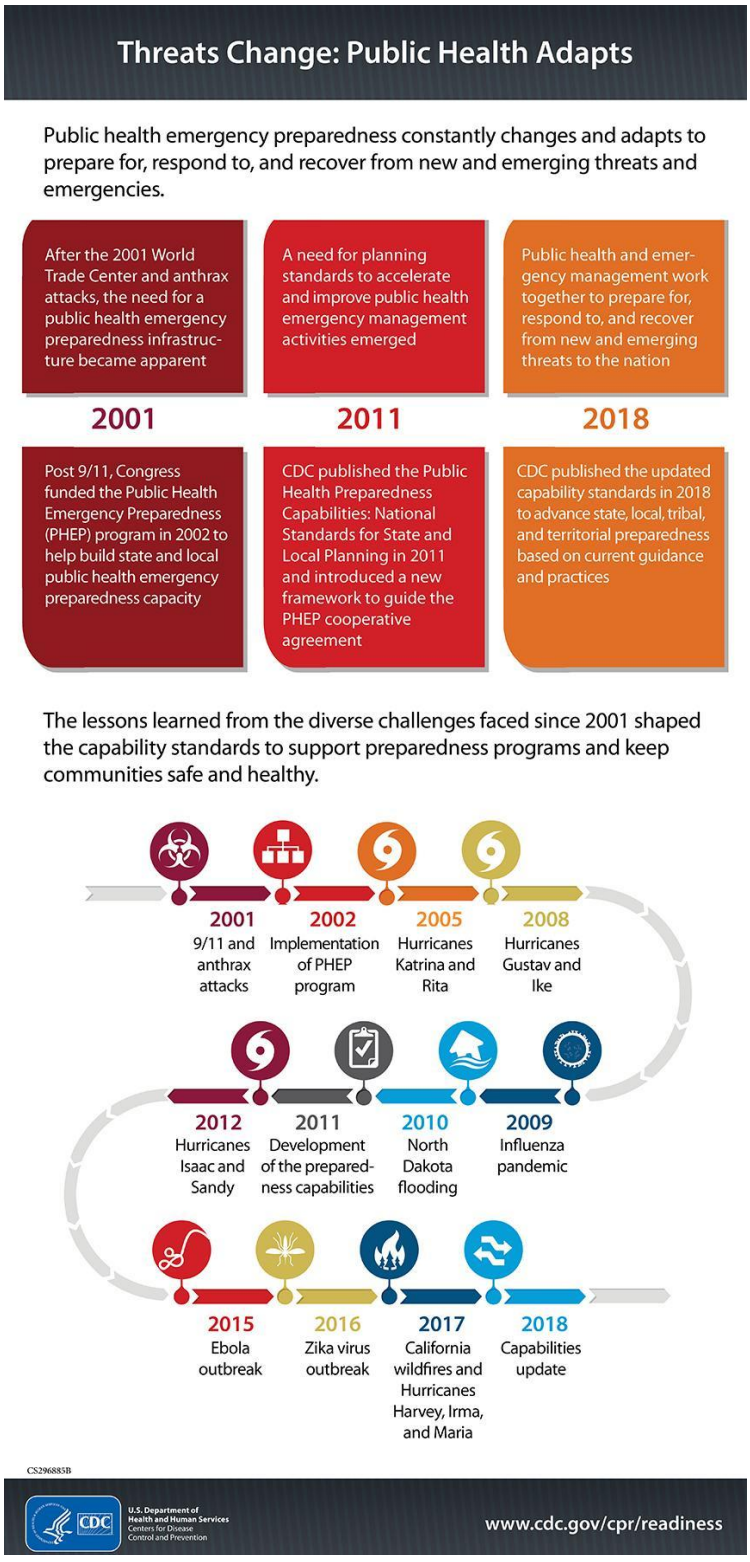
We have two health care systems: public health and health care delivery. They operate mostly independently in silos. At this time of the COVID pandemic, public health works to prevent people from getting COVID-19 and the health care system treats those sickened with COVID-19. The science and practice of public health is focused on the health of the overall population (population health), concentrating on being a catalyst for things like safe food, clean water, vaccines, injury prevention, clean air, sanitation, and control of communicable diseases such as COVID-19. In the U.S., public health is under-resourced and underappreciated until there is a crisis. But managing disease outbreaks is not a new idea and is why, in 1879, Texas Governor Oran Roberts was made head of a state health department, called the Texas Quarantine Department, with authority to appoint a state health officer.

In the U. S., we tend to be reactive to public health crises instead of proactive. Following September 11th, 2001, and the terrorist attacks and anthrax attacks a month later our policy makers devoted attention and resources to public health. They committed resources to expand our strategic national stockpile and create a project bio shield. But this energy quickly waned and funding for public health facing organizations such as CDC has decreased over the past decade. This responding to crisis and then relaxing our attention is a pattern followed repeatedly in U. S. Public Health history.

Those choices haunt us today in the wake of 4,649,102 COVID infections and 154,471 deaths as of August 3rd, 2020.

Texas has a history of ignoring the importance of maintaining robust, reliable, and sustainable funding for public health activities. Public health is responsible for epidemiologic disease detection and investigation, immunization, vaccination, disease prevention, public health laboratories and other population health services. The Institute of Medicine's, now known as the National Academy of Medicine, Committee on Public Health Strategies to Improve Health, concluded in 2012 that in order to improve physical and environmental health data collection, reporting, and action that the laws and policy need improvement and are inadequate. The Committee found issues with insufficient funding for public health and dysfunction in how public health infrastructure is funded, organized and equipped to use its funding. In short, the nation does not invest sufficiently in public health and that funding for governmental public health is inadequate, unstable, and unsustainable in light of its responsibilities and the expectations of the public.

Public Health Infrastructure



Public Health Infrastructure

The CDC's Public Health Emergency Preparedness (PHEP) cooperative agreement is the main source of federal support for state and local public health emergency preparedness and response. From FY 2003-19, the CDC's funding for state and local preparedness was cut by a third despite population growth and persistent threats. There is evidence of historical instability in public health funding from state and national lawmakers. There is an absence of a long-term commitment by policy makers to provide sustainable public health funding. State and national policy maker's commitment to public health funding is uneven and fluctuates with major health threats of the moment, political winds, and economic realities. History shows we mobilize episodically in response to threats then let our guard down when the threat subsides. Inadequate funding leaves public health departments poorly equipped to prevent, detect, and control disease outbreaks. Funding comes from separate appropriation processes at the local, state and federal levels with little coordination and each funder has their own priorities. There are three principle challenges: inadequate funding, compartmentalized, inflexible funding, and uncoordinated funding with varied rules for use.

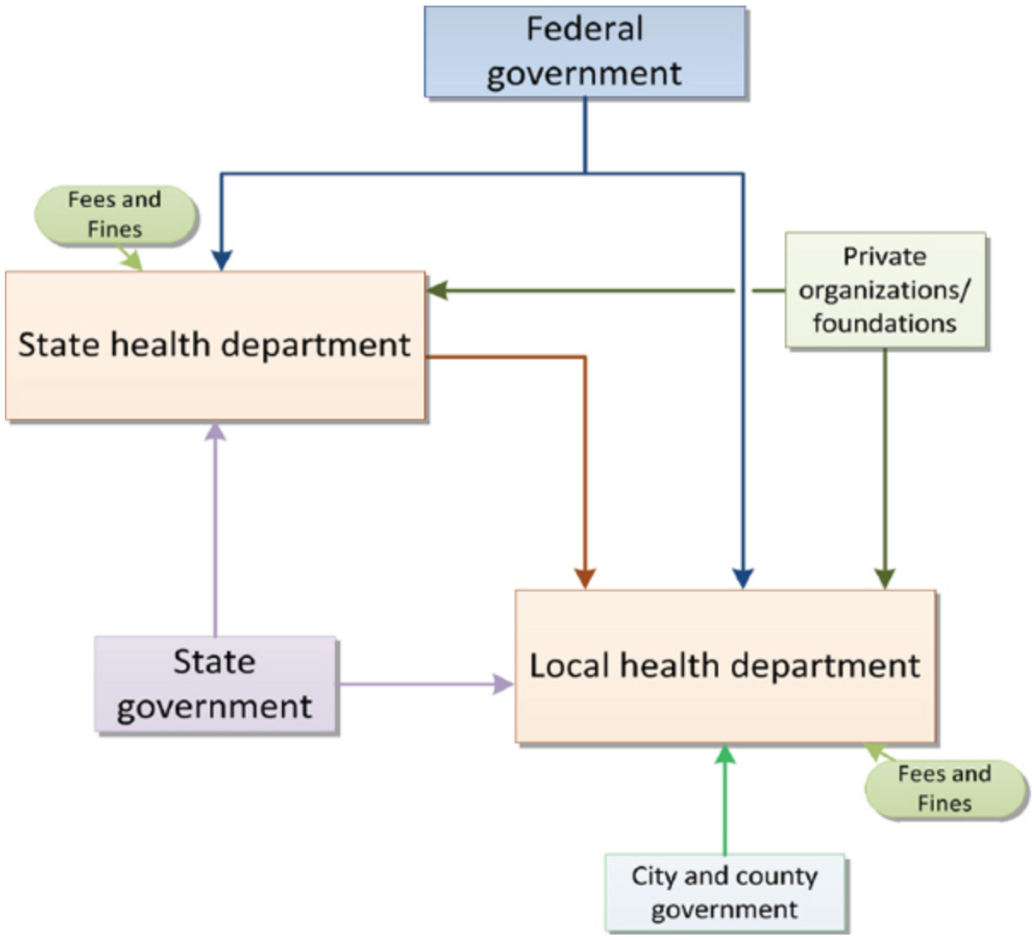


FIGURE 2-1 Public health funding flows.

The lack of reliable funding reduces the ability of public health departments to prevent disease, promote health, and protect the health of their communities in the face of a variety of threats. In the last 6 years, we have faced Ebola, Zika and Chikungunya viruses and a resurgence of Sexually Transmitted Disease (STDs), including syphilis. All the while, the burden of chronic conditions such as obesity is increasing in Texas which increases the risk of death in pandemics like COVID-19.

Public Health Infrastructure

Recommendation 7: **In times of public health emergencies, activate an incident command system to stand up a communications and collaboration infrastructure capable of informing the public, addressing dis- and mis-information, and communicating with the field, and that can provide for coordination within/between health departments, clinical care systems, social services, schools and businesses.**

From the onset of a public health crisis, public health authorities are expected to provide the general public with timely, accurate information and answers about its impact. News media are among the critical channels to inform and educate the public. When public health officials manage health crisis risk communication, they are helping community members know what to do and how to cope with both physical and mental health impacts. Public health is expected to use medical, epidemiological, behavioral, and statistical knowledge and good data and synthesize it all into useful information converted into messages and readily understandable and actionable concepts. Public health communications operate on the principles of transparency, reliability, and trust.

Communication management challenges have increased in the age of social media. With the addition of news from credible sources, the public is also exposed to misinformation and disinformation. Misinformation stems from our knowledge gaps, speculation based on less than full factual analysis. Disinformation is spread when social media channels are used to sow seeds of distrust or advance rumors. During a health crisis or any disaster, utilization of media sources increases. Internet usage following the September 11th attacks increased from 6 million to 12 million people visiting online news sites each day. Internet and media communications are not peer reviewed, and this may result in the dissemination of inaccurate information. Approximately 4 in 10 U.S. residents receive their news from online sources and 6 in 10 receive their news from social media.

Public Health Infrastructure

A health crisis highlights the importance of a systematic approach to assure effective collaboration and strong communications. The CDC developed a set of actionable recommendations, Crisis and Emergency Risk Communications (CERC), that should be considered as a guideline for effective communications during a crisis. The right communications help create a sense of order and understanding during a public health crisis. Practicing the CERC principles in your communications before and during a crisis can prevent harmful behaviors. We intuitively understand that poor communications can fuel chaos, add uncertainty, elicit a negative public response and result in poor outcomes. Proper planning, coordination, research, and training can improve communications. The focus in a crisis is to prevent illness, death and injury and return life to normal as soon as possible.

The importance of collaboration, especially during a crisis cannot be overstated. Even during normal operations, collaborating and coordinating can reduce inefficiencies in the larger health and health care system, result in improved responses to public health crises, and increase the support for public health. By creating and maintaining robust collaborative organizational structures in public health, with health providers and health care organizations, as well as social services, schools and businesses we improve our ability to exchange information and optimize real time solutions for our communities. As we work toward improving collaboration we should remember that the definition of public health is broad, encompassing the prevention of epidemics and disease, protection against environmental hazards, prevention of injuries, promotion of healthy behaviors and mental health, disaster and recovery assistance for communities, and provision of accessible and quality health services.

The third of the 10 Essential Public Health Services is to “inform, educate, and empower people about health issues.” Emphasis on accessibility of resources to serve the culturally and linguistically diverse population is essential.

Public Health Infrastructure

A report on community outreach and education organized by the Robert Wood Johnson Foundations addresses how to talk about social determinants of health in a manner that is accessible and acceptable by a larger audience. The report focuses on conveying the concept of the social determinants of health in more receivable language particularly for voters and policy decision makers. Conscious use of language is necessary for communities and stakeholders to understand that health starts well before the doctor's office; it starts where we live and work. According to the report, effective communication incorporates common vernacular, a narrative and emotional appeal, and a driving fact, but not overly data ridden. A common communication infrastructure would embrace these techniques to help effectively educate the public, address misinformation, and provide coordination on all aspects of health, not just those related to the doctor's office.

Public Health Infrastructure

Recommendation 8: **Address local and regional variation of PH authorities in urban and rural areas by creating a quasi-governmental Council of Government (COG) type of multi-county resource pooling for data, services and programs and increase the number of accredited health departments including DSHS and not yet accredited local health departments.**

In addition to being the state's public health agency, DSHS divides Texas into public health regions that are supported by DSHS through the Division for Regional and Local Health Operations (https://dshs.texas.gov/regions/lhds.shtm). Each regional unit provides essential public health services, supports local public health agencies and provides leadership and coordination for public health emergency preparedness and response. Each region has a regional medical director and/or a regional deputy director, employed by DSHS.

The Public Health Accreditation Board (PHAB) is a national organization that accredits state and local health departments in the US in order to "improve and protect the health of the public by advancing and transforming the quality and performance of governmental public health agencies in the U.S. and abroad." DSHS is not accredited and is one of 16 states whose public health agency is not accredited. Texas has 7 accredited local health departments which include Austin Public Health, Dallas County Health and Human Services, Harris County Public Health, Houston Health Dept., San Antonio Metropolitan Health District, Tarrant County Public Health, and Williamson County and Cities Health District.

The DSHS regional organizational construct helps place state-managed public health services closer to where they are needed and helps to complement the resources and capacity of local health departments across the state.

Ancillary to Public Health

Recommendation 9: **Prepare for the future health related resource needs of Texans. For example, resources needed in mental health, post-covid19 complications, avoided care.**

> *"Our response to the COVID-19 pandemic involved the suspension of many state laws and regulations so our access to medical care, prescriptions, food, rental and utility support could be made readily available in this time of crisis. It is important that we use these valuable lessons and experiences to review our current laws and processes. We should seriously consider moving forward in retaining those changes that proved to be successful in responding to this pandemic!"*
>
> *Jaime Wesołowski, President & CEO, Methodist Foundation*

COVID-19 is a grey swan event, a highly probable event that it is predictable and carries an impact that can easily cascade. The convergence of a pandemic that would disproportionately impact vulnerable segments of a population and its impact was predictable.

A clear pattern has emerged. In addition to persons age 65 and older and persons with some underlying medical conditions being at higher risk of severe or fatal COVID-19, Black Americans, Latino/Hispanic persons, and indigenous Americans and the poor are being disproportionately adversely affected by COVID-19 in terms of cases, hospitalizations, and deaths. Before COVID-19, persons with lower educational attainment, lower household income, and no health insurance experienced worse health outcomes, had higher prevalence of disease risk factors and struggled more to access the health system than persons who were better educated, had higher income, had more wealth, and had a higher likelihood of having health insurance. COVID-19 has highlighted the impact of those differences.

These health inequities are driven in large measure by public policies. Health is influenced by a range of social, environmental, and economic factors: educational attainment (which is affected by quality of education), health insurance status, affordability and quality and location of housing, food, and quality of medical care. Until we appropriately and equitably invest in these health equity pillars, health disparities will persist, and our society and economy cannot thrive.

> *"COVID-19 has put a finer point on the historical inequities that are pervasive in our country and throughout Texas' most vulnerable communities – including vast differences in health status, health access and the distribution of health resources based on age, race, gender or geography. The heavy and difficult days faced by our community have served as an awakening for some, and a reminder for others, of the health inequity all around us. We must work together—state and local governments with municipalities and non-profit and for-profit organizations—to inspire real change. Let's seize this historic moment today and commitment to a better tomorrow."*
>
> *Edward B. Burger, Ph.D., President and CEO, St. David's Foundation*

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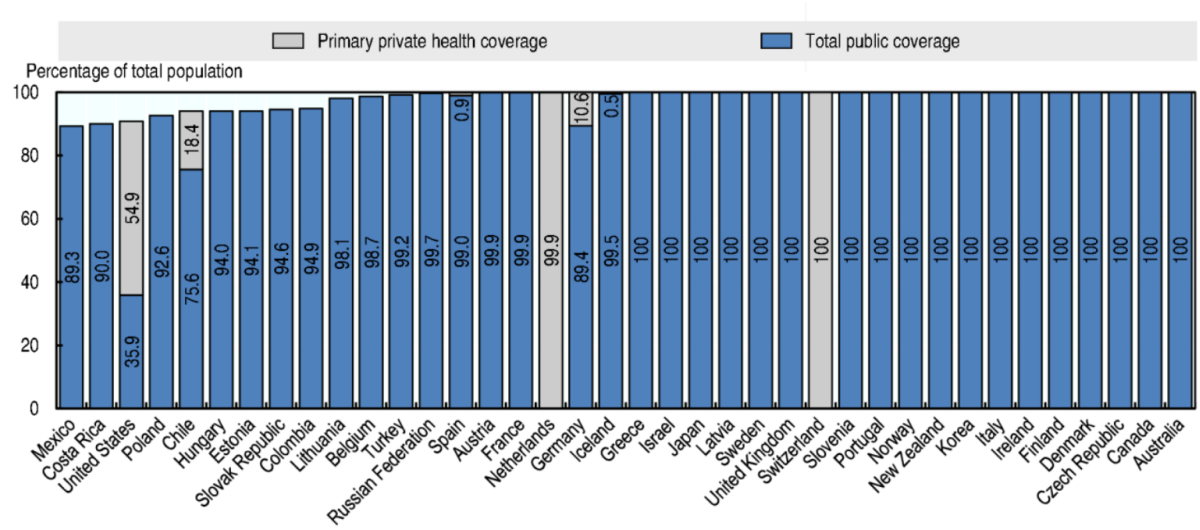
A report on community outreach and education organized by the Robert Wood Johnson Foundations addresses how to talk about social determinants of health in a manner that is accessible and acceptable by a larger audience. The report focuses on conveying the concept of the social determinants of health in more receivable language particularly for common voters and policy decision makers. Conscious use of language is necessary for communities and stakeholders to understand that health starts well before the doctor's office; it starts where we live and work. According to the report, effective communication incorporates common vernacular, a narrative and emotional appeal, and a driving fact, but not overly data ridden.

A common communication infrastructure would embrace these techniques to help effectively educate the public, address misinformation, and provide coordination on all aspects of health, not just those related to the doctor's office.

Public health experts say focusing on these disparities is crucial for helping communities respond to the virus effectively — so everyone is safer. "I think it's incumbent on all of us to realize that the health of all of us depends on the health of each of us," says Dr. Alicia Fernandez.

Figure 3. Population coverage for a core set of services, 2017 (or nearest year)



Source: OECD Health Statistics 2019, https://doi.org/10.1787/health-data-en.

As we “stay at home”, social distance, set up home office environments, and manage our children’s education, we struggle. Experts say many of us are experiencing high anxiety, increased frustration, and loneliness. The ‘fall out’ from this will be seen in increased demand for mental health (MH) services with some estimating as much as a 100% increase. Nationally the ‘expressed need’ (defined as the need acted upon) for current MH services is 12 %. Following the crisis that may double to 24 %. Studies show that MH services were insufficient before the pandemic; 53 million Americans (21%) wanted to see a mental health professional but were unable to do so in 2017.

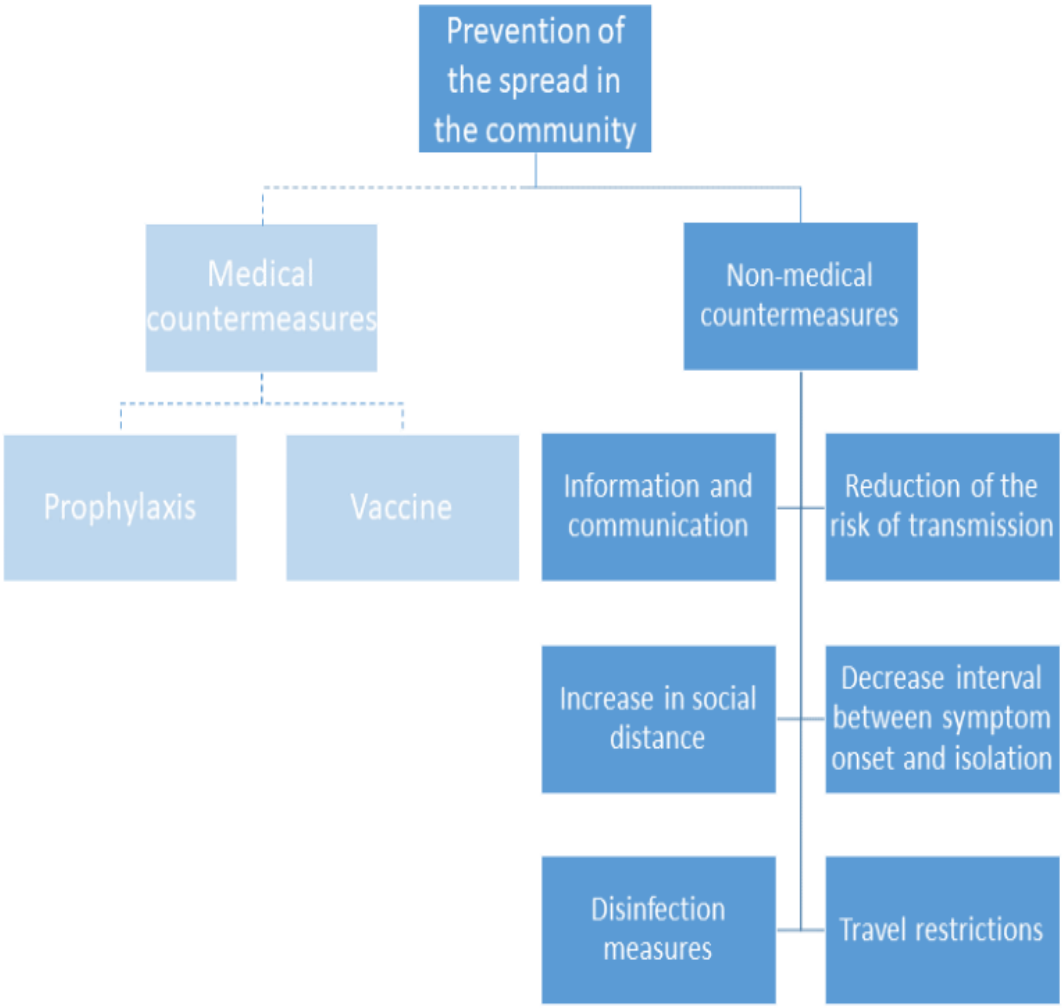
The COVID-19 pandemic has resulted millions of cases of COVID-19, millions of persons losing their jobs and health insurance, and millions of people being forced to or choosing to forego ongoing clinical care for underlying medical conditions. Among those who survive COVID-19, some may have lingering sequelae, a condition which is the consequence of a previous disease and needs ongoing chronic disease care. The public health and epidemiologic consequences are not clear but should be anticipated and planned for.

Ancillary to Public Health

> *"The single most influential action Texas could take for significant progress across all three sections of these recommendations is to enable all Texans to carry health insurance. Covered Texans maintain personal responsibility for their own wellness and contribute to our ability to detect, prevent, respond and recover from a public health crisis. Texas could achieve a simple coverage matrix by implementing currently available federal Medicaid and coverage waiver opportunities, establishing its own state-based health insurance exchange, and enacting savings incentives for businesses to offer more coverage choices. When Texans carry health insurance, they help fund the workforce, contribute crucial health statistics for surveillance, and strengthen our public health infrastructure."*
>
> *Catherine Mitchell, M.S., EVP and Chief Operations Officer, Community Health Choice*

These are challenging times for municipalities, counties, states and the nation and the world but the value of population-based health interventions and the need for vibrant public health enterprises is an imperative. In many respects we should consider a system redesign.

The DSHS supports city and county health departments and serves an important role in collaboration, fostering the growth of healthy communities resulting in greater prosperity. One important component to fostering healthier communities is taking time to improve health literacy. Our Advisory members suggest building curriculum in public schools for things like 'germ spread theory' for example.



Main public health policy responses to epidemics, including COVID-10 pandemic

Ancillary to Public Health

Recommendation 10: **Build the system that can "know" in real time the health status of individuals to enable appropriate mobilization of health and health care resources. (NOTE: We are researching this topic further and will be issuing a supplement this Winter.)**

The virus has managed to shine a glaring light on some of public health's and health care's most foundational cracks. Gaps in care, data, and IT systems have become more visible in the midst of the confusion and uncertainty of the pandemic. Issues around data access, sharing, and quality have adversely impacted public health's ability to understand, predict and manage the crisis. Scientists are faced with analyzing which public policy strategies work best. In this process they are contending with problems related to compiling data, merging distinct reporting systems and methods among cities, states, and regions and standardizing information collected from a mix of health systems, public agencies, private health insurance plans, and providers. What is needed is interoperability - the ability of different information systems devices or applications to connect, in a coordinated manner, within and across organizational boundaries to access, exchange and cooperatively use data amongst stakeholders. We should consider deploying something similar to a Universal Patient Identifier (UPI), creating a base standard for all health systems to operate upon. Knowing each person's health status during a public health crisis allows public health professionals to triage who to test and treat first. Having real time information saves lives and helps ensure our health systems do not exceed capacity. Today more than 30 countries use some form of a UPI. Our Advisors recognize that Texas does not have a statewide Health Information Exchange (HIE) and the lack of a mechanism to exchange information has further compounded the problem.

Ancillary to Public Health

"I would like to echo Dr. Cigarroa's statement; 'It is critical to the future health of Texas that we appropriately invest in public health to help prevent disease and to be able to respond swiftly and accurately to a public health crisis whether it be a pandemic or not. This requires a public health surge capacity, innovative ways of educating more public health professionals and the appropriate Information Technology infrastructure to be able to acquire reliable data, metrics and enhance communication among Departments of Public Health.'"

Greg Hartman, Texas A&M University, Chief Operating Officer & Senior Vice President | Health Science Center, Vice Chancellor | Texas A&M University System

Ancillary to Public Health

Recommendation 11: **Create an electronic passport/health record for epidemiological purposes (NOTE: We are researching this topic further and will be issuing a supplement this Winter.)**

> *"If we learn anything from the COVID-19 crisis is the need to take a dramatically different approach to preparing for a wide variety of public health crises. We're lucky that the virulence of the virus, in its current manifestation, is not more lethal nor more easily spread. The next epidemic or iteration of COVID-19 may be much worse and that is the scenario we must be prepared to confront."*
>
> *Don Hall, M.P.H., Principal, Delta Sigma, LLC*

E Passports or biometric/electronic passports can be an enormous asset in a pandemic. Currently they are used principally in the travel industry making it easier to move about from country to country.

This digital ID can easily be used to screen travelers for diseases when traveling from country to country thereby limiting the number of travelers exposed to a disease. This information can help public health authorities collect vital data for tracking diseases. With no need to exchange physical documents, a digital ID provides a kind of touchless system when people are maintaining social distancing and avoiding potentially contaminated/infected surfaces. Biometrics such as face recognition help ensure privacy is maintained.

To make them useful to public health, they need to contain current immunization records and travel histories at a minimum while being mindful of individual privacy. Finding the right solutions to put in place before another infectious spread across borders is important to our success in preventing another pandemic. Our Advisory believes that as a first step toward having vital tracking information, Texas needs to improve its immunization registry.

Ancillary to Public Health

Ancillary to Public Health

"The Public Health response to COVID 19 has been the challenge of a lifetime. This report highlights areas where we need to invest in the future. As COVID 19 has severely impacted those with chronic health conditions and obesity, work is needed to encourage everyone to take steps towards becoming healthier through proper diet and exercise to make sure that our bodies are stronger to fight any virus! Efforts are also needed to address updated data and technology platforms, and workforce surge capacity. Knowledge that "in the US, 97 cents of every dollar goes to medical care, and only 3 cents goes to public health" should move us towards the need to spend more of our resources on the prevention side that Public Health needs."

George T. Roberts, Jr. FACHE, Chief Executive Officer, Northeast Texas Public Health District

References

American Public Health Association. “COVID-19.” 2020. https://www.apha.org/covid19.

American Public Health Association. “Centers for Disease Control and Prevention and the Health Resources and Services Administration.” https://www.apha.org/-/media/files/pdf/advocacy/speak/200611_cdc_hrsa.ashx?la=en&hash=9AF3A3AA2BC352199D7BCAB16DBB0C139C858896.

American Public Health Association. “What is Public Health?” https://www.apha.org/what-is-public-health.

Anderson, Roy M. et. al. *How will country-based mitigation measures influence the course of the COVID-19 epidemic?* The Lancet 395. no. 10228 (March 21, 2020): 931-934. https://doi.org/10.1016/S0140-6736(20)30567-5.

Apa, James. “Introducing Scan: The Greater Seattle Coronavirus Assessment Network.” *Public Health Insides*, March 23, 2020. https://publichealthinsider.com/2020/03/23/introducing-scan-the-greater-seattle-coronavirus-assessment-network/.

Apple. “Mobility Trends Reports.” Maps. https://covid19.apple.com/mobility.

Association of State and Territorial Health Officials. “Coronavirus Disease 2019 (COVID-19) Response Hub.” ASTHO. https://coronavirus-astho.hub.arcgis.com.

Association of State and Territorial Health Officials. “National Public Health Performance Standards.” Accreditation and Performance, 2020. https://www.astho.org/Programs/Accreditation-and-Performance/National-Public-Health-Performance-Standards/.

ASTHO Staff. “16 Key Considerations for Drive-Through or Mobile Testing.” ASTHO Experts Blog, Association of State and Territorial Health Officials, March 19, 2020. https://astho.org/StatePublicHealth/16-Key-Considerations-for-Drive-Through-or-Mobile-Testing/03-19-20/.

Bates, Jonathan. “Drones Aiding Fight Against COVID-19.” *NCSL Blog*, National Conference of State Legislatures, May 7, 2020. https://www.ncsl.org/blog/2020/05/07/drones-aiding-fight-against-covid-19.aspx.

Benjamin, Georges C. “Ensuring health equity during the COVID-19 pandemic: the role of public health infrastructure.” Pan American Journal of Public Health, Rev Panam Salud Publica 44, June 2020. https://doi.org/10.26633/RPSP.2020.70.

Bicharra Garcia, Ana Cristina, et. al. “Collaboration and Decision Making in Crisis Situations.” (February 2016). DOI: 10.1145/2818052.2855520.

Blanford, Emily. “How States Are Leveraging Their Medicaid Programs to Respond to COVID-19.” *NCSL Blog*, National Conference of State Legislatures, April 9, 2020. https://www.ncsl.org/blog/2020/04/09/how-states-are-leveraging-their-medicaid-programs-to-respond-to-covid-19.aspx.

Boland-Krouse, Scott and Lawrence Burka. “After Coronavirus, E-Passports Could Help Prevent The Next Pandemic.” *Forbes*, June 5, 2020. https://www.forbes.com/sites/oliverwyman/2020/06/05/after-covid-19-how-e-passports-could-help-prevent-the-next-pandemic/#1f7d41cb1d5f.

Carr, Brendan G. and Judd E. Hollander. “Virtually Perfect? Telemedicine for Covid-19” New England Journal of Medicine 382, no. 18 (April 30, 2020). https://doi.org/10.1056/NEJMp2003539.

Center for Disease Control and Prevention. “10 Essential Public Health Services.” Public Health Professionals Gateway, U.S. Department of Health and Human Services. https://www.cdc.gov/publichealthgateway/publichealthservices/essentialhealthservices.html.

Center for Disease Control and Prevention. “National Public Health Performance Standards.” Public Health Professionals Gateway, U.S. Department of Health and Human Services. https://www.cdc.gov/publichealthgateway/nphps/index.html.

Centers for Disease Control and Prevention. “Sending Early Warning Signals from Emergency Departments to Public Health.” National Syndromic Surveillance Program (NSSP). Last modified August 12, 2020. https://www.cdc.gov/nssp/index.html.

Centers for Disease Control and Prevention. “Ten Essential Public Health Services and How They Can Include Addressing Social Determinants of Health Inequities.” U.S. Department of Health and Human Services. https://www.cdc.gov/publichealthgateway/publichealthservices/pdf/Ten_Essential_Services_and_SDOH.pdf.

Changoiwala, Puja. “Covid-19 Threatens to Overwhelm India’s Health Care System.” *Undark*, April 14, 2020. https://undark.org/2020/04/14/covid-19-india/.

Colombo, Francesca. *Resilient Health Systems: What we are learning from the COVID-19 crisis*. Paris: OECD, April 2, 2020. https://www.oecd-forum.org/posts/64973-resilient-health-systems-what-we-are-learning-from-the-covid-19-crisis.

“Coronavirus emphasizes challenges for rural communities.” *Texas Agriculture Daily*, Texas Farm Bureau, March 13, 2020. https://texasfarmbureau.org/coronavirus-emphasizes-challenges-for-rural-communities/.

“COVID-19: Impact on Employment and Labor.” *NCSL Blog*, National Conference of State Legislatures, May 13, 2020. https://www.ncsl.org/research/labor-and-employment/covid-19-impact-on-employment-and-labor.aspx.

Crisis and Emergency Risk Communication, 2nd ed. Atlanta: Centers for Disease Control and Prevention, 2018. https://emergency.cdc.gov/cerc/ppt/cerc_2014edition_Copy.pdf.

Criss, Tamara, Celia N. Hagan, and Emily J. Holubowich. *Driving Public Health in the Fast Lane: The Urgent Need for a 21st Century Superhighway.* Atlanta, Georgia: Council of State and Territorial Epidemiologists, 2019. https://resources.cste.org/data-superhighway/mobile/index.html.

Crock Bauerly, Brittney et. al. “Broadband Access as a Public Health Issue: The Role of Law in Expanding Broadband Access and Connecting Underserved Communities for Better Health Outcomes.” *Journal of Law, Medicine & Ethics*, Sage Journals (July 12, 2019). https://doi.org/10.1177/1073110519857314.

De Visser, Edwart J. et al. “AREA: A Mobile Application for Rapid Epidemiology Assessment.” Procedia Engineering 107, (2015): 357-365. https://doi.org/10.1016/j.proeng.2015.06.092.

Dorsett, Jennifer, “FCC grants temporary broadband access to help rural communities.” *Texas Agriculture Daily*, Texas Farm Bureau, April 2, 2020. https://texasfarmbureau.org/fcc-grants-temporary-broadband-access-to-help-rural-communities/.

Elflein, John. “Total number of U.S. coronavirus (COVID-19) cases and deaths as of August 20, 2020.” Statista, Aug 21, 2020. https://www.statista.com/statistics/1101932/coronavirus-covid19-cases-and-deaths-number-us-americans/.

Emmanuel, Zeke. et. al. “A National and State Plan to End the Coronavirus Crisis.” Center for American Progress, August 3, 2020. https://www.americanprogress.org/issues/healthcare/news/2020/04/03/482613/national-state-plan-end-coronavirus-crisis/.

Enlund, Sydne and Iris Hentze. “Mitigating Health Workforce Barriers During the COVID-19 Pandemic.” *NCSL Blog*, National Conference of State Legislatures, March 27, 2020. https://www.ncsl.org/blog/2020/03/27/mitigating-health-workforce-barriers-during-the-covid-19-pandemic.aspx.

Ensuring Integrity in Governments' Response to COVID-19 (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/801501588782665210/Ensuring-Integrity-in-Governments-Response-to-COVID-19.

Executive Director Bill McBride to Governors’ Offices, March 18, 2020, National Governors Association. https://www.nga.org/wp-content/uploads/2020/03/MedSurgMemo_FINAL.pdf.

Executive Director Bill McBride to Governors’ Offices, March 27, 2020, National Governors Association. https://www.nga.org/wp-content/uploads/2020/05/EO-CARES-Act_Workforce_Summary_032520.pdf.

Executive Director Bill McBride to Governors’ Offices, April 3, 2020, National Governors Association. https://www.nga.org/wp-content/uploads/2020/04/Memo-on-Older-Adults-and-Disabled-Final-formatted.pdf.

Executive Director Bill McBride to Governors’ Offices, April 6, 2020, National Governors Association. https://www.nga.org/wp-content/uploads/2020/03/NGA-Health-Workforce-and-Facility-Memo-Final-formatted.pdf.

Executive Director Bill McBride to Governors, April 27, 2020, National Governors Association. https://www.nga.org/wp-content/uploads/2020/03/COVID-19-Telehealth-Memo-20200320450pm.pdf.

Federation of State Medical Boards. “COVID-19.” https://www.fsmb.org/advocacy/covid-19/.

Fishbane, Lara and Adie Tomer. “Broadband is too important for this many in the US to be disconnected.” *The Avenue*. Brookings, August 14, 2019. https://www.brookings.edu/blog/the-avenue/2019/08/14/broadband-is-too-important-for-this-many-in-the-us-to-be-disconnected/.

Flahive, Paul. “Texas Legislature Poised For Biggest Broadband Push In State History But Still Catching Up.” Texas Public Radio, May 14 2019. https://www.tpr.org/post/texas-legislature-poised-biggest-broadband-push-state-history-still-catching.

Galea, Sandro and Nason Maani. “COVID-19 and Underinvestment in the Public Health Infrastructure of the United States.” Milbank Quarterly, vol. 98, no. 2 (June 2020): 250-259. https://doi.org/10.1111/1468-0009.12463.

Gardner, Heidi K. and Marviak, Ivan. “7 Strategies for Promoting Collaboration in a Crisis.” *Harvard Business Review*, July 08, 2020. https://hbr.org/2020/07/7-strategies-for-promoting-collaboration-in-a-crisis.

Glik, Deborah C. “Risk Communication for Public Health Emergencies.” Annu. Rev. Public Health, 2007. https://doi.org/10.1146/annurev.publhealth.28.021406.144123

Google. “COVID-19 Community Mobility Reports.” https://www.google.com/covid19/mobility/.

Google. “Texas.” Mobility Changes, COVID-19 Community Mobility Reports. May 9, 2020. https://www.gstatic.com/covid19/mobility/2020-05-09_US_Texas_Mobility_Report_en.pdf.

Haaland, Connor and Brent Skorup. “How Drones Can Help Fight the Coronavirus.” *COVID-19 Crisis Response*, Mercatus Center, March 30, 2020. https://www.mercatus.org/publications/covid-19-policy-brief-series/how-drones-can-help-fight-coronavirus

Hentze, Iris. “COVID-19: Occupational Licensing During Public Emergencies.” *NCSL Blog*, National Conference of State Legislatures, August 3, 2020. https://www.ncsl.org/research/labor-and-employment/covid-19-occupational-licensing-in-public-emergencies.aspx.

Himmelstein, David U. and Steffie Woolhandler “Public Health’s Falling Share of US Health Spending.” American Journal of Public Health 106, (January 2016): 56-57. doi: 10.2105/AJPH.2015.302908

Igoe, Katherine J. “Developing Public Health Communication Strategies—And Combating Misinformation—During COVID-19.” Harvard School of Public Health, April 3, 2020. https://www.hsph.harvard.edu/ecpe/public-health-communication-strategies-covid-19/.

Institute of Medicine. For the Public's Health Investing in a Healthier Future. Washington, DC: National Acad. Press, 2012. https://www.ncbi.nlm.nih.gov/books/NBK201023/.

Interlandi, Jeneen. “Why We’re Losing the Battle With Covid-19.” New York Times, July 14, 2020. https://www.nytimes.com/2020/07/14/magazine/covid-19-public-health-texas.html.

Kaiser Family Foundation. “Medicaid Emergency Authority Tracker: Approved State Actions to Address COVID-19.” Coronavirus (COVID-19). August 21, 2020. https://www.kff.org/medicaid/issue-brief/medicaid-emergency-authority-tracker-approved-state-actions-to-address-covid-19/.

Kent, Jessica. “Could COVID-19 Help Refine AI, Data Analytics in Healthcare?” *Health IT Analytics*, April 24, 2020. https://healthitanalytics.com/features/could-covid-19-help-refine-ai-data-analytics-in-healthcare.

Krishen, Anjala S. and Michelle Petrescu. “The importance of high-quality data and analytics during the pandemic.” *Journal of Marketing and Analytics* 8, (2020): 43–44. https://doi.org/10.1057/s41270-020-00079-3.

Lacina, Linda. “COVID-19 reveals gaps in health systems: WHO Briefing.” *World Economic Forum*, May 6, 2020. https://www.weforum.org/agenda/2020/05/covid-19-reveals-gaps-in-public-health-system-who-briefing/.

Minton, Lisa, Liz Vela, and Bruce Wright. “Counting the Cost of Texas Health Care.” Texas Comptroller of Public Accounts, March 2017. https://comptroller.texas.gov/economy/fiscal-notes/2017/march/health-care.php#:~:text=%2443%20Billion%20and%20Rising&text=In%20fiscal%202015%2C%20Texas%20spent, dedicated%20accounts%20within%20general%20revenue.

National Association for School Psychologists. “Need for Crisis Training in Schools.” 2019, https://www.nasponline.org/professional-development/prepare-training-curriculum/need-for-crisis-training-in-schools.

National Conference of State Legislatures. “State Action on Coronavirus (COVID-19).” https://www.ncsl.org/research/health/state-action-on-coronavirus-covid-19.aspx.

National Conference of State Legislatures. “State Fiscal Responses to Coronavirus (COVID-19).” September 4, 2020. https://www.ncsl.org/research/fiscal-policy/state-fiscal-responses-to-covid-19.aspx.

National Governors Association. “Coronavirus Response.” NGA Center for Best Practices, 2020. https://www.nga.org/bestpractices/.

National Governors Association. “Coronavirus State Action Chart.” May 12, 2020. https://www.nga.org/wp-content/uploads/2020/05/CoronavirusStateActionsChart_12May2020.pdf.

National Governors Association. Roadmap to Recovery: A Public Health Guide for Governors. NGA, April 21, 2020. https://www.nga.org/wp-content/uploads/2020/04/NGA-Report.pdf.

National Governors Association to Governors’ Offices. June 8, 2020. https://www.nga.org/wp-content/uploads/2020/03/3.23.20-Health-Waivers-in-Disasters-Final.pdf.

Oderkirk, Jillian. “Readiness of Electronic Health Record Systems to Contribute to National Health Information and Research.” *OECD Health Working Papers,* No. 99, OECD Publishing, Paris (2017). https://doi.org/10.1787/9e296bf3-en

OECD. “Beyond Containment: Health Systems Responses to COVID-19 in the OECD Countries.” April 16, 2020. https://read.oecd-ilibrary.org/view/?ref=119_119689-ud5comtf84&title=Beyond_Containment:Health_systems_responses_to_COVID-19_in_the_OECD.

OECD. “Flattening the COVID-19 Peak: Containment and Mitigation Policies.” March 24. 2020. https://read.oecd-ilibrary.org/view/?ref=124_124999-yt5ggxirhc&title=Flattening_the_COVID-19_peak-Containment_and_mitigation_policies.

OECD. “Health at a Glance 2019: OECD Indicators.” OECD Publishing, Paris (2019). https://doi.org/10.1787/19991312.

OECD. “Health for Everyone? Social Inequalities in Health and Health Systems.” OECD Health Policy Studies, OECD Publishing, Paris (September 27, 2019). https://www.oecd.org/publications/health-for-everyone-3c8385d0-en.htm.

OECD. “Public Integrity for an Effective COVID-19 Response and Recovery.” OECD Policy Responses to Coronavirus (COVID-19), OECD, April 19, 2020. http://www.oecd.org/coronavirus/policy-responses/public-integrity-for-an-effective-covid-19-response-and-recovery-a5c35d8c/.

OECD. “Recommendation of the Council on Health Data Governance.” *OECD Legal Instruments* (2019). https://www.oecd.org/health/health-systems/Recommendation-of-OECD-Council-on-Health-Data-Governance-Booklet.pdf.

Potter, Lloyd B., and Nazul Hoque. “Texas Population Projections, 2010 to 2050.” Office of the State Demographer. Accessed April 10, 2020. https://demographics.texas.gov/Resources/Publications/2014/2014-11_ProjectionBrief.pdf.

Public Health Accreditation Board. “Accreditation Snapshot.” Public Health Accreditation Board, 2019. https://www.phabdata.org/data-portal.

Public Health Accreditation Board. “Benefits of PHAB Accreditation Reaching More Communities as Covered Population Continues to Climb.” Public Health Accreditation Board, 2020. https://phaboard.org/2019/09/03/benefits-of-phab-accreditation-reaching-more-communities-as-covered-population-continues-to-climb/.

Ramsey, Ross. “Analysis: A digital divide with dire consequences for Texas.” *Texas Tribune*, April 1, 2020. https://www.texastribune.org/2020/04/01/digital-divide-dire-consequences-texas/.

Ramsey, Ross. “Analysis: Funding for rural broadband in Texas is in trouble. The pandemic might save it.” *Texas Tribune*, July 29, 2020. https://www.texastribune.org/2020/07/29/broadband-rural-texas-pandemic/.

Rippe, James M. “The Health Promoting Power of Daily Habits and Practices.” *American Journal of Lifestyle Medicine,* (July 20, 2018). https://doi.org/10.1177/1559827618785554.

Robert Wood Johnson Foundation. “A New Way to Talk About the Social Determinants of Health.” Vulnerable Populations Portfolio. Robert Wood Johnson Foundation, January 1, 2010. http://www.rwjf.org/content/dam/farm/reports/reports/2010/rwjf63023.

Rovner, Julie. “Opinion: Always The Bridesmaid, Public Health Rarely Spotlighted Until It's Too Late.” *NPR*, May 1, 2020. https://www.npr.org/sections/health-shots/2020/05/01/848628724/opinion-always-the-bridesmaid-public-health-rarely-spotlighted-until-its-too-lat.

Rowe, Karly. “The time is now for universal patient identifiers.” *Digital Commerce 360*, August 25, 2019. https://www.digitalcommerce360.com/2019/08/25/the-time-is-now-for-universal-patient-identifiers/.

Texas Department of Health Services. “Texas Medical Reserve Corps.” Last updated January 11, 2018. https://www.dshs.texas.gov/commprep/TexasMRC.aspx.

Texas Health and Human Services. “Public Health Regions.” Texas Department of State Health Service, 2020. https://dshs.texas.gov/regions/default.shtm.

Texas Health and Human Services. “Texas Local Public Health Organizations.” Texas Department of State Health Service, 2020. https://dshs.texas.gov/regions/lhds.shtm.

Texas Medical Association. “Health Information Exchange.” https://www.texmed.org/HIE/.

“Texas Senate Bill 14.” Legiscan. https://legiscan.com/TX/bill/SB14/2019.

Texas Workforce Commission. “Occupational Employment Statistics (OES).” Texas Labor Market Information, 2020. https://texaslmi.com/LMIbyCategory/Wages.

Thale. “The electronic passport in 2020 and beyond.” Thale Group, 2019. https://www.thalesgroup.com/en/markets/digital-identity-and-security/government/passport/electronic-passport-trends.

Thompson, Kelly and Nicholas Anderson. “Emergency Suspension Powers.” The Policy Surveillance Program. June 21, 2017. http://lawatlas.org/datasets/emergency-powers.

Tumpey, Abbigail J., David Daigle, and Glen Nowak. “Communicating During an Outbreak or Public Health Investigation.” *The CDC Field Epidemiology Manual*, (2018). https://www.cdc.gov/eis/field-epi-manual/chapters/Communicating-Investigation.html.

U.S. Bureau of Labor Statistics. “Epidemiologists.” Occupational Outlook Handbook, U.S. Department of Labor. visited June 24, 2020. https://www.bls.gov/ooh/life-physical-and-social-science/epidemiologists.htm.

U.S. Bureau of Labor Statistics. “May 2019 State Occupational Employment and Wage Estimates.” Occupational Employment Statistics, U.S. Department of Labor, 2019. https://www.bls.gov/oes/current/oessrcst.htm.

U.S. Bureau of Labor Statistics. “May 2019 State Occupational Employment and Wage Estimates Texas.” Occupational Employment Statistics, U.S. Department of Labor, 2019. https://www.bls.gov/oes/current/oes_tx.htm.

U.S. Bureau of Labor Statistics. “Occupational Employment and Wages, May 2019.” Occupational Employment Statistics, U.S. Department of Labor, 2019. https://www.bls.gov/oes/current/oes191041.htm.

U.S. Census Bureau. “State Population Totals and Components of Change: 2010-2019.” Census.Gov, U.S. Department of Commerce, December 30, 2019. https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html#par_textimage_1574439295.

U.S. Department of Agriculture, 2020. *USDA Invests $19 Million In Broadband For Rural Texas Communities.* February 28, 2020. https://www.usda.gov/media/press-releases/2020/02/28/usda-invests-19-million-broadband-rural-texas-communities.

Washington State Department of Health. “National Accreditation.” Public Health System Resources and Services. https://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthSystemResourcesandServices/NationalAccreditation.

World Health Organization. “Contact Tracing in the Context of COVID-19: Interim Guidance.” May 10, 2020. https://apps.who.int/iris/handle/10665/332049.

World Health Organization. “Surveillance Strategies for COVID-19 Human Infection: Interim Guidance.” Institutional Repository for Information Sharing, May 10, 2020. https://apps.who.int/iris/handle/10665/332051.