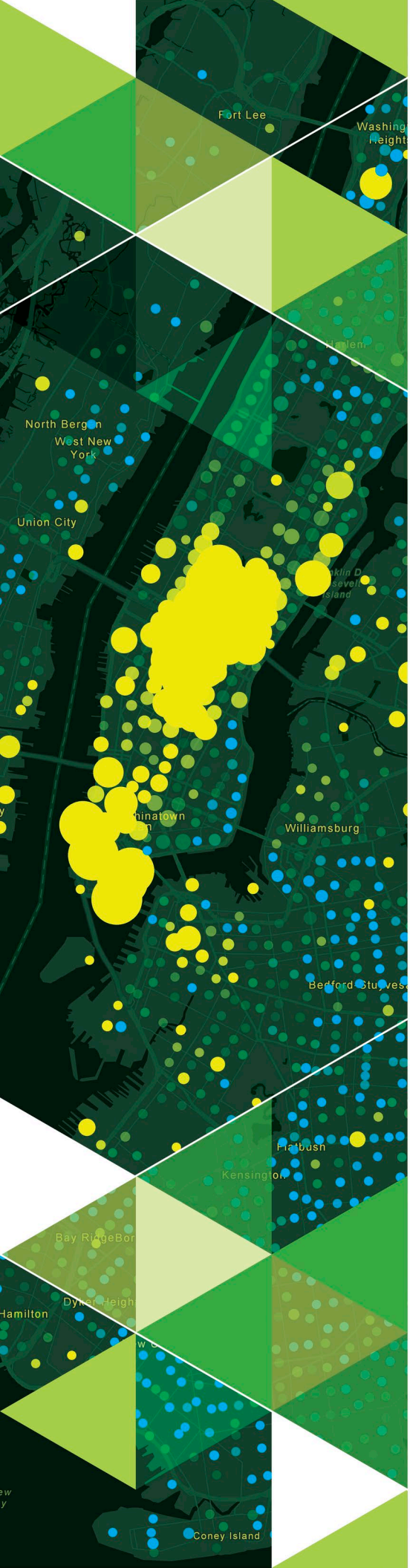

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WHITE PAPER

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Locating COVID-19 Testing, Treatment, and Resource Distribution Sites

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Locating COVID-19 Testing, Treatment, and Resource Distribution Sites

Introduction

This white paper details a geographic modeling approach to identify the optimal locations for coronavirus disease 2019 (COVID-19) testing sites, treatment sites, and food/resource distribution sites.

This is a two-step approach. First, spatial statistical methods are applied to calculate exposure, susceptibility, transmission, and health-care resource scarcity risk at a detailed level across a large geographic area to calculate population demand. Second, location-allocation analysis is used to model the most suitable locations within a predefined travel distance. The result of this work is a decision-making tool for government leaders to ensure that those individuals most in need have priority access to the care they will require during this crisis.

General Approach

There are multiple types of sites needed for the COVID-19 response:

- Testing sites—High throughput, drive-through and pedestrian walk-up locations
- Treatment sites—Overnight care, isolated from hospitals, suitably equipped, with access to medical personnel
- Food/Resource distribution sites—High throughput, drive-through and pedestrian walk-up locations, based on the Federal Emergency Management Agency (FEMA) Distribution Management Plan Guide, found here: https://www.fema.gov/media-library-data/1567005162420-6a397b542cf5a7678781414cfa4e3661/FEMA_Distribution_Management_Plan_Guide_EMPG_FY2019.pdf

Esri can analyze site characteristics relative to demand for services at those sites and determine site suitability to accommodate that demand. Facility Location Modeling (FLM) can be used to evaluate a set of candidate sites at different locations and with varying characteristics (e.g., capacity) and determine the optimal subset of those candidate sites to put into service to address demand.

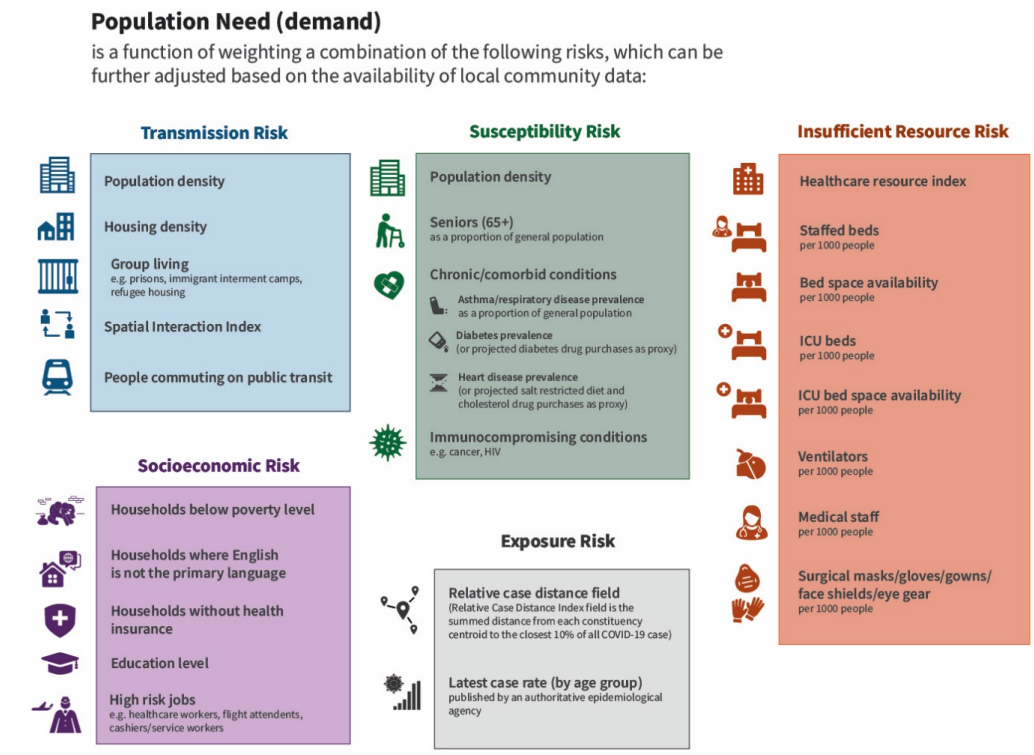
Step 1 Understanding Population Demand through Creating Risk Surfaces

As COVID-19 testing kits become more available, decisions about where to administer the tests must be prioritized, based on communities where exposure and transmission risk are highest, and focused on those within the community who are most susceptible.

Likewise, as cases continue to increase in communities across the US, it is expected that the current health-care system will be pushed to, and possibly beyond, its limits despite aggressive social distancing policies in place to "flatten the curve." As such, identification of sites capable of treating COVID-19 patients, apart from existing hospitals but near enough to available resources and medical personnel, are needed to extend existing health-care infrastructure to meet demand.

Time is of the essence. As communities continue to be impacted socially and economically, much like other catastrophic disasters, the distribution of food, water, and other commodities may be required to meet basic needs. Putting into action the national Point of Distribution (POD) model may be necessary. Optimizing POD locations will also need to be accomplished in a similar way, using a risk-based population assessment.

For a set of step-by-step instructions on how to calculate COVID-19 risk surfaces using spatial statistics in ArcGIS® Pro, please see learngis.maps.arcgis.com/home/item.html?id=b49f4226fd1f4bccb72ab5d308c7da73.



The output of this analysis is a risk surface for each risk type in the form of a map, providing a risk ranking at the block group level. These risk surfaces are then weighted and used to generate overall risk-based population demand estimates to be used as noted in the section "Step 2—Identifying Optimal Locations for Testing, Treatment, and Commodity Distribution."

Step 2 Identifying Optimal Locations for Testing, Treatment, and Commodity Distribution

Location-allocation helps find the best locations for facilities to serve the population based on where demand for the service is expected to be occurring. Decision-makers may be trying to stand up enough sites to cover demand or cover as much of the demand as possible with a limited number of sites. The location-allocation process can be associated with a local network dataset to base site accessibility on road network conditions.

For a set of step-by-step instructions on how to use location-allocation in ArcGIS Pro, please see pro.arcgis.com/en/pro-app/help/analysis/networks/location-allocation-tutorial.htm.

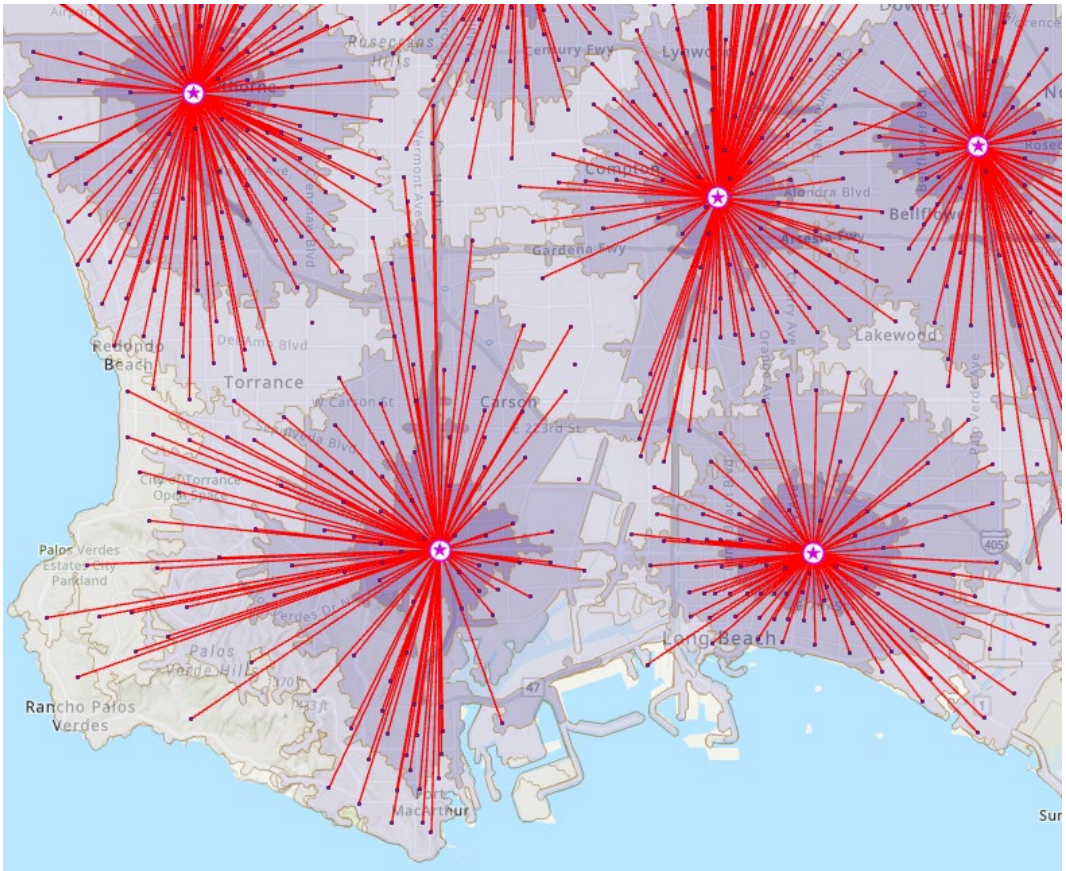
Testing Sites

The goal of establishing testing sites is to reach populations most susceptible to the disease. Demand is modeled as a function of population, weighted by prevalence of those over 65 years of age and with comorbidities.

Inputs to the Facility Location Model are those risk surfaces mentioned above, candidate locations for testing sites, and any supply chain capacity constraints for staffing facilities and administering tests. The FLM can be easily adjusted for variable scenarios and rerun until the desired output is achieved. For example, if supply chain constraints would permit opening only 10 facilities, the FLM could be configured to determine the top 10 optimal sites from the entire population of candidates. If supply chain capacity constraints are not a concern, the FLM could be configured to open facilities to satisfy all calculated demand.

Candidate locations for potential testing sites, based on local availability, should consider the following:

- Convention centers
- Major sporting arenas
- Fairgrounds
- Public buildings
- Large parking lots with secure ingress and egress
- Schools



Treatment Sites

Treatment sites will provide capacity to isolate and treat presumptive and confirmed COVID-19 cases. Treatment sites will serve to extend the existing health-care infrastructure, minimizing cross-exposure into the general health-care system while maximizing access to the preexisting medical personnel resources and equipment in the community. This requires sites capable of housing an inpatient population during convalescence and that are separate from but near existing health-care facility locations, medical personnel, and available medical equipment.

Demand is modeled as a function of the population, weighted by the projected incidence of COVID-19 and transmission risk (social distancing effectiveness) with consideration to account for demographic segmentation where structured, self-isolation at home is more practical.

Characteristics of potential treatment sites are based primarily on the capacity of the site (i.e., occupancy potential). Other factors considered are as follows:

- Weighted travel distance from high-demand block groups
- Different objective-based scenarios (i.e., satisfying all demand versus a capacity-limited, or demand-prioritized, subset).

Candidate locations for potential treatment sites, based on local availability, should consider the following:

- Closed hospitals, assisted living facilities, decommissioned prisons
- Hotels/Motels
- University campuses (dormitories)
- Other locations with large enclosed areas that could be subdivided

Points of Distribution and/or Dispensing

A point of distribution and/or dispensing (POD) is where affected members of the public go to pick up basic commodities, such as food, water, and emergency supplies during and following a disaster. A POD is also a site for dispensing medication and vaccinations. The need for a POD is based on the availability of infrastructure to support normal distribution of medicine or other supplies. Planning is required for PODs; in the event that the COVID-19 response is protracted, communities may be impacted to the point of being unable to fulfill the basic needs of individuals. POD locations are also critical during the COVID-19 recovery process for distribution of the Strategic National Stockpile (SNS) and, when COVID-19 specific antiviral medications and vaccines are available, to effectively distribute to the community at scale. Testing site locations, once established during the response phase, are also potential candidates for consideration as POD sites.

FEMA provides national guidance and training to local emergency management agencies in accordance with the Emergency Management Institute IS-26 Guide to Points of Distribution regarding the role and creation of PODs during response and recovery. More details from FEMA regarding PODS can be found here: https://training.fema.gov/is/courseoverview.aspx?code=IS-26

Many state and local jurisdictions have already identified and currently maintain a list of POD locations as part of their existing Pandemic Influenza and General Catastrophic Disaster Response Plans. Identifying previously planned POD locations for a given

jurisdiction is the first step, followed by using the IS-26 Guide to Points of Distribution, to identify gaps in existing plans.

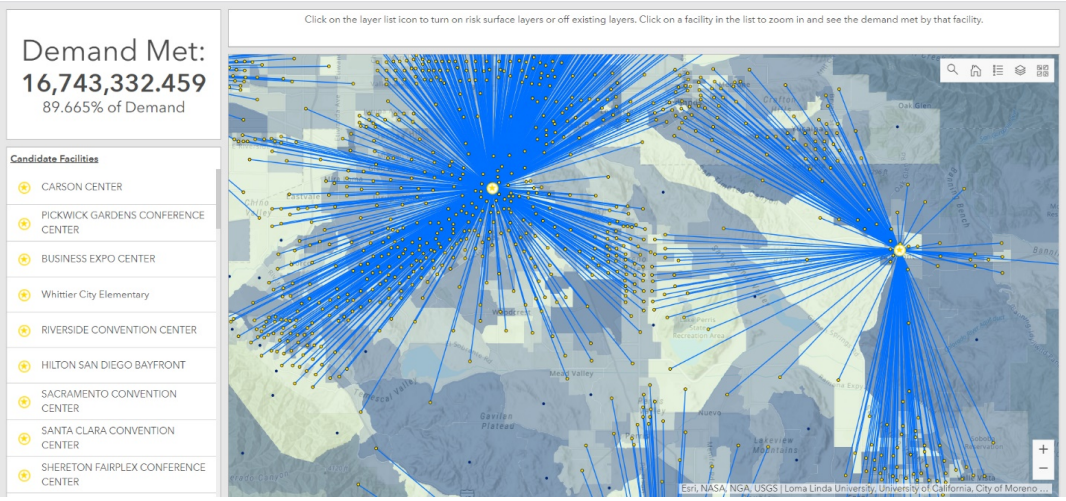
Characteristics of potential POD sites are that they can accommodate vehicle drive-through or pedestrian walk-up with mass transit availability. Some communities require a combination of both vehicle and pedestrian POD locations. An ideal POD site should also consider proximity to the inbound supply chain, for example, accessibility to large delivery trucks with loading dock potential and staging areas. Also beneficial for consideration is proximity to upstream supply chain locations like ports, warehouses, and manufacturing facilities.

Candidate locations for potential POD sites could include the following:

- Convention centers
- Major sporting arenas
- Fairgrounds
- Large parking lots with secure ingress and egress
- Public buildings
- Schools
- Transit centers
- Drive-through restaurants

Sharing the Results for Making Critical Decisions

Results of the analysis can be published to ArcGIS Online or ArcGIS Enterprise. There the data can be consumed in web mapping applications such as ArcGIS Web AppBuilder or ArcGIS Dashboards, allowing decision-makers to easily review and operationalize the information.



Once decisions are made to move forward with the chosen sites, additional map-based applications can then be used to track progress in standing up the sites and monitoring the ability of each site to meet ongoing population needs.

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