

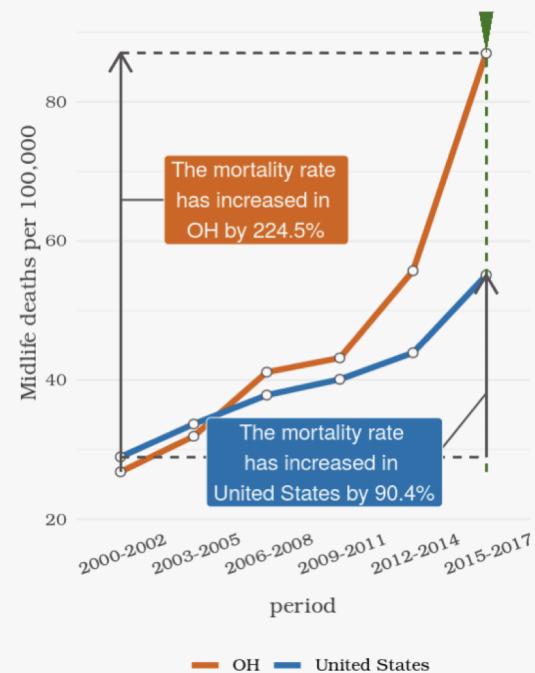
MORTALITYMINDER

MortalityMinder.idea.rpi.edu

Open source web application enabling healthcare researchers, providers, payers, and policy makers to gain actionable insights into how and why mortality rates are rising in the United States (US)

- Explores mortality trends for midlife adults ages 25-64 across the United States from 2000 to 2017.
- Identifies social and economic factors associated with increased mortality trends at the county-level for US and individual states.
- Visualizations demonstrate determinants and their impact on mortality trends.

Midlife Mortality Rates for Deaths of Despair in Ohio vs. United States



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National View reveals national and state mortality trends through time

User selects Cause of Death and State or United States.

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Which county-level social and economic factors increase mortality in the United States?

MortalityMinder analyzes trends of premature death in the United States which are caused by:

- Deaths of Despair
- Cardiovascular Disease
- Cancer
- All Causes

MortalityMinder is a four-view interactive presentation that examines county-level factors associated with midlife mortality trends.

Pick state (or United States) and cause of death on the menu bar at the top of the page to see how mortality rates in the United States have changed from 2000 to 2017.

Data for age-specific mortalities are from CDC WONDER.

Nationwide View: All Cause Rates Over Time

2000-02 2003-05 2006-08 2009-11 2012-14 2015-17

Nationwide All Cause Rates for 2009-2011

Mortality Rate: Deaths per 100,000 for midlife due to all causes. Darker colors indicate higher rates. ⓘ

Data Source: CDC WONDER Analysis: The Rensselaer Institute for Data Exploration and Analysis (IDEA)

64 due to All Cause for three year periods for counties (left) and state and nation (right). Darker colors indicate higher rates. ⓘ

United States.

Cause of Death: All Cause State: Ohio

Nationwide All Cause Rates for 2009-2011

Midlife Mortality Rates for All Cause in Ohio vs. United States

Midlife deaths per 100,000

period

OH United States

The mortality rate has increased in OH by 28.9%

The mortality rate has increased in United States by 8.2%

»

Rate Graph reveals change in state and national midlife mortality rates from 2000-2017.

»

Users can get more details at the state and factor levels by clicking << or >>.

US map of county-level midlife mortalities exhibits regional differences in mortality.

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Data Sources and Preparation

Mortality Rate Data from Wonder.CDC.org from 2000-2017

- Selected crude midlife detailed mortality rates of adult ages 25-64 because it demonstrate actual premature mortalities rates experienced by Americans.
- Calculated mortality rates in three year chunks from CDC Wonder Detail to reveal trends and avoid data suppression. Suppressed data is imputed for visualizations.
- Used national, state and county rates for major causes: *All Cause, Cancer Deaths, Cardiovascular Deaths, Cancer Deaths, Deaths of Despair (suicide and self harm)*.

Open source MortalityMinder easily expands to other age-adjusted, age-specific, and group-specific mortality rates, other death causes, and other features.

County-level Social and Economic Factors From CountyHealthRankings.org

- Gathered factors from over 20 primary sources gathered from CountyHealthRankings.org, maintained by Robert Woods Johnson Foundation.
- Started with 150 Factors addressing health behaviors, clinical care, education, employment, social supports, community safety and physical environments.
- Curated factors and limited to those correlating with at least one cause of death at national level.
- Descriptions linked to primary sources.

State View: Summarizes within state mortality disparities

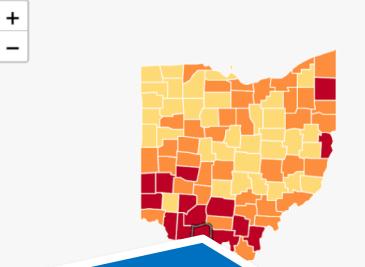
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County Risk Clusters are found by K-Means clustering algorithm and shown in map to reveal regional disparities. Means provide cluster summaries.



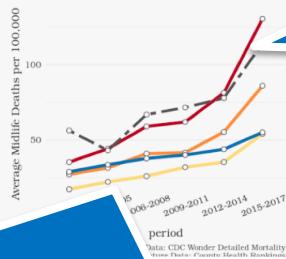
Deaths of Despair Risk Clusters for Ohio

Geographic distribution of risk clusters for Ohio. Darker clusters indicate higher mortality risk.



Deaths of Despair Trends for Ohio

The average midlife death trends for each cluster; the national average is shown in blue. Click on any map to see the trend for a specific county.



User selects specific county to show its data on Trend Graph.

Cause of Death: Deaths of Despair State: Ohio

Factors Associated with Deaths of Despair for Ohio

User selects time period shown in the Mortality Rate Map.



Trend Graph highlights regional disparities through time by showing population-weighted mean rates for each risk group. National average through time is shown in blue.

For effective visualization, suppressed mortality rates are imputed. Analysis uses only actual data.

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State View: Shows Factors Associated with Mortality



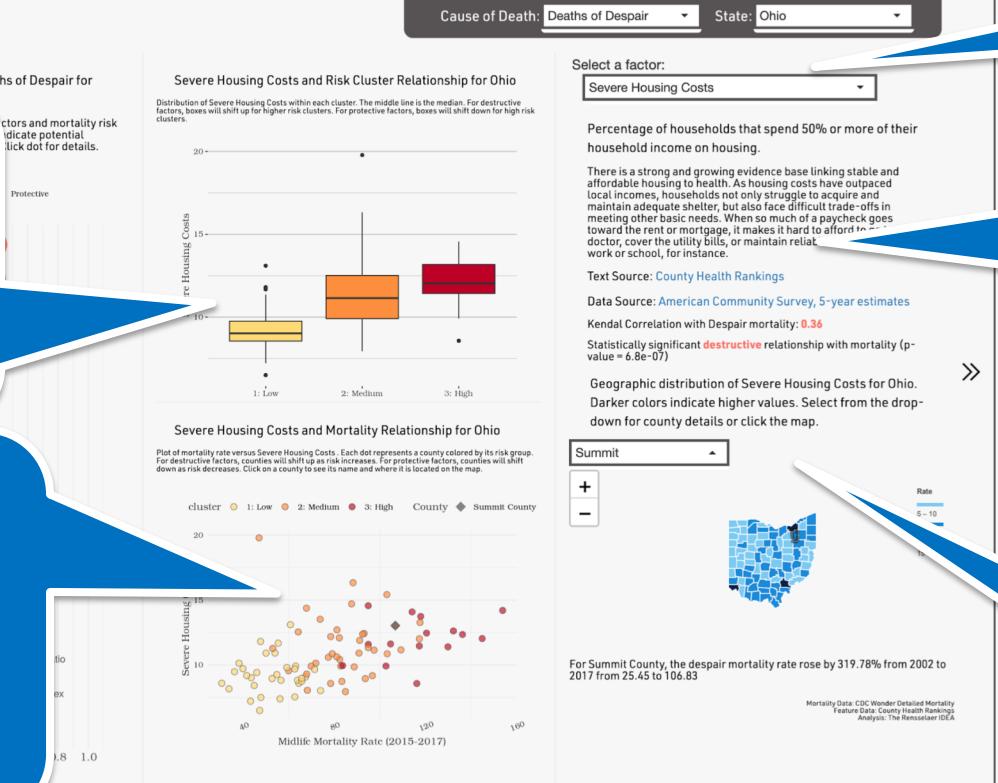
Hover on dot to see factor definition.
Click on dot to see details in **Factor View**.

- Performs association study by ordering counties **Risk Clusters** by 2015-2017 mortality rate, and computes Kendall Tau Correlation between **Factors and Risk Clusters**.
- Reports top 15 significant ($p\text{-value} < .05$) associated factors.
- Alternative analysis methods easily added to open source architecture.

Factor View: Examines potential determinants

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Box plots show distribution within each cluster of the selected Factor.



Implementation as Public Open Source Project

- Best-practice code and full documentation available on Github
 - Implemented in open source R language and environment for statistical computing and graphics using standard packages.
 - Can evolve to address feedback.
- Highly Interactive Design
 - Combines R's Shiny platform with popular Javascript frameworks to provide a modern, highly interactive user experience.
 - Phase 2 design based on Formal Usability Study (20+ users) and recommendations of advisory board of healthcare and design professionals.
- Easily Customized, Reusable, and Maintainable Framework
 - App can evolve to include new data streams, analyses, visualization, and health care problems.
- Readily ingests reliable high-quality surveillance data from wonder.cdc.org and over 20 sources via CountyHealthRankings.org

The screenshot shows the GitHub repository page for 'TheRensselaerIDEA / MORTALITYMINDER'. The page includes a header with repository details, a main content area with sections like 'Home', 'MORTALITYMINDER', 'DATA UTILIZATION AND PREPARATION', 'INNOVATION', and 'Developer Guide', and a sidebar with navigation links and developer tools.

Home
John S. Erickson, PhD edited this page 3 minutes ago · 19 revisions

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Mortality rates are rising in the United States with significant community and regional variations. MortalityMinder (MM) is a web-based visualization tool that enables interactive exploration of social, economic, and environmental factors associated with mortality rates. MortalityMinder version 2.0 is a freely available, publicly-accessible, open source, easily maintained tool designed to help healthcare providers, public health agencies, and other stakeholders better understand and address unmet healthcare needs, healthcare costs, and healthcare utilization.

- <http://mortalminder.risesbyapps.com/mortalminder/> (primary site)
- <https://github.com/TheRensselaerIDEA/MORTALITYMINDER/> (backup site)

DATA UTILIZATION AND PREPARATION

MortalityMinder uses county-level mortality rates and related socioeconomic factors measurements available from the CDC WONDER portal. Mortality rates from 2000-2017 are obtained through the CDC WONDER portal, the definitive source of mortality information in the United States. Social factors data for 2015-2017 are obtained through County Health Rankings (CHR), an aggregate of county-level data from more than 3,000 local governments across the United States. There are twenty (20) sources, including datasets such as [AHDR](#), [BRFSS](#), the [Labor Statistics](#), the [FBI](#), and many others. This version of MM focuses on multiple deaths attributed to leading causes of death, including heart disease, stroke, cancer, and all causes, but the approach can be readily generalized to any health problem of interest.

Not all 168 factors obtained from various sources were used in determining which factors are associated with mortality. Less-relevant factors were filtered out, first using the Benjamini-Hochberg Multiple Comparison procedure to identify the most significant factors using permutation methods, with only the most relevant factors (approx 70) ultimately being used in the analysis.

Age-specific mortality rates were calculated in three-year chunks to allow more robust estimation by considering multiple years. MM aims to capture the actual experience of mortality in America in a comprehensive manner. The user can explore the data at the national level, down to the county level, and even to the individual level. The user can also filter the data by cause of death, race, gender, and ethnicity. MM provides a visual representation of the data, allowing the user to quickly identify trends and patterns. The data is presented in a user-friendly interface, making it easy for anyone to understand and interpret the results. The app is built using the Shiny framework, which allows for a highly interactive and responsive user experience. The data is sourced from various government agencies and organizations, ensuring its accuracy and reliability. The app is designed to be accessible to a wide range of users, from healthcare professionals to the general public. It provides a valuable tool for understanding and addressing health disparities in the United States.

INNOVATION

MortalityMinder enables users to dynamically investigate county and regional variations across mortality trends at the national, state, and local levels and the social determinants and other factors associated with these trends. MM prioritizes and visualizes the most significant factors associated with higher risks for each cause of death and allows the user to explore individual factors include its relative risk, predicted cause of death at a county level for each state, and the distribution of those factors within each state.

With MM the user can visually explore the growth of mortality rates in the United States using county level three-year averages (2000-2002), providing both national and state levels. For each cause of death, the user can select a specific state or county to view the corresponding mortality trends. The app also identifies mortality clusters, visualizes the geographic distribution of those clusters, and illustrates the mortality trends of those clusters and user-selected counties over time. MM does a similar analysis

Developer Guide

- Data Utilization and Preparation
- Analysis
- Deployment
- Open-Source Architecture

Applications

- Data
- Installation
- Upgrading the App
- Source control

Code this wiki locally

<https://github.com/TheRensselaerIDEA/MORTALITYMINDER>



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Insights

- MortalityMinder documents the disturbing rise in midlife Deaths of Despair due to suicide, overdose, and self-harm and other national/regional increases in midlife mortality rates due to All Causes, Cancer, and Cardiovascular Disease.
- Highlights potential social determinants through statistical analysis of factors associated with disparities in regional trends in mortality rates.
 - Provides county-level confirmation of trends and hypothesized causes.
 - Insights can be used to create region-specific interventions and best practices.
- Confirms the midlife mortality rate increases in recent literature (e.g. Wolf and Schoomaker, JAMA 2019) but provides much greater insight into community-level variations and their associated factors to help determine remedies.
- Enables rigorous analysis of potential determinants of health by local, state, and national healthcare organizations to support development of programs, policies, and procedures to find and address unmet health care needs to improve longevity.



Tool Benefits

- Repeatability and Scalability:
 - Analytical and visualization results are fully repeatable and reproducible, by cloning the GitHub code repository or by directly downloading results via the app.
 - Users can get analyses at the National, State, and County levels.
 - The app will scale based on the hosting resources available. It was developed, tested and hosted for the competition on multi-core servers, but performs well on personal machines.
 - Similar apps could be developed for other health trends and associated social determinants by adding data sources.
- Future Deployment:
 - MortalityMinder is currently hosted on a virtual server at Rensselaer and at Shinyapps.io.
 - MortalityMinder continues as an open source project dedicated to improving life expectancy in the United States.
 - The innovative visualizations and analytics in MortalityMinder can be customized and/or incorporated into other applications by using the provided code.
 - App is designed for use on laptops and monitors. Mobile devices are left as future work.
 - Long-term plans include expanding analytic methods, exploratory capabilities, and user experience.



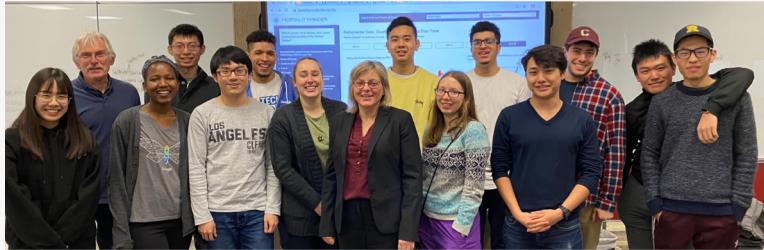
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Further Information

- MortalityMinder public deployments:
 - <https://mortalityminder.idea.rpi.edu/>
 - <https://olyerickson.shinyapps.io/MortalityMinder/>
- Link to video
- MortalityMinder OpenSource GitHub:
 - <https://github.com/TheRensselaerIDEA/MortalityMinder>
 - Full documentation provided on GitHub Wiki

MortalityMinder was created by undergraduate and graduate students in the Health Analytics Challenge Lab at Rensselaer Polytechnic Institute with support from the **United Health Foundation** and the **Rensselaer Institute for Data Exploration and Applications**. MortalityMinder was directed by Kristin P. Bennett and John S. Erickson. Many thanks to the MortalityMinder Advisory Board: Ms. Anne Yau, United Health Foundation; Dr. Dan Fabius, Continuum Health; Ms. Melissa Kamal, New York State Department of Health; and Dr. Tom White, Capital District Physicians' Health Plan (CDPHP). Refer questions to: erickj4@rpi.edu or bennek@rpi.edu



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