

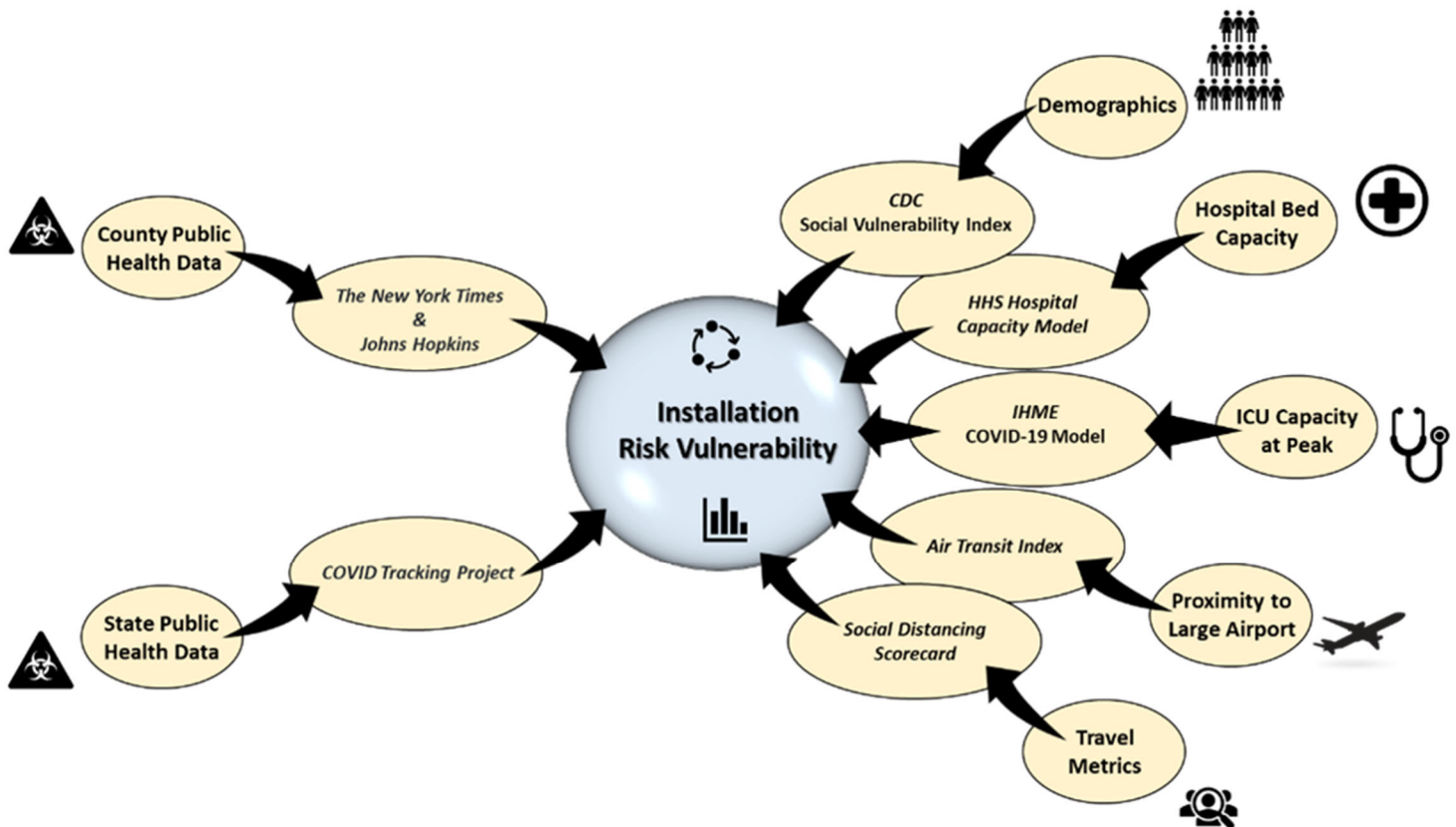


Installation Risk Vulnerability Library (RIVAL)

Executive Summary: RIVAL (Installation Risk Vulnerability Library) is a tool that presents a snapshot of installation COVID-19 vulnerability based on current conditions, disease vectors and human factors. It is intended to provide decision-makers with focused and relevant data by comparing and rank ordering installations by key risk factors.

Data Collection:

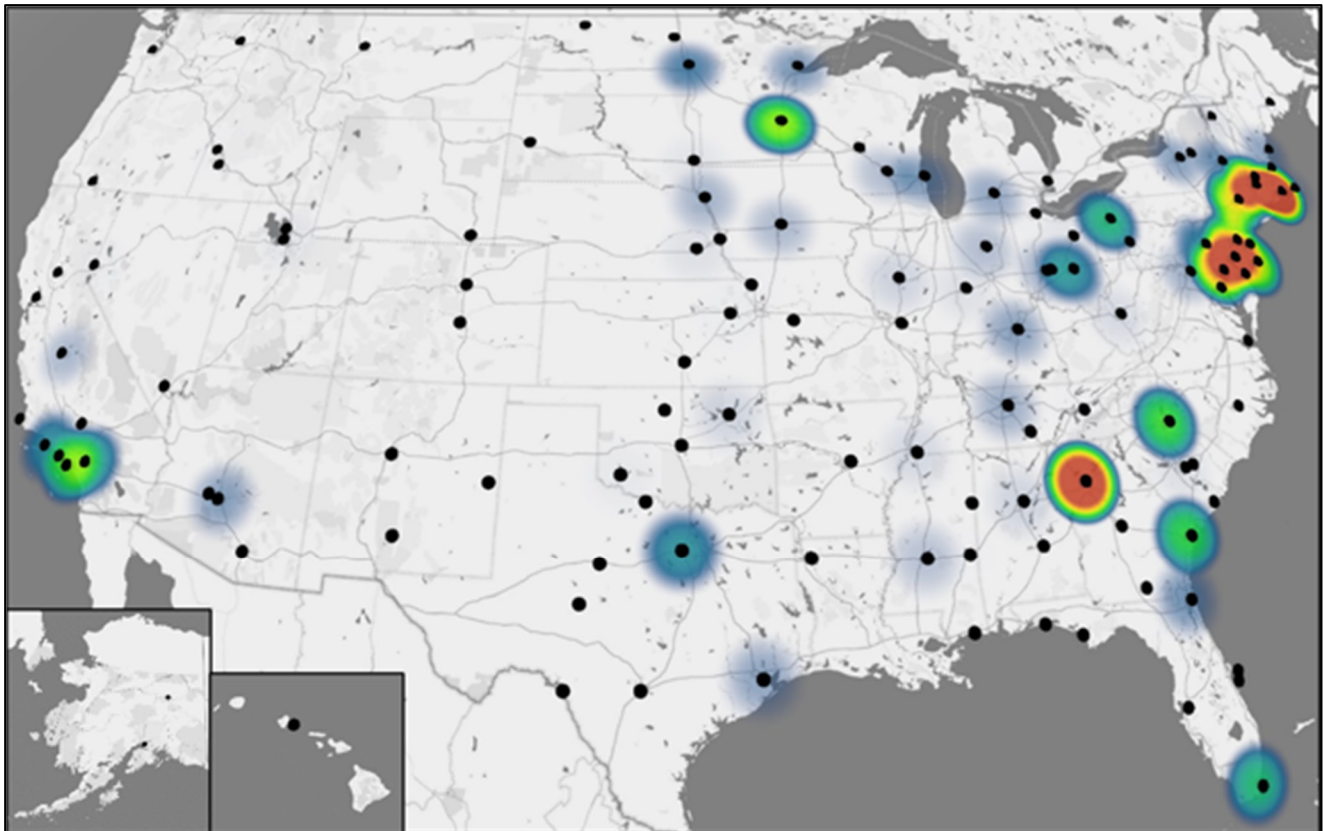
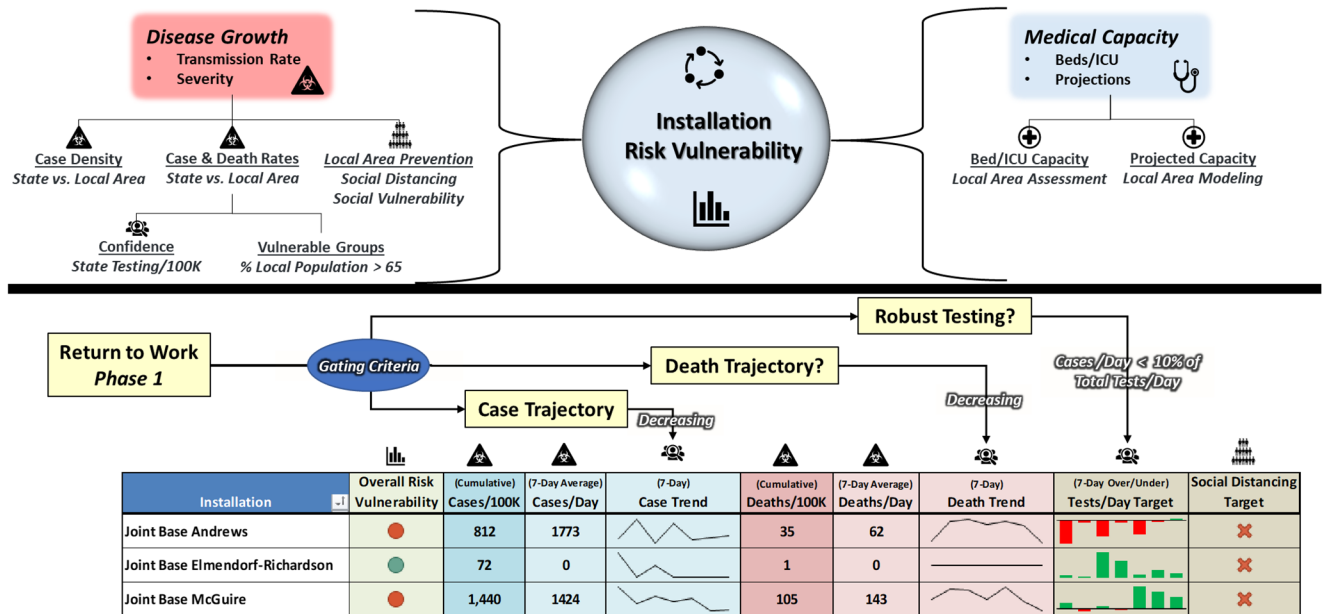
1. Confirmed Cases of COVID-19 (State and County)
2. Confirmed Deaths of COVID-19 (State and County)
3. Total COVID-19 Tests (State)
4. Department of the Air Force installation name, MAJCOM, location, and state
5. US county FIPS codes, location, state, population, land area
6. Hospital HHR / FIPS codes, location, bed/ICU bed availability
7. US Large Airports, state, location, passenger throughput
8. Social Vulnerability Index by County (demographics, emergency preparedness)
9. Social Distancing compliance metrics (state and county)





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APPENDIX A: Output





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APPENDIX B: Data Sources

1. Johns Hopkins University

JHU provides daily updated information every morning for cumulative cases and deaths from the COVID-19 in every county around the U.S.

- https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_time_series/time_series_covid19_confirmed_US.csv
- https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covid_19_time_series/time_series_covid19_deaths_US.csv

2. COVID Tracking Project

The COVID Tracking Project provides daily updated information every morning for cumulative cases and deaths from the COVID-19 in every county around the U.S.

- COVID Tracking Project: <https://covidtracking.com/data/>
- Excel data source: <https://covidtracking.com/api/v1/states/daily.csv>

3. New York Times

The New York Times data is the product of dozens of journalists working across several time zones to monitor news conferences, analyze data releases and seek clarification from public officials on how they categorize cases.

- NY Times COVID-19 Data: <https://github.com/nytimes/covid-19-data>
- Excel data source: <https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv>

4. Harvard Global Health Institute

HGHI, in conjunction with ProPublica, created a new model that builds on bed capacity data for each of 306 U.S. hospital markets to provide localized estimates of available beds, and beds needed to accommodate COVID-19 patients over the coming months.

- <https://globalepidemics.org/our-data/hospital-capacity/>

5. Institute for Health Metrics and Evaluation (IHME)

The IHME fatality and hospitalization projections are recorded for every state, and many countries. Model updates occur typically 2-3 times a week.

- <https://covid19.healthdata.org/projections>

6. Center for Disease Control

The CDC's social vulnerability index (current as of 2016) weights local demographic, emergency response and medical capacity to combat and recover from an infectious disease outbreak.

- CDC's Social Vulnerability Index: <https://svi.cdc.gov/>

7. Unacast

Unacast created this interactive Scoreboard, updated daily, to empower organizations to measure and understand the efficacy of social distancing initiatives at the local level.

- Social Distancing Scorecard: <https://www.unacast.com/covid19/social-distancing-scoreboard>



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APPENDIX C: Analysis and Synthesis

State Inputs	Variable
Cases/100K	D_s
Case Doubling Rate	CD_s
Death Doubling Rate	DD_s
Testing/Million	T_s
7-Day Compounded Case Growth Rate	CGR_s
7-Day Compounded Death Growth Rate	CDR_s
Social Distancing Decrease in Mobility	Cm_s
Social Distancing Decrease in Non-Essential Visits	Cv

Installation+60 Miles Inputs	
Cases/100K	D_{60}
Case Doubling Rate	CD_{60}
Death Doubling Rate	DD_{60}
7-Day Compounded Case Growth Rate	CGR_{60}
7-Day Compounded Death Growth Rate	CDR_{60}
Air Travel Index	Cm_{60}
Hospital Beds Required	Beds
Hospital ICU Beds Required	ICU
ICU Peak Capacity Projection	Peak
% Population >65	P65

Installation (County) Inputs	
Social Distancing Decrease in Mobility	Cm_l
Social Vulnerability Index	SVI

Analysis	Equations
Risk Vulnerability	$RVF = C_f \times G_f$
• Capacity Factor	$C_f = r(\text{Beds}) + s(\text{ICU}) + t(\text{Peak})$
• Growth Factor	$G_f = R_f(NC_r^{P_f})$
○ Prevention Factor	$P_f = x(Cm_l) + y(Cv) + z(SVI)$
○ Number of Cases Factor	$NC_r = \ln_{60l}(D_{60} + (\ln_{60s} * D_s))$
○ Rate Factor	$R_f = \ln_{60l}(R_{60} + (\ln_{60s} * R_s))$
▪ 60 Mile Rate Factor	$R_{60} = (1 - D_f)(Cr_{60}) + (D_f)(Dr_{60})$
• 60 Mile Case Rate	$Cr_{60} = a(CD_{60}) + b(CGR_{60})$
• 60 Mile Death Rate	$Dr_{60} = c(DD_{60}) + d(CDR_{60})$
• Death Factor	$D_f = 1/(T_s * P65)$
▪ State Rate Factor	$R_s = e(CD_s) + f(CGR_s) + D_f(Dr_s)$
• State Case Rate	$Cr_s = e(CD_s) + f(CGR_s)$
• State Death Rate	$Dr_s = g(DD_s) + h(CDR_s)$
• Death Factor	$D_f = 1/(T_s * P65)$
▪ State:60 Mile Insularity Factor	$\ln_{60s} = \log^2(Cm_{60}/Cm_{\text{State}}) - 1$
▪ 60 Mile:Installation Insularity Factor	$\ln_{60l} = \log^2(Cm_l/Cm_{60}) - 1$



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60 Mile Case Rate Weighting		
a	<i>Case Doubling 60 Miles</i>	1
b	<i>Case Growth 60 Miles</i>	2

60 Mile Death Rate Weighting		
c	<i>Death Doubling 60 Miles</i>	1
d	<i>Death Growth 60 Miles</i>	2

State Case Rate Weighting		
e	<i>Case Doubling State</i>	1
f	<i>Case Growth State</i>	1

State Death Rate Weighting		
g	<i>Death Doubling State</i>	1
h	<i>Death Growth State</i>	1

Prevention Weighting		
x	<i>Decrease Mobility</i>	2
y	<i>Decrease Non-Essential Visits</i>	1.5
z	<i>SVI</i>	0.5

Capacity Weighting		
r	<i>Beds</i>	1
s	<i>ICU</i>	1
t	<i>Peak</i>	2



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APPENDIX D: Concept of Operations

This appendix describes how RIVAL is constructed and walks through its internal workflow. RIVAL is a collection of six Excel 365 Workbooks connected to four external data sources. The workbooks make extensive use of Microsoft's new "Array Formulas" found in Office 365 and the "Analysis ToolPak" Excel Add-in is required. The following table breaks down each sheet:

Workbook/Worksheet	Connected Data
RIVAL Master Aggregates 4x Data-Engine workbooks and outputs 2x PDF files <ul style="list-style-type: none">- [Active & Reserve]- [ANG]- [Analysis Table]- [Data Table]	<ul style="list-style-type: none">- Compiles from 4x Data Engine workbooks- Print the first two worksheets to Adobe PDF- Saves as RIVAL-Active.pdf and RIVAL-ANG.pdf in the /output folder- Open GitHub Desktop, Commit to master, push- PDFs are hosted at: https://github.com/JCCriv76/RIVAL/tree/master/Upload
Data Engine-Capacity <i>Calculates 7-Day ICU capacity</i> <ul style="list-style-type: none">- [Hospital Capacity and IHME tabs]	<u>Hospitalization_all_locs.csv</u> <ul style="list-style-type: none">- https://ihmecovid19storage.blob.core.windows.net/latest/ihme-covid19.zip- <u>Download Script</u>: imhe.bat (executed within <i>Update-RIVAL.bat</i>)- <u>Update Script</u>: Auto-Capacity.vbs (executed within <i>Update-RIVAL.bat</i>)
Data Engine-County <i>Aggregates counties within 60 miles of each installation and calculates case/death rates</i> <ul style="list-style-type: none">- [60-Mile, Filtered, Source tabs]	<u>US-Counties.csv</u> <ul style="list-style-type: none">- https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv- <u>Download/Update Script</u>: <i>Update-RIVAL.bat</i>
Data Engine-State <i>Aggregates state data and calculates case/death rates</i> <ul style="list-style-type: none">- [State and Source tabs]	<u>Daily.csv</u> <ul style="list-style-type: none">- https://covidtracking.com/api/v1/states/daily.csv- <u>Download/Update Script</u>: <i>Update-RIVAL.bat</i>
Data Engine-Social Distancing <i>Organizes and standardizes each FIPS grade</i> <ul style="list-style-type: none">- [SDS and Social Distancing Grades]	<u>SDS.csv</u> <ul style="list-style-type: none">- Generated by <i>ParseHub</i>- Scrapes a list of FIPS locations found in Data Engine-Social Distancing-URL.csv- <u>Download Script</u>: <i>Get-Scrape.bat</i>
Dev Tools <ul style="list-style-type: none">- [US Large Airports]- [Radius Generator (FIPS)]- [County Population (FIPS)]	<u>None connected, but derived from USA Data, US Census, and IATA</u>