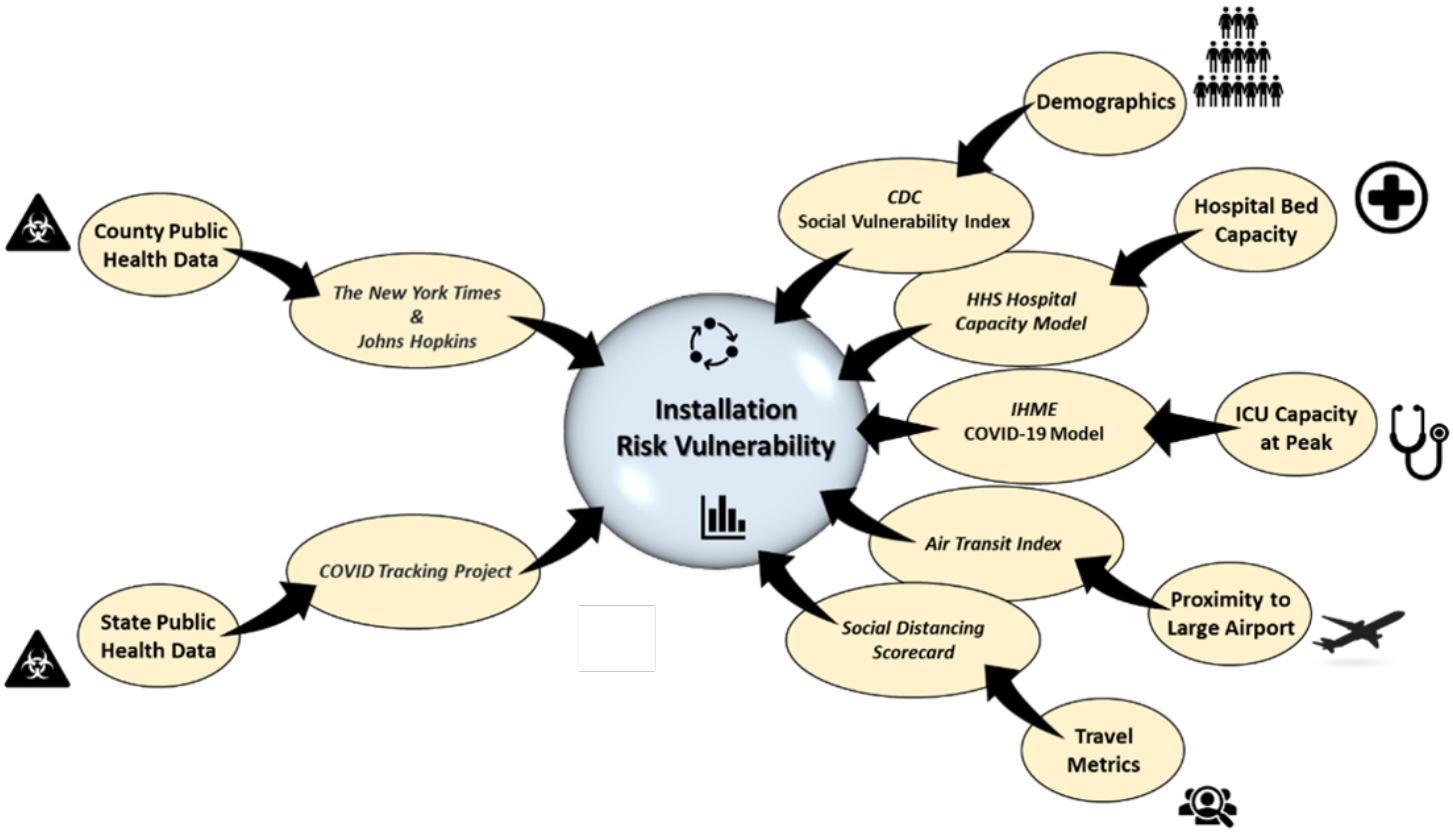
Installation Risk Vulnerability Library (RIVAL)

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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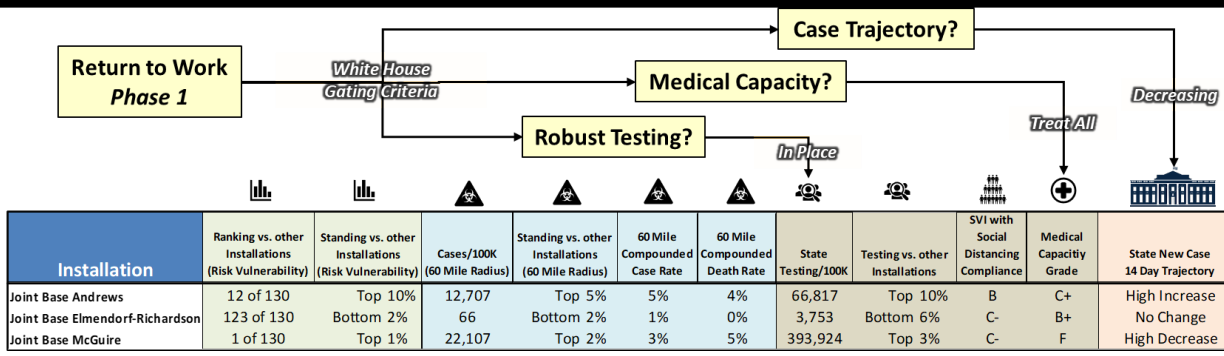
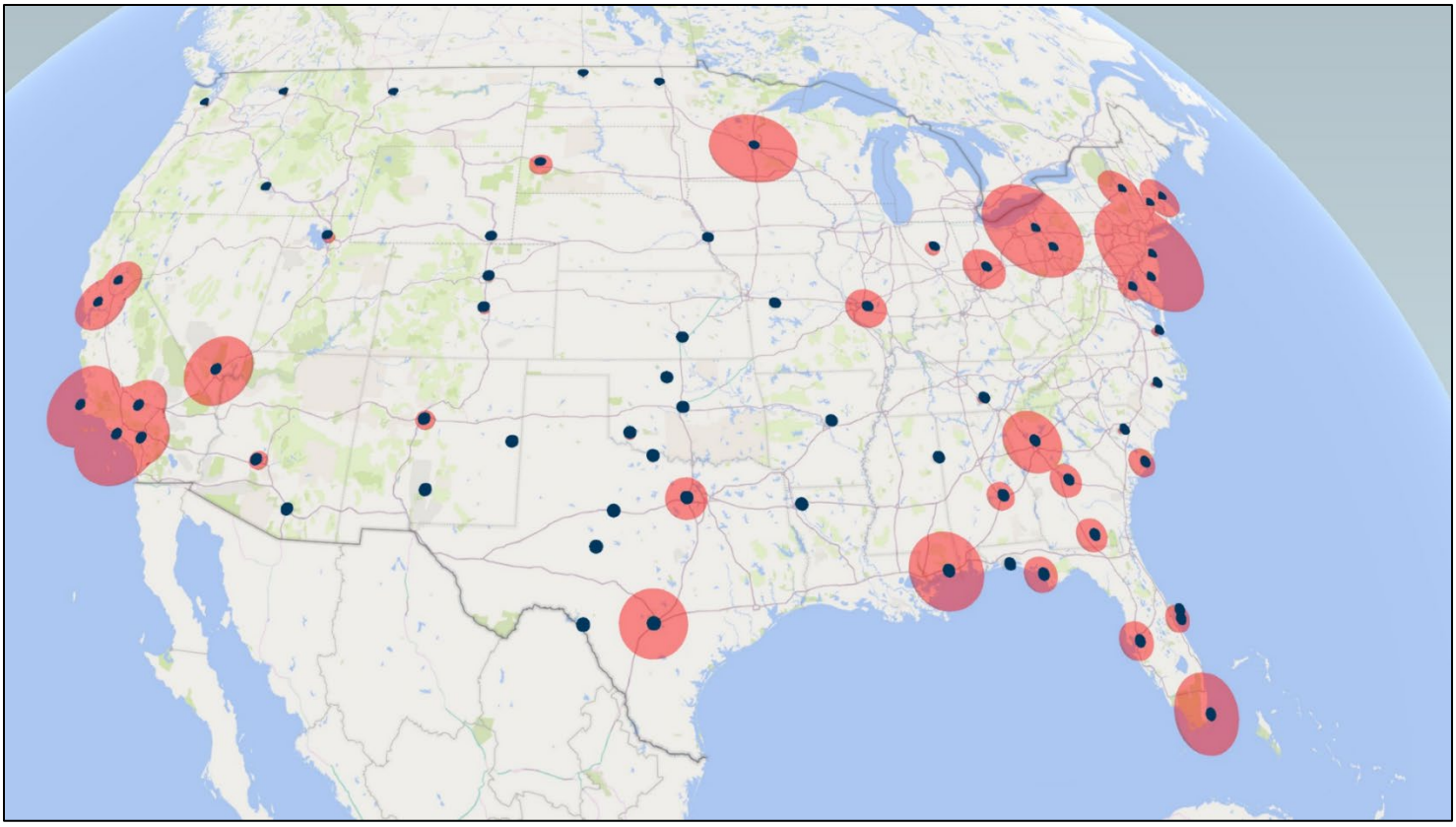
APPENDIX A: Output



Installation	Ranking vs. other Installations (Risk Vulnerability)	Standing vs. other Installations (Risk Vulnerability)	Cases/100K (60 Mile Radius)	Standing vs. other Installations (60 Mile Radius)	60 Mile Compounded Case Rate	60 Mile Compounded Death Rate	State Testing/100K	Testing vs. other Installations	SVI with Social Distancing Compliance	Medical Capacitiy Grade	State New Case 14 Day Trajectory
Joint Base Andrews	12 of 130	Top 10%	12,707	Top 5%	5%	4%	66,817	Top 10%	B	C+	High Increase
Joint Base Elmendorf-Richardson	123 of 130	Bottom 2%	66	Bottom 2%	1%	0%	3,753	Bottom 6%	C-	B+	No Change
Joint Base McGuire	1 of 130	Top 1%	22,107	Top 2%	3%	5%	393,924	Top 3%	C-	F	High Decrease



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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**
   Uncast 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

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_I
Social Vulnerability Index	SVI

Analysis	Equations
Risk Vulnerability	$RVF = C_f \times G_f$
• Capacity Factor	$C_f = r(Beds) + s(ICU) + t(Peak)$
• Growth Factor	$G_f = R_f(NC_f^{Pf})$
○ Prevention Factor	$P_f = x(Cm_I) + y(Cv) + z(SVI)$
○ Number of Cases Factor	$NC_f = In_{60I}(D_{60} + (In_{60S} * D_S))$
○ Rate Factor	$R_f = In_{60I}(R_{60} + (In_{60S} * R_S))$
▪ 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	$In_{60S} = Log^2(Cm_{60}/Cm_{State}) - 1$
▪ 60 Mile:Installation Insularity Factor	$In_{60I} = Log^2(Cm_I/Cm_{60})-1$

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60 Mile Case Rate Weighting		
a	*Case Doubling 60 Miles*	**1**
b	*Case Growth 60 Miles*	**2**

60 Mile Death Rate Weighting		
c	*Death Doubling 60 Miles*	**1**
d	*Death Growth 60 Miles*	**2**

State Case Rate Weighting		
e	*Case Doubling State*	**1**
f	*Case Growth State*	**1**

State Death Rate Weighting		
g	*Death Doubling State*	**1**
h	*Death Growth State*	**1**

Prevention Weighting		
x	*Decrease Mobility*	**2**
y	Decrease Non-*Essential* Visits	**1.5**
z	*SVI*	**0.5**

Capacity Weighting		
r	*Beds*	**1**
s	*ICU*	**1**
t	*Peak*	**2**

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