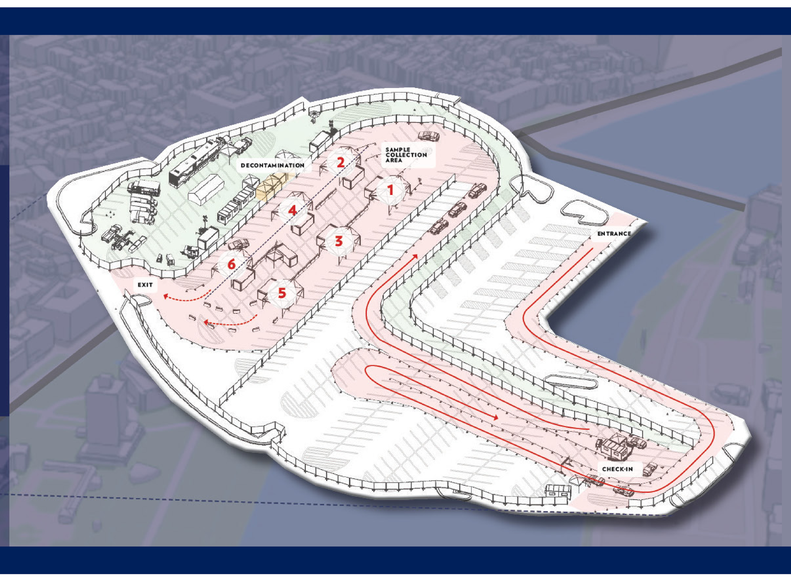
COVID-19 Testing in SC

Public Health | GIS | Architecture



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COVID-19 TESTING: A TOOL TO IDENTIFY AND ASSESS A SUITABLE TESTING LOCATION

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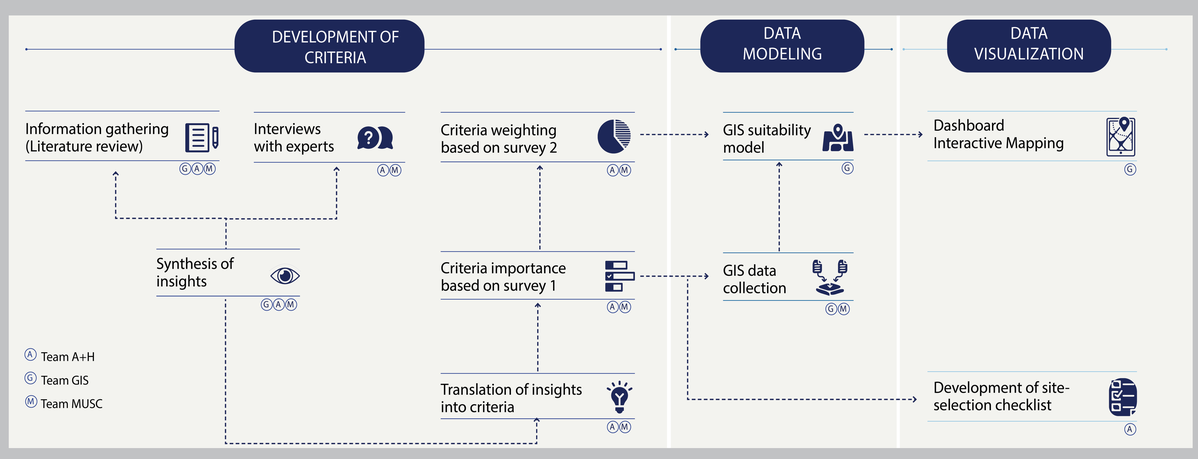
Project Overview

As COVID-19 spreads rapidly in the United States, there has arisen a need to aggressively test individuals who may be suspected of being COVID-19 positive as well as asymptomatic carriers. This collaborative project brings together students of Architecture and GIS from Clemson University and a multidisciplinary cohort from Medical University of South Carolina to **develop tools for identifying areas of highest demand for COVID-19 testing as well as appropriate locations for drive-thru or walk-up COVID-19 testing sites in different areas throughout South Carolina, USA.** This project ran from September 2020-December 2020.

Process

Conducting a review of literature and interviewing experts helped us understand the criteria that were important to consider while identifying locations for setting up COVID-19 testing sites. Surveys were conducted to refine and weight the criteria. The zip code level criteria were used to create a GIS suitability model to identify top priority zip codes for COVID-19 testing sites. The site-level criteria were developed as a checklist to evaluate shortlisted sites for drive-thru or walk-up testing sites within the zip code. The end product is a tool to support site selection decisions in the state of South Carolina.



Summary of Literature and Expert Interviews

More than ever, the pandemic has illustrated our need to appreciate how disease spreads. To gain an understanding, we must collect and process accurate and timely information. As suggested by the WHO, widespread diagnostic testing is critical in mitigating the spread of COVID-19 (Araz et al., 2020). It is important to remember that Emergency Departments (EDs) alone cannot undertake the daunting task of mass testing. To do so would overwhelm the hospital's capacity and potentially jeopardize the staff and patients (Modrzynski, Pastre, & Whitaker, 2020). This is where drive-thru and walk-up testing sites' rapid deployment introduces an effective solution to mass testing of COVID-19 in the United States and globally (Araz et al, 2020).

For more than a year healthcare systems and organizations have been using available resources to understand and administer testing for the public. However, there still seems to be a lack of research and clear, universal guidelines for how to select a testing site, necessary infrastructure to create the site, or site-level needs for operation. **The overall aim of this review is to understand how to implement useful processes from lessons learned and research from the year.** Link to the full report here.

Part 1 of this review focused on the identification and examination of health-related trends and outcomes to influence the location of future COVID-19 testing and, potentially vaccination sites. Based on initial interviews with experts, this work focused on five topic areas: COVID-19 disease trends, types and varieties of COVID-19 tests, population demographics and COVID-19 outcomes, underlying and pre-existing conditions correlated with worsening COVID-19 outcomes, and social determinants of health related to COVID-19. Based on reviews of the literature in these areas, key "macro" criteria were identified for placement of testing sites by zip codes. Initial macro criteria were validated and weighted by subject matter experts.

Part 2 of this review focused on identifying the determinants of site-selection for COVID-19 testing. Recent interviews and the established guidelines demonstrate that amid the changes of available sites over time, many factors remain consistent among organizational decision-makers on where to establish a COVID-19 testing site. Determining staffing requirements and logistical considerations like size and availability of site, traffic management, specimen handling etc. are critical factors to consider.

Methodoloy & Survey Design

Using an online platform (Qualtrics), the zip code level and site-level criteria were evaluated by experts in two phases.

Phase 1. The survey items (site selection criteria) were developed based on experts' input and review of the existing literature. The criteria were categorized as macro-level (e.g., overall demographic, disease related and other regional and national factors) and micro or site-level (e.g. type of facility, traffic flow, access to highway, adjacencies) in this survey. The experts were asked to rank each criterion on a five-point Likert scale with 1 being "Not Important" and 5 being "Extremely important". The experts were also asked to provide qualitative comments in case the criteria needed revisions or clarifications. At the end of the survey, experts also added any criteria that they considered missing from the survey.

Phase 2. Based on the results in the first phase of the survey, the criteria were narrowed down to those that were deemed moderately important or highly important by more than 75% of the experts. In the second phase of the survey, the experts were asked to assign weights on a scale of 0 to 100 to each macro-level criterion (criteria used for determining the zip code with the highest demand for a testing site) relative to the others for the purpose of constructing a GIS model. In addition, experts were asked to classify the selected micro or site-level criteria as most critical to consider (Tier 1), moderately critical (Tier 2) and least critical (Tier 3) while selecting sites for drive-thru and walk-up testing.

Survey Results: Phase 1

Institution	*Percentage*	*Count*
Medical University of South Carolina (MUSC)	44.44%	4
Prisma Health	11.11%	1
Other (e.g., higher education)	44.44%	4
Total	100%	9
Role		
Healthcare Administrator	16.67%	
Researcher	8.33%	
Data Analytics	0.00%	
Public Health Expert	16.67%	
Testing Site Management	16.67%	
Clinician	0.00%	
Other	41.67%	
Total	100%	

Table 1. Role and affiliation of the experts who participated in phase one of the survey

	Categories	Variables	Score
Macro Criteria	COVID-19 related trends	COVID-19 active cases	89%
		Location of existing COVID-19 testing sites	100%
		Public health strategies mandated / not mandated	22%
	Demographic characteristics	Minority population	78%
		Older population	56%
		Social vulnerability index	78%
	Underlying Health characteristics	Conditions leading to increased risk	56%
		Conditions that may be linked to increased risk	44%
	Resource access	No insurance or under-insured	78%
		Medicaid/Medicare status	56%
		Low food access	56%
		No private vehicle availability	100%
		Primary care access/needs	100%
	Regional characteristics	Population density (urban/rural)	67%
	Housing/occupational characteristics	Number of Homeless	44%
		Number of people in Nursing homes and Assisted Care	56%
		Number of people in adult correctional facilities	33%
		Number of people working in meat processing plants	33%
Micro Criteria	Site availability	Existing infrastructure availability	89%
		Churches	67%
		Shopping Centers	44%
		Large indoor spaces (e.g., gymnasiums)	22%
	Site location within community	Distance to hospital/ER or other healthcare facilities	44%
		Central and accessible location within the community	89%
		Pedestrian access (walk up testing)	89%
		Location in relation to other business/traffic flows	89%
		Flexible site to accommodate overflow capacity	100%
	Site overall space requirements	Adequate square footage/lot space (drive through sites)	100%
		Adequate space for traffic lanes and turning radius	100%
		Adequate square footage (walk up sites)	78%
		Adequate space for site setup	100%
		Adequate space for setting up a command center	78%
	Testing set up requirements	Adequate space for overnight storage	44%
		Climate control for clinical staff	78%
		Climate-controlled rest areas	100%
		Site security	78%
		Access to infrastructure	100%
		Access to power & refrigeration	100%

Table 2. Selected items based off 75% cut-off criterion during analysis

Survey Results: Phase 2

Macro-level Criteria Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
COVID-19 active daily cases	0	70	23.9	21.83	476.54	9
Location/distance to existing COVID-19 testing sites	0	20	10.0	5.77	33.33	9
Conditions linked to increased risk (Per CDC)	0	15	7.2	5.83	33.95	9
No insurance or under-insured	0	20	6.7	7.07	50	9
Medicaid/Medicare status	0	10	1.7	3.33	11.11	9
Low food access	0	5	0.8	1.62	2.62	9
No private vehicle availability	0	10	3.3	3.92	15.33	9
Emergency department safety-net utilization	0	10	1.3	3.13	9.78	9
Population density (urban/rural)	0	70	11.7	21.47	461.11	9
Number of Homeless	0	30	4.4	9.26	85.8	9
Number of people in Nursing homes and Assisted Care	0	10	2.1	3.35	11.21	9
Minority population and Language	0	60	13.3	18.26	333.33	9
Socioeconomic status	0	20	6.4	6.75	45.58	9
Household Composition and Disability	0	20	3.0	6.22	38.67	9
Housing Type	0	20	4.1	6.47	41.88	9
Total			100.0			

Table 3. Macro Level criteria and their associated weights incorporated in building the GIS model

Walk-up: Micro-level Criteria	*Points out of 100
Central and accessible location within the community	10
Existing infrastructure availability	9
Climate control for clinical staff	9
Climate controlled rest areas	9
Access to power and registration	9
Duration of site availability (operation hours)	9
Flexible site to accommodate overflow capacity	8
Adequate space for waiting area	8
Site security	8
Access to infrastructure	8
Pedestrian access	6
Adequate square footage for walk-up sites (ability to set modules at least 6 feet away from each other, site set up, command center etc.)	6
Total score	**100**

*The point will be assigned to the considered site if the criterion is met. If the criterion is NOT met, the score should be considered zero.

Table 4. The final micro-level criteria scores for walk-up testing sites

Drive-thru: Micro-level Criteria	*Points out of 100
Adequate Square footage for drive through (traffic lanes, site setup, command center etc.)	10
Existing infrastructure availability	10
Flexible site to accommodate overflow capacity	10
Climate control for clinical staff	9
Climate controlled rest areas	9
Access to power and registration	9
Duration of site availability (operation hours)	9
Central and accessible location within the community	9
Site security	9
Access to infrastructure	9
Location in relation to other business/traffic flows	8
Total score	**100**

*The point will be assigned to the considered site if the criterion is met. If the criterion is NOT met, the score should be considered zero.

Table 5. The final micro-level criteria scores for drive-thru testing sites

Site Selection Tools

These survey results helped inform two tools that help locate areas in need of a testing site, by zip-code, in South Carolina. The tools, GIS Interactive Mapping and the Site-Level Checklist, aim to streamline the site-selection process and allow healthcare systems as well as state/county level organizations to compare multiple site options in an area to determine which meets the criteria best.

GIS Interactive Mapping

Site-Level Checklist

GIS Dashboard Interactive Mapping

With the collaboration of students from Clemson University's GIS class, as well as the multidisciplinary cohort from Medical University of South Carolina, a functioning Interactive Mapping tool was created with a dashboard of updated information related to COVID-19 and the CDC health updates. This dashboard acts as a tool for providers and frontline health employees to help determine high priority testing areas based on the zip-code level criteria shown most critical in the survey results. Link to dashboard here.

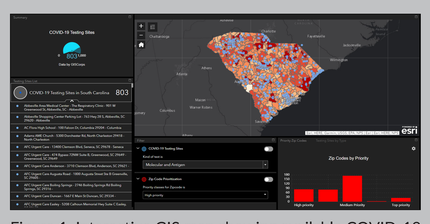


Figure 1. Interactive GIS map showing available COVID-19 testing sites in low-high priority areas in South Carolina.

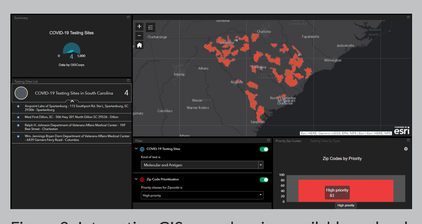


Figure 2. Interactive GIS map showing available molecular and antigen COVID-19 testing sites in high priority areas in South Carolina.

Site-Selection Checklist

Based on the opinions of experts, this checklist tool was generated to provide a structure to compare potential sites in hotspot zip codes. The tool is created to inform healthcare systems as well as state/county level organizations to streamline and improve the process of decision-making while selecting sites for COVID-19 testing. Link to access full checklist and project information here.

What does the tool entail?

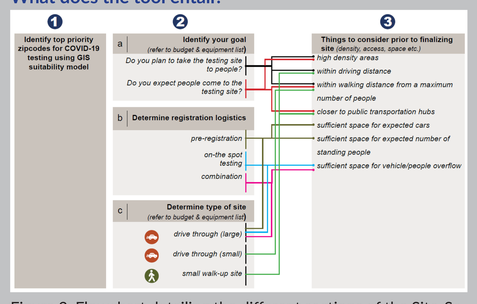
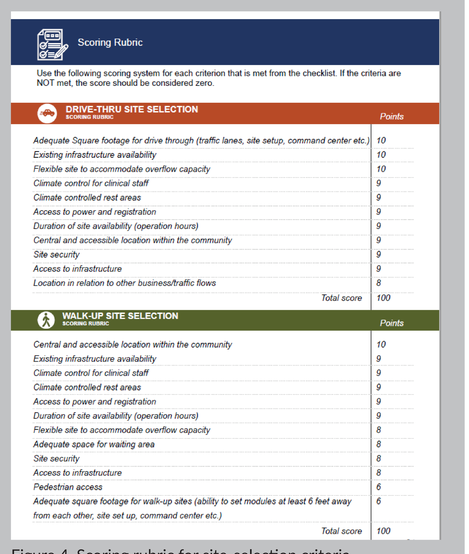


Figure 3. Flowchart detailing the different sections of the Site-Selection Checklist



Scoring Rubric

Use the following scoring system for each criterion that is met from the checklist. If the criteria are NOT met, the score should be considered zero.

DRIVE-THRU SITE SELECTION SCORING RUBRIC	Points
Adequate Square footage for drive through (traffic lanes, site setup, command center etc.)	10
Existing infrastructure availability	10
Flexible site to accommodate overflow capacity	10
Climate control for clinical staff	9
Climate controlled rest areas	9
Access to power and registration	9
Duration of site availability (operation hours)	9
Central and accessible location within the community	9
Site security	9
Access to infrastructure	9
Location in relation to other business/traffic flows	8
Total score	100

WALK-UP SITE SELECTION SCORING RUBRIC	Points
Central and accessible location within the community	10
Existing infrastructure availability	9
Climate control for clinical staff	9
Climate controlled rest areas	9
Access to power and registration	9
Duration of site availability (operation hours)	9
Flexible site to accommodate overflow capacity	8
Adequate space for waiting area	8
Site security	8
Access to infrastructure	8
Pedestrian access	6
Adequate square footage for walk-up sites (ability to set modules at least 6 feet away from each other, site set up, command center etc.)	6
Total score	100

Figure 4. Scoring rubric for site-selection criteria