Providing Continuity of Care for Chronic Diseases After Natural Disasters: A Resource Allocation Model for Public Health Preparedness in Texas

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PROBLEM STATEMENT

- Population groups with debilitating chronic, noncommunicable diseases (NCDs) are among those at risk after natural disasters
  - heart disease, cancer, chronic respiratory disease, and diabetes
- A critical problem in the resulting health crisis was "the inability of the displaced population to manage their chronic diseases"(Greenough & Kirsch, 2005).
- The Center for Disease Control and Prevention (CDC) reported that chronic NCDs accounted for five of the six most reported conditions after Hurricane Katrina (Mensah et al., 2005).
- The number of individuals with **1 or more chronic illness** diagnoses in Houston shelters after Hurricane Katrina was **41%** (Brodie, Weltzien, Altman, Blendon, & Benson, 2006).
- **More than 45% of evacuees** did not bring their daily medications with them, and so more than **two thirds** of all medications provided during the response were for the **treatment of chronic diseases** (Jhung et al., 2007).

OPPORTUNITY

- **Observed trend:** Increasing disaster frequency and severity and an increasing prevalence of NCDs and disabilities.
- Struggling to anticipate and actualize prevention of the morbidity and mortality of NCDs in disaster preparedness and response will prove increasingly costly.

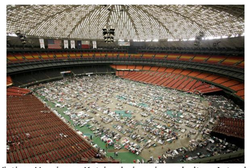


Fig.1 Victims Hurricane Katrina being given shelter -Astrodome

Fig.2 Victims Hurricane Katrina being given shelter – Houston Convention Center

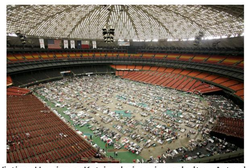
GOALS AND OBJECTIVES

- **RO1:** Identify key interventions essential for public health preparedness when facing a natural disaster in Texas through interviews with health and social service providers and literature review. [**completed**]
- **RO2:** Test and validate an existing agent-based simulation model that will be used to assess the impact of system interventions on chronic NCDs health outcomes after a natural disaster (Pérez, Li, & Pagán, 2021). [**completed**]
- **RO3:** Evaluate health simulated outcomes resulting from implementing selected interventions in the agent-based model. The model is designed to help policy-makers assess and compare different intervention programs targeting chronic NCDs prevention for the population of their interest. [**on-going**]
- **RO4:** Propose and recommend the best interventions for caring for Texans after natural disasters.

R01 - Interventions

- There are multiple challenges to improve the management of chronic NDCs during disasters.
- Horn and Kirsch (2018) identify the following as high priorities:

1. Reducing demand
   - **Personal preparedness:** providers and insurers assist patients
   - **Improved informatics and availability of health records**



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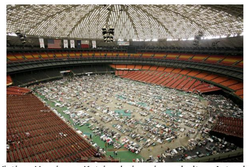
R01 - Interventions

2. Increasing capacity
   - **Access after disaster:** Better access to pharmaceuticals, medical goods, and medical records after the disaster
   - **Standardized treatment plans:** protocols, decision charts, and data collection forms to document health needs and resources.
   - **Training modules:** training modules for first responder and health care professionals
   - **Shelter capacity:** expanding special-needs shelter capacity, resources, and budget allocation to prevent those with chronic NCDs from decompensating in the aftermath of a disaster.



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R02- MODELS

- Our model also provides an interface that allows users to define

Basic demographic characteristics
- Population size
- Age (mean, standard deviation, min, max)
- Proportion of women (%)

Health behaviors
- Proportion of people who are not currently smoking (%)
- Proportion of people who are physically active (%)
- Proportion of people who eat a healthy diet (%)

Health factors
- Proportion of people who do not have diabetes (%)
- Proportion of people who do not have hypertension (%)
- Proportion of people who do not have high cholesterol (%)

CVD
- Proportion of people who have a history of MI (%)
- Proportion of people who have a history of stroke (%)

Other
- Simulation time horizon (years)

Fig.2 Model user interface

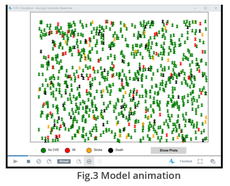

Fig.3 Model animation

- After the initial population is generated, users can easily track and visualize **population health outcomes** and **mortality** over a given period of time.
- Then users can compare the effectiveness of different interventions on the population of their interest.

R02- MODELS

- We obtained nationally representative data from the Behavioral Risk Factor Surveillance System (BRFSS) (Centers for Disease Control and Prevention (CDC) 2014a)

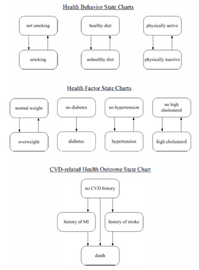

Table 1: Population characteristics from 2007 BRFSS.

	All	Age 20-39	Age 40-59	Age 60-79	White	Black	Hispanic	Asian
Mean Age	45.5	30.1	48.8	68.1	47.1	44.0	40.2	43.7
Female (%)	51.1	49.9	50.9	53.6	51.5	54.3	49.6	46.0
No currently smoking (%)	80.0	76.8	79.3	87.5	79.5	77.6	83.5	90.4
BMI < 25 (%)	34.2	39.7	30.7	30.8	35.6	24.5	28.3	61.7
Physically active (%)	36.9	38.2	36.6	35.2	40.1	28.2	29.6	25.8
Healthy diet (%)	24.4	23.3	24.3	26.7	24.3	23.3	23.8	29.4
No diabetes (%)	91.7	98.1	91.3	80.3	92.4	87.0	91.2	94.3
No hypertension (%)	73.1	90.1	71.1	45.3	72.8	63.4	79.0	83.6
No high cholesterol (%)	70.5	87.7	65.6	47.8	68.1	73.9	78.2	74.6
History of MI (%)	3.7	0.6	3.1	10.9	3.9	3.7	2.8	1.5
History of Stroke (%)	2.3	0.6	1.9	6.5	2.2	3.9	1.7	1.0

Table 4: Comparison between actual and simulated normal progression results in 2012.

	Diabetes (%)			MI (%)			Stroke (%)		
	Actual	Simulated	*p*	Actual	Simulated	*p*	Actual	Simulated	*p*
All	11.4	13.9	<.001	4.9	5.2	*.165*	3.1	3.1	*1.000*
Age subgroups									
Age 25-44	3.9	4.1	*.301*	1.1	0.9	*.055*	1	0.9	*.339*
Age 45-64	13.5	15.3	<.001	5.2	4.7	*.024*	3.2	2.5	<.001
Age 65-84	22.1	27.8	<.001	11.9	13.7	<.001	7.2	8.3	<.001
Race subgroups									
White	10.2	13.4	<.001	5.3	5.5	*.372*	3.1	3	*.587*
Black	15.7	18.4	<.001	4.5	4.9	*.057*	4.4	4.6	*.329*
Hispanic	13.3	13.1	*.567*	3.4	3.7	*.098*	2	2.2	*.153*
Asian	9.7	9.6	*.748*	1.9	2.4	<.001	2.1	1.5	<.001

R02- MODELS

Benefits of current model:

- Forecast the impact of interventions for a predetermined amount of time
- Allows for planning for resource needs and allocation based on the population impacted by the natural hazard
- Provide an evaluation tool for trade-off analysis given limited resources

Acknowledgments

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