Responding to the COVID-19 pandemic - A collaboration framework for cities and solutions providers

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Target Audience and How to Use this document

This white paper was created with the following objectives:

1. Provide cities and municipalities with an easy to use structure and framework to map all their current COVID-19 response needs, projects and initiatives
2. Provide solution providers with a structure to demonstrate where and how their specific solutions fit within a city or municipality's COVID-19 response initiatives
3. Provide cities and solution providers with a tool to ensure that all relevant areas of need are identified and considered

Summary

The coronavirus COVID-19 pandemic has disrupted cities and communities worldwide. Although cities have emergency and disaster response plans, the scale of the outbreak has strained their resources and capabilities. "Smart City" technologies, with their innovative digital approaches and capabilities, offer the potential to facilitate city responses to COVID-19. As a result, municipalities have turned to technology companies for help.

Many established and start-up technology companies have responded with ideas and proposals. However, the results have been mixed and uneven. Some problem areas get a lot of ideas while other problems get none. Still other ideas are unfeasible. Many respondents lack understanding of how cities respond to public health emergencies.

This white paper describes a Smart City-Public Health Emergency Collaboration framework. It provides a structured way to identify the collaboration opportunities between cities, public health systems and the technology community. It integrates typical smart city ecosystem capabilities with the CDC Public Health Emergency Preparedness and Response Capabilities.

Introduction

The coronavirus COVID-19 pandemic has had a devastating and disruptive impact on cities and communities worldwide. From the loss of lives, interruption of essential day-to-day services, to disruption of the global economy, no one person, organization or country is spared. Local, regional and national governments are urgently responding with varying degrees of effectiveness.

As the number of infections and deaths surge, governments are turning to technology and innovative approaches for help. For example, eighteen countries around the world are using mobile phone tracking and contact tracing methods[1]. Several major technology companies have partnered with the World Health Organization (WHO) to host a global hackathon to facilitate development of creative software solutions[2].

Cities have borne the burden of the COVID-19 outbreak. Can smart cities, with innovative technologies such as the Internet of Things (IoT), artificial intelligence (AI), 5G, open data, and analytics, respond more effectively? This white paper provides a framework listing the potential areas of opportunity for smart cities and their associated technologies. Cities and technology companies can use this to structure their own

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[1] COVID-19 Digital Rights Tracker, https://bit.ly/3ayn568, Top10VPN, 3/26/2020.
[2] Microsoft partners with WHO to host Covid-19 hackathon, https://bit.ly/2UXAeyO, The Record, 3/25/2020

thinking, and to ensure they have considered all the dimensions of the problem. In addition, we provide a sample set of innovative solutions, taken from current and real-world examples, and mapped into this framework.

A vision for national preparedness

In 2011, the United States Department of Homeland Security announced the country's National Preparedness Goal[3] in response to Presidential Policy Directive 8 (PPD 8: National Preparedness)[4]. This goal[5] states:

A secure and resilient Nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk.

This goal has five mission areas:

- **Prevention:** Preventing, avoiding, or stopping a threatened or an actual act of terrorism.
- **Protection:** Protecting our citizens, residents, visitors, assets, systems, and networks against the greatest threats and hazards in a manner that allows our interests, aspirations, and way of life to thrive.
- **Mitigation:** Mitigating the loss of life and property by lessening the impact of future disasters.
- **Response:** Responding quickly to save lives, protect property and the environment, and meet basic human needs in the aftermath of an incident.
- **Recovery:** Recovering through a focus on the timely restoration, strengthening, and revitalization of infrastructure, housing, and the economy, as well as the health, social, cultural, historic, and environmental fabric of communities affected by an incident.

To achieve this goal, the United States Federal Emergency Management Agency (FEMA) developed the National Preparedness System, a set of resources, processes and tools, to help the nation and its communities address the risks posed by natural and man-made hazards and disasters[6].

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[3] DHS Press Release: DHS Announces First National Preparedness Goals, https://bit.ly/2UTOXeb, 10/7/2011
[4] https://en.wikipedia.org/wiki/Homeland_Security_Presidential_Directive_8
[5] DHS Document: National Preparedness Goal, 2nd Edition, September 2015, https://bit.ly/2yoijtz
[6] DHS Document: National Preparedness System, https://bit.ly/2R2d0q5, 10/2018

CDC establishes capability standards for responding to public health emergencies

Supporting the health related areas specified in the National Preparedness System, the Centers for Disease Control and Prevention (CDC) defined fifteen standardized public health emergency preparedness and response capabilities[7]. The fifteen capabilities are organized into six domains (Figure One). These standards, created in 2011 and updated in 2018, facilitate the development of the capabilities of cities, and local and state public health systems to address health emergencies.

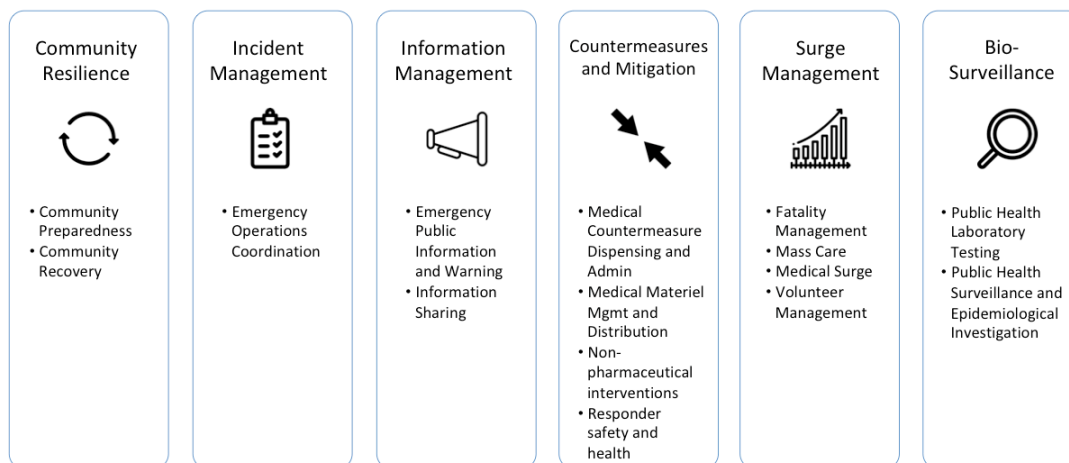| Community Resilience	Incident Management	Information Management	Countermeasures and Mitigation	Surge Management	Bio-Surveillance
• Community Preparedness • Community Recovery	• Emergency Operations Coordination	• Emergency Public Information and Warning • Information Sharing	• Medical Countermeasure Dispensing and Admin • Medical Materiel Mgmt and Distribution • Non-pharmaceutical interventions • Responder safety and health	• Fatality Management • Mass Care • Medical Surge • Volunteer Management	• Public Health Laboratory Testing • Public Health Surveillance and Epidemiological Investigation

Figure One. CDC National Public Health Emergency Preparedness and Response Capabilities

Each of these fifteen capabilities, when fully realized, enables the municipality and its community partners to carry out specific activities necessary to enable the public health systems to respond effectively. A summary of these capabilities and activities is described in the Appendix Tables One (a) and (b).

The Smart City ecosystem framework

Cities offer services and perform a variety of activities that deliver desired outcomes for its residents, businesses and visitors. During the COVID-19 outbreak, cities are actively mobilizing emergency resources and capabilities to keep its residents healthy and safe, and to ensure vital services are maintained.

The application of innovative smart city technologies, such as IoT, AI, 5G, open data, and analytics, is poised to transform what cities can do, and how they do it. Existing services can be delivered faster, with better quality, more reliably, and with less cost. In addition,

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[7] Public Health Emergency Preparedness and Response Capabilities, https://bit.ly/2UVKGXx, 10/2018

cities can create and offer new services not possible before. There may therefore be enormous applications to unprecedented events such as the current pandemic.

The use of these advanced technologies enables cities to "know" more, collaborate more effectively, and become more responsive. Figure Two shows the Strategy of Things model for a smart city ecosystem[8]. However, while technology is top of mind and most visible in the smart city, it is just one layer of many in the ecosystem. Each layer has a different but equally important role. No one layer is more relevant than another. For example, technology "powers" the smart city, but it is data that leads to insights and new services. However, to create and deliver relevant services, cities must be able to bring the community and the separate municipal agencies to innovate the right solutions. To get the right outcomes that matter consistently and at scale, civic leaders must establish sensible operational, technology and data policies. Finally, savvy cities use public private partnerships (PPP) to maximize their resources, go faster and scale effectively. This will be as true of smart cities' pandemic responses as it will be of any other application.
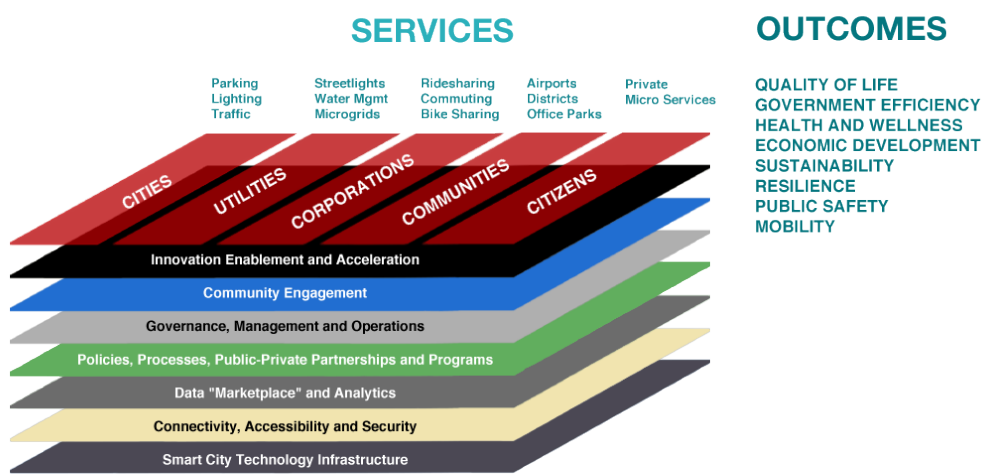

Figure Two. Strategy of Things® Smart City Ecosystem Framework

Challenges in engaging the technology community

Community resilience, health and wellness, and public safety are top of mind with city and public health leaders during the COVID-19 outbreak. Although cities have some resources, capabilities and capacity to respond to emergencies, the scale of the COVID-19 outbreak has overwhelmed many of them. Local and state governments are pushing existing resources and capabilities to its limits with limited effectiveness.

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[8] Planning Sustainable Smart Cities with the Smart City Ecosystem Framework, http://bit.ly/2BmQ4uJ, 1/24/2018

Governments have turned to the technology community in an effort to track the virus, slow new infections, prevent the healthy from falling ill, and to help the infected recover. Technology providers and innovators have responded in a variety of ways. These include manufacturing additional ventilators, 3D printing facemasks and shields for healthcare workers, and using AI to accelerate the development of new cures.

However, current efforts to engage the innovation communities are reactive, piecemeal, and have limited effectiveness. Many technology companies lack context and bombard cities with "solutions" that may not be relevant. Some cities focus on the technology element, but not on equally important elements like community engagement. As a result, some problems get a lot of attention from the innovation community while others go unaddressed. Other problems cannot be addressed because the communities lack supporting infrastructure. Still other solutions have limited effectiveness because they lack community support.

Developing a better way to collaborate

The Smart Cities and Public Health Emergency Collaboration framework was developed with these realities in mind. It is aligned with how public health systems respond to and manage emergencies. The framework was constructed by taking the CDC Public Health Emergency and Response Capabilities standards (Figure One) and overlaying it with a simplified version of the Strategy of Things® smart city ecosystem framework (Figure Two). This approach is shown in Figure Three. Actions and solutions can then be posited at each intersection; indeed, existing responses can also be mapped, enabling possible gaps (aka additional opportunities!) in a city's current approach to be seen.

Figure Three. Approach for developing the Smart Cities-Public Health Emergency Collaboration Framework.

The four capability layers from the smart city ecosystem framework (innovation, community engagement, information and data, and technology infrastructure) augment municipal capabilities listed in the six domains of the CDC Public Health Emergency and Response Capabilities. In addition, these layers facilitate the integration of the six domains with each other.

Innovation and Use Cases Layer. This layer represents the services, solutions and applications providers that can be applied to the six CDC domains. The solutions and services come from a broader innovation community. These innovation ecosystem partners include the city, utility companies, businesses, the community (universities, non-profits, etc.), other government agencies, and individuals.

Community Engagement Layer. The layer represents the ability to consistently engage residents, businesses and others in a transparent and meaningful way. Community engagement can be "bottom up" (citizens to city), "top down" (city to citizens) and "side to side" (citizen to citizen, citizen to business, business to business)[9]. Community engagement is critical for planning and deploying new services, while updating and improving existing ones. An informed, willing and committed community is a critical asset, as government cannot "do it all" in defeating the COVID-19 pandemic.

Data and Analytics Layer. This layer represents the data assets and analytics resources and capabilities that can provide warnings and updates on progress in dealing with the outbreak, facilitate emergency operations, and accelerate the mitigation, response and recovery from the COVID-19 outbreak. Information and data is the currency that drives the collaboration between multiple agencies, government entities and the community.

Technology Infrastructure Layer. This layer provides the foundational infrastructure needed to enable or facilitate the application of the innovations, the community engagement, and the data and analytics capabilities and resources. Examples of technology infrastructure include connectivity, cloud and edge platforms, infrastructure integration tools, operational and digital skills and resources.

Smart Cities-Public Health Emergency Collaboration framework

The resulting Smart Cities-Public Health Emergency Collaboration framework is shown in Figure Four. Each "square" or intersection in the framework represents a collaboration point where smart city digital technologies and innovation capabilities can be used to augment the municipalities' public health emergency response needs. This framework broadly captures and proactively maximizes the full range of collaboration opportunities between cities, public health systems and the technology community. The more

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[9] Peter Williams Consulting LLC

"squares" in the framework that can be populated, the more effective the overall response is likely to be.

This framework is most effective when:

- It is used as a starting point for collaboration. Cities and health systems bring domain knowledge, while technology companies bring the digital expertise.
- Cities and health systems use it to plot their existing responses and then identify their capability gaps and needs. They must articulate those gaps and needs to the technology companies.
- Technology companies align their offers to the CDC specified capabilities and activities. It may be necessary to partner to offer an "end to end" solution.
- Everyone thinks beyond individual "squares". The squares are a starting point. Some needs cross multiple capability domains and require a combination of technology, community engagement, and data.
- Collaboration opportunities are separated into two categories. One for tactical immediate responses, and a separate set for mid-term, longer efforts.

	Community Resilience	Incident Management	Information Management	Counter-measures and Mitigation	Surge Management	Bio-Surveillance
Innovation Use Cases						
Community Engagement						
Data and Analytics						
Technology Infrastructure						

Figure Four. The Smart Cities-Public Health Emergency Collaboration framework.

The framework in action

We share a few current examples to show the framework in action. These examples are sourced from local and international media outlets. We then map these innovations to the appropriate square(s) in the framework (Figure Five).

There is no limit to the number of collaboration initiatives possible for each square. Some collaboration initiatives may span multiple CDC capability domains, and some initiatives may span multiple smart city layers.

Example One. Infected Individual Tracing

A number of governments[1] are using the data from mobile phones to track infected individuals, to see where they went, and whom they may have come into contact with. This information is then used to identify those who have potentially been infected, how many people were infected, and when they may have been infected.

Collaboration Area(s):
- Bio-Surveillance (Public Health Surveillance and Epidemiological Investigation) and Data and Analytics Layer (Smart City Capability Layer)

Example Two. COVID-19 Screening Website

Verily Life Sciences, a subsidiary of Alphabet, the parent company of Google, has created a website that screens for COVID-19, and directs people to local testing locations[10]. This effort supports California's community based testing program, and is available in four counties.

Collaboration Area(s)
- Countermeasures and Mitigation (Non-pharmaceutical interventions) and Community Engagement (Smart City Capability Layer)

Example Three. Community Broadband

Comcast is providing the communities that it operates in with access to broadband Internet service. This includes lifting data caps for its existing customers, and access to its nationwide network of Xfinity WiFi hotspots to non-customers[11]. In addition, new customers are given two months of complimentary service. This supports the community, businesses, and others affected by "shelter in place" directives intended to reduce community spread of COVID-19.

Collaboration Area(s)
- Countermeasures and Mitigation (Non-pharmaceutical interventions) and Technology Infrastructure (Smart City Layer)

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[10] https://www.projectbaseline.com/study/covid-19/
[11] https://bit.ly/3aBpugm, 3/16/2020

	Community Resilience	Incident Management	Information Management	Counter-measures and Mitigation	Surge Management	Bio-Surveillance
Innovation Use Cases	• Citizen sentiment analysis • Home body-heat sensors			• Social distancing sensors • App for Home quarantine		
Community Engagement	• Information kiosks in high traffic areas • Citizen portals			• Example Two: COVID 19 Screening website	• Volunteer sign up and dispatch portals	
Data and Analytics			• Information portal • COVID-19 Open Dataset (CORD 19)			• Example One: Tracing Infected Individuals
Technology Infrastructure	• Telemedicine support infra-structure	• Interop and redundancy of first responder systems		• Example Three - Community Broadband		• Maps of antibody test outcomes

Figure Five. Examples of collaboration opportunities

Next steps

The framework provides a structure to broadly consider and maximize collaboration opportunities between the smart city innovation community and municipalities for the COVID-19 outbreak. It is aligned with the things public health systems need to respond to and manage health related emergencies. The framework is intended to be a starting point. It should be adapted to the specific needs and capabilities of the municipality, community and health system.

With an initial understanding of the framework, the following are recommended next steps for municipalities, communities and public health systems:

- Review the framework and understand each of the fifteen capabilities within the six domains as defined by the CDC. Appendix Tables One (a) and (b) summarizes these capabilities. Additional information can be found in the CDC Public Health Emergency Preparedness and Response Capabilities document (footnote 7).
- Evaluate the current state of your preparedness and response capabilities. Identify the level of readiness, as well as gaps in your capabilities.
- Map the gaps and wants into the framework. This becomes a "challenge" list that can be used to solicit innovative ideas and solutions.

- Invite the technology and innovation community to review this list. Host various brainstorming and ideation sessions. Create open challenges and invite the community to participate.

For technology and innovative solutions providers, the next steps are:

- Review and understand what each of the fifteen capabilities are, and what activities they enable.
- Review the framework, and identify those areas of current and future potential opportunity for your solution or capabilities. It may be necessary to establish partnerships with other technology companies in order to provide an integrated offering.
- Using this framework as a guide, discuss with public health and emergency operations and response planners their capabilities, gaps, and areas of potential collaboration and opportunity.

Appendix: Table One (a) – CDC Public Health Emergency and Response Capabilities[7] (Summary)

Capabilities	Definition	Key Activities
Community Preparedness	Prepare for, withstand, and recover from public health incidents in both the short and long term	• Determine risks to the health of the jurisdiction • Strengthen community partnerships to support public health preparedness • Share information through community social networks • Coordinate training & provide guidance to support community involvement
Community Recovery	Critical assets, facilities, and other services within public health, health care, emergency management, human services, mental and behavioral health, environmental health sectors support recovery operations	• Identify and monitor community recovery needs • Support recovery operations for public health and related systems • Implement corrective actions to mitigate damage from future incidents
Emergency Operations Coordination	Coordinate with emergency management and to direct and support an incident or event	• Preliminary assessment to determine the need for activation of public health emergency operations • Activate public health emergency operations • Develop and maintain an incident response strategy • Manage and sustain the public health response • Demobilize and evaluate public health emergency operations
Emergency Public Information and Warning	Develop, coordinate, and disseminate information, alerts, warnings, and notifications to the public and incident management personnel.	• Activate the emergency public information system • Determine the need for a Joint Information System • Establish and participate in information system operations • Establish avenues for public interaction and information exchange • Issue public information, alerts, warnings, and notifications
Information Sharing	Conduct multijurisdictional and multidisciplinary exchange of health-related information and situational awareness data among federal, state, local, tribal, and territorial levels of government and the private sector	• Identify stakeholders that should be incorporated into information flow and define information sharing needs • Identify and develop guidance, standards, and systems for information exchange • Exchange information to determine a common operating picture
Medical Countermeasure Dispensing and Admin	Provide medical countermeasures to targeted population(s) to prevent, mitigate, or treat the adverse health effects of a public health incident	• Determine medical countermeasure dispensing and administration strategies • Receive medical countermeasures to be dispensed and administered • Activate medical countermeasure dispensing and administration operations • Dispense and administer medical countermeasures to targeted population(s) • Report adverse events
Medical Materiel Management and Distribution	Acquire, manage, transport and track medical materiel during a public health incident or event and the ability to recover and account for unused medical materiel, such as pharmaceuticals, vaccines, gloves, etc. after an incident.	• Direct and activate medical materiel management and distribution • Acquire medical materiel from national stockpiles or other supply sources • Distribute medical materiel • Monitor medical materiel inventories and medical materiel distribution operations • Recover medical materiel and demobilize distribution operations
Non-pharmaceutical Interventions	Actions that help slow the spread of illness or reduce the adverse impact, such as isolation, quarantine, travel restrictions, social distancing, hygiene, external decontamination, and precautionary protective behaviors	• Engage partners and identify factors that impact non-pharmaceutical interventions • Determine non-pharmaceutical interventions • Implement non-pharmaceutical interventions • Monitor non-pharmaceutical interventions

Appendix: Table One (b) – CDC Public Health Emergency and Response Capabilities[7] (Summary)

Capabilities	Definition	Key Activities
Responder Safety and Health	Protect public health and other emergency responders during pre-deployment, deployment, and post-deployment	• Conduct or support public health surveillance • Conduct public health and epidemiological investigations • Recommend, monitor, and analyze mitigation actions • Improve public health surveillance and epidemiological investigation systems
Fatality Management	Coordinate with partner organizations and agencies to provide fatality management services	• Determine the public health agency role in fatality management • Identify & facilitate public health resources to support fatality mgmt. operations • Assist in the collection and dissemination of antemortem data • Support the provision of survivor mental/behavioral health services • Support fatality processing and storage operations
Mass Care	Ability of public health agencies to coordinate with and support partner agencies to address, within a congregate location, the public health, health care, mental/behavioral health, and human services needs of those impacted	• Determine public health role in mass care operations • Determine mass care health needs of the impacted population • Coordinate public health, health care, and mental/behavioral health services • Monitor mass care population health
Medical Surge	Provide adequate medical evaluation and care during events that exceed the limits of the normal medical infrastructure of an affected community	• Assess the nature and scope of the incident • Support activation of medical surge • Support jurisdictional medical surge operations • Support demobilization of medical surge operations
Volunteer Management	Coordinate with emergency management and partner agencies to identify, recruit, register, verify, train, and engage volunteers to support the jurisdictional public health agency's preparedness, response, and recovery activities during pre-deployment, deployment, and post-deployment.	• Recruit, coordinate, and train volunteers • Notify, organize, assemble, and deploy volunteers • Conduct or support volunteer safety and health monitoring and surveillance • Demobilize volunteers
Public Health Laboratory Testing	Implement and perform methods to detect, characterize, and confirm public health threats. Report timely data, provide investigative support, & address actual or potential exposures	• Conduct laboratory testing and report results • Enhance laboratory communications and coordination • Support training and outreach
Public Health Surveillance and Epidemiological Investigation	Create, maintain, support, and strengthen routine surveillance and detection systems and epidemiological investigation processes.	• Conduct or support public health surveillance • Conduct public health and epidemiological investigations • Recommend, monitor, and analyze mitigation actions • Improve public health surveillance and epidemiological investigation systems

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