Community Disaster Resilience Tool (CDRT) Methodology
Methodology and development details for CDRT

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Introduction

The Community Disaster Resilience Tool (CDRT) is an online, publicly accessible map-based tool developed by Healthcare Ready that helps local and regional officials, leaders of community-based organizations [CBOs], and emergency management systems better understand the nuanced risks their communities face due to overlapping vulnerabilities, healthcare infrastructures, and exposure to hazards in the United States. Healthcare Ready's intent in providing this information is to empower state and local officials, along with emergency managers and community leaders, with salient data to aid them in helping residents prepare for, respond to, and recover from the impact of natural disasters and pandemics to safeguard public health.

Dataset Identification and Selection

Each of the primary factors (hazard exposure, healthcare infrastructure, and existing vulnerabilities) addressed by the CDRT were selected due to their potential impact on a community's resilience in a disaster scenario. Furthermore, data for these factors were gathered at the county level to best pinpoint vulnerabilities, health risks, and existing gaps in preparedness in the face of future crises. Healthcare Ready obtained data from the following sources:

- National Interagency Fire Center's Fire Potential Outlook (2020)
- The Federal Emergency management Agency's (FEMA) National Flood Hazard Layer data (2020)
- National Oceanic and Atmospheric Association's Storm Surge Hazard maps (2020)
- US Geological Survey's Earthquake Hazard maps (2020)

- American Community Survey (ACS) 5-year estimate census (2019)
- Center for Disease Control (CDC) datasets on Vaccinations and active COVID case counts from the within Google BigQuery (2021)
- FEMA's Disaster Declaration Summaries (2020)
- Centers for Medicaid & Medicare Services' (CMS) data on Chronic Conditions   experienced by CMS recipients (2018)

Calculation Processes and Platforms

The CDRT's data storage and calculations are housed in [Google BigQuery](), a fully-managed, server-less data warehouse that enables scalable analysis over petabytes of data and is accessible through any web browser. BigQuery allows for the querying and organization of all the above datasets, as well as the manipulation into a format conducive for visualization. BigQuery is able to access multiple data inputs – some larger than could be stored safely on a single computer – safely and quickly, allowing for mass data matching and transfers. By housing CDRT data in BigQuery, Healthcare Ready can quickly append new datasets into our analysis and partially automate updates, which improves the long-term sustainability of the tool. Calculations for the CDRT are performed exclusively within BigQuery.

With the goal of the CDRT to communicate the cross-section of population health needs with potential disaster scenarios, we initially selected the above datasets as they provided the necessary data on population and disaster at the county level. We then utilized Google BigQuery to process the multiple data sources into a single database, sorted by county.

As we began to build out the tool, we asked for the opinions from a pre-selected "Council of Experts," former community and state emergency management officials, to get their input on how we can succeed in ensuring our tool is an asset to the field. Once this feedback was received and digested, we began drafting the tool, using an iterative review process to arrive at the final version.

Data Descriptions and Calculations

The separate worksheets or "tabs" of the CDRT are split into four major categories: *Natural Hazards*, *Socioeconomic Data, Chronic Conditions,* and *Healthcare Infrastructure.* Each of the data points contained within these tabs is laid out in detail below. Parentheses indicate that a calculation has occurred to create the preceding variable in the tool.

Chronic Conditions

To measure and communicate vulnerability specific to each county, we utilized the chronic condition prevalence of [21 conditions defined by CMS](). We calculated the ratio of county prevalence per chronic condition to national prevalence per chronic condition for use in the CDRT to show where those conditions are most prevalent across the country. This ratio is vital to connecting health vulnerability to hazard potential, as the raw data on chronic conditions would not be communicative of the actual prevalence within a specific county. Therefore, the ratio of chronic condition prevalence per county to the national chronic condition prevalence is the most useful statistic for county comparison, as well as for communication of the high chronic condition prevalence.

Additionally, we selected "thresholds" for Wildfire, Flood, and Seismic Hazards to assist in populating the text box on the right-hand side of the visualization. Should this threshold per natural hazard be

reached, then the text box on the right side of the visualization will be populated with information relating to intersectionality between "Chronic Conditions" and "Natural Hazards." For example, a wildfire threshold of X% can be understood as the following: "If more than X% of the area of the county is at a high or medium potential for wildfires, then the "Chronic Condition" text box will populate with information regarding the chronic conditions prevalent within the county which may be exacerbated by wildfire hazard."

Variables

- State
- County Name and Federal Information Processing Standard (FIPS) Code
- County Alcohol Disorder Prevalence Ratio
  - ((County Alcohol Disorder Prevalence Rate) / (National Alcohol Disorder Prevalence Rate))
- County Alzheimer's Prevalence Ratio
  - ((County Alzheimer's Prevalence Rate) / (National Alzheimer's Prevalence Rate))
- County Arthritis Prevalence Ratio
  - ((County Arthritis Prevalence Rate) / (National Arthritis Prevalence Rate))
- County Asthma Prevalence Ratio
  - ((County Asthma Prevalence Rate) / (National Asthma Prevalence Rate))
- County Autism Prevalence Ratio
  - ((County Autism Prevalence Rate) / (National Autism Prevalence Rate))
- County Cancer Prevalence Ratio
  - ((County Cancer Prevalence Rate) / (National Cancer Prevalence Rate))
- County COPD Prevalence Ratio
  - ((County COPD Prevalence Rate) / (National COPD Prevalence Rate))
- County Depression Prevalence Ratio
  - ((County Depression Prevalence Rate) / (National Depression Prevalence Rate))
- County Diabetes Prevalence Ratio
  - ((County Diabetes Prevalence Rate) / (National Diabetes Prevalence Rate))
- County Drug Abuse Prevalence Ratio
  - ((County Drug Abuse Prevalence Rate) / (National Drug Abuse Prevalence Rate))
- County Heart Failure Prevalence Ratio
  - ((County Heart Failure Prevalence Rate) / (National Heart Failure Prevalence Rate))
- County Hepatitis (B/C) Prevalence Ratio
  - ((County Hepatitis (B/C) Prevalence Rate) / (National Hepatitis (B/C) Prevalence Rate))
- County HIV / AIDS Prevalence Ratio
  - ((County HIV / AIDS Prevalence Rate) / (National HIV / AIDS Prevalence Rate))
- County Hyperlipidemia Prevalence Ratio
  - ((County Hyperlipidemia Prevalence Rate) / (National Hyperlipidemia Prevalence Rate))
- County Hypertension Prevalence Ratio
  - ((County Hypertension Prevalence Rate) / (National Hypertension Prevalence Rate))
- County Ischemic Heart Disease Prevalence Ratio
  - ((County Ischemic Heart Disease Prevalence Rate) / (National Ischemic Heart Disease Prevalence Rate))

- County Kidney Disease Prevalence Ratio
  - ((County Kidney Disease Prevalence Rate) / (National Kidney Disease Prevalence Rate))
- County Osteoporosis Prevalence Ratio
  - ((County Osteoporosis Prevalence Rate) / (National Osteoporosis Prevalence Rate))
- County Schizophrenia Prevalence Ratio
  - ((County Schizophrenia Prevalence Rate) / (National Schizophrenia Prevalence Rate))
- County Stroke Prevalence Ratio
  - ((County Stroke Prevalence Rate) / (National Stroke Prevalence Rate))

Healthcare Infrastructure

The CDRT communicates information on healthcare infrastructure, specifically information on hospitals, pharmacies, federally qualified health centers (FQHCs), dialysis centers, and the average Health Professional Shortage Area (HPSA) score across the county (when applicable). The number of hospitals was sourced from the American Hospital Association, pharmacy and dialysis center information was taken from Healthcare Ready's Rx Open tool, and we referenced the CDC for the number of active COVID cases and vaccination rates per county.

The "Health Professional Shortage Area" is a measurement performed by the Health Resources & Services Administration to highlight where existing healthcare infrastructure is present but understaffed. This measurement designates the ratio of healthcare staff needed to operate at maximum capacity, which can inform emergency management personnel if additional aid can be supplied simply with workers. Finally, the locations of pharmacies, dialysis centers, and hospitals have been included so they could be mapped for the user to explore and find the locations of these healthcare facilities.

Variables
- State
- County Name and FIPS Code
- Active COVID cases per county
- Total Hospitals per county
- Individual Hospital Latitude
- Individual Hospital Longitude
- Hospitals per capita per county
  - (Total Hospitals / Total Population)
- Total Pharmacies per county
- Pharmacies per capita
  - (Total Pharmacies / Total Population)
- Individual Pharmacy Address
- Total Dialysis Centers per county
- Dialysis Centers per capita
  - (Total Dialysis Centers / Total Population)
- Individual Dialysis Center Address
- Total Federally Qualified Health Centers per county
- Federally Qualified Health Centers per capita

- o (Total FQHCs / Total population)
- County Average HPSA Score
- County Average HPSA Shortage

Socioeconomic Data – Population Information

This is where you will find population demographics (e.g., age, employment status, and number of residents living under the federal poverty level) for each county as well as data on FEMA Disaster Declarations issued within the last 10 years. It should be noted that the American Community Survey considers those identifying as Hispanic to be separate from race demographics. Finally, the five and 10-year Disaster Declaration Count (DDC) per county is a quick reference for users to see which counties are more likely to undergo a disaster scenario based on data points from the last 10 years. The ratio of Disaster Declaration counts (five-year DDC/10-year DDC) shows whether the rate of these disaster scenarios is increasing, staying similar across the past two partitions of five years, or whether they are diminishing in number.

Variables

- State
- County Name and FIPS Code
- Total Population per county
- Total Population identifying as American Indian
- Total Population Percent identifying as American Indian per county
  - o (American Indian Population per county / Total population per county)
- Total Population identifying as Black
- Total Population Percent identifying as Black per county
  - o (Black Population per county / Total population per county)
- Total Population identifying as Pacific Islander per county
- Total Population Percent identifying as Pacific Islander per county
  - o (Pacific Islander Population per county / Total population per county)
- Total Population identifying as Two or more Races per county
- Total Population Percent identifying as Two or more Races per county
  - o (Two or more Races Population per county / Total population per county)
- Total Population identifying as White per county
- Total Population Percent identifying as White per county
  - o (White Population per county / Total population per county)
- Total Population identifying as Hispanic per county
- Total Population Percent identifying as Hispanic per county
  - o (Hispanic Population per county / Total population per county)
- Total Population aged 18 years or less per county
- Total Population Percent aged 18 years or less per county
  - o (Population aged 18 years or less per county / Total population per county)
- Total Population aged 65 years or more per county
- Total Population Percent aged 65 years or more per county
  - o (Population aged 65 years or more per county / Total population per county)
- Total Population living in poverty per county

- Total Population Percent living in poverty per county
  - (Population living in poverty / Total population per county)
- Percent of the Population Unemployed per county
  - (Unemployed Population per county / Total population per county)
- Number of FEMA Disaster Declarations over the past five years
- Number of FEMA Disaster Declarations over the past 10 years
- FEMA Disaster Declarations Ratio
  - (5-year DDC / 10-year DDC)
- Per county, most recent FEMA Disaster Declaration Date
- Per county, most recent FEMA Disaster Declaration Category

Natural Hazards

Natural hazards expressed in the CDRT include fire hazard potential, flood potential, and storm surge, as well as both short-term and long-term seismicity. This data, taken from the variety of sources listed above, is more granular than a county specific statistic. As such, these variables were calculated as "the percentage of the county under high risk per natural hazard." This method allows a more uniform statistic to be applied evenly across counties, while still communicating the general risk each county faces.

Variables
- Wildfire
  - State
  - County Name and FIPS Code
  - Legend – Sum of Wildfire High Potential and Wildfire Medium Potential – Percent of County
  - Total Population per county
  - Sum of Wildfire Not Applicable (N/A)potential (No potential) – Percent of County
  - Sum of Wildfire Low Potential – Percent of County
  - Sum of Wildfire Medium Potential – Percent of County
  - Sum of Wildfire High Potential – Percent of County
- Flood Potential
  - State
  - County Name and FIPS Code
  - Legend - Sum of High Flood Potential – Percent of County
  - Sum of Storm Surge Potential – Percent of County
  - Sum of Low & Medium Flood Potential – Percent of County
  - Total Population per County
- Seismic Activity Potential
  - State
  - County Name and FIPS Code
  - Sum of High Potential for Long Term Seismic Activity – Percent of County
  - Sum of Medium Potential for Long Term Seismic Activity – Percent of County
  - Sum of Low Potential for Long Term Seismic Activity – Percent of County
  - Sum of High Potential for Short Term Seismic Activity – Percent of County
  - Sum of Medium Potential for Short Term Seismic Activity – Percent of County

- o Sum of Low Potential for Short Term Seismic Activity – Percent of County
- o Total Population per County

Conclusion

The Community Disaster Resilience Tool (CDRT) is a map-based interactive tool created by Healthcare Ready to help state and local officials as well as emergency management and community leaders better understand the nuanced risks their residents face due to overlapping vulnerabilities, healthcare infrastructure, and exposure to hazards. By highlighting the intersectionality of these statistics, this tool provides a picture of how public health issues can be exacerbated by natural disasters and which counties are most at risk.

Healthcare Ready believes the true value of the CDRT is the ability to combine predominant risk factors to specify our messaging per county. We have created a tool that can easily cross-reference counties with high chronic condition prevalence ratios with our county hazard prevalence data. Our goal is to provide insight into what hazardous events are most likely to occur per county, as well as which patient populations will need assistance during a crisis. By narrowing down patient populations in this way, Healthcare Ready strives to better assist state and local officials as well as emergency management and community leaders prepare for the next disaster and safeguard public health.

Acknowledgements

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