

Model can predict hospital resilience for natural disasters, pandemics

April 29 2020, by Anne Manning



Credit: CC0 Public Domain

When a natural disaster like an earthquake strikes, a community can literally be shaken to its core. One way to assess how well and how quickly that community recovers is to measure how, and how quickly, its



hospitals and wider healthcare systems can become fully functional again and take care of its patients. Predicting the trajectory of that recovery is no easy task.

That's because the resilience measures of a <u>healthcare</u> system are dizzyingly complex. They span everything from the availability of hospital staff, to the protection of critical equipment, to the state of the roads for ambulances to travel on, to the efficiency by which hospitals can transfer critically ill patients to different hospitals.

Hussam Mahmoud, an associate professor in the Department of Civil and Environmental Engineering at Colorado State University, and his students spend a lot of time thinking about how to define and describe "community resilience." Mahmoud and graduate student Emad Hassan have created a modeling tool that could help city planners and emergency managers understand the full functionality and recovery of a healthcare system, in the wake of a natural disaster.

"We set out to develop models allowing us to understand, what is the demand on a hospital healthcare facility after an event like an earthquake," Mahmoud said. "When we started looking into this, we were shocked to learn that there are no models currently that allow you to understand, what is the demand on the hospital, how is the hospital being impacted by the natural disaster, how is that going to impact demand and capacity, and how will that change over time?"

Their model, described in a forthcoming issue of the journal *Reliability Engineering and System Safety*, has wider implications for use in other disasters, including pandemics, like the one the world is experiencing now with COVID-19.

Healthcare as a complex network



In their paper, Mahmoud and Hassan seek to understand healthcare systems as complex networks that can be visualized as nodes of different functionalities. These include number of staffed beds, hospital staff availability, housing functionality, patient waiting time for treatment, and even things like the probability of patient X going to healthcare facility Y. The availability of water, power, transportation and telecommunication also support hospital operation and factor into the model. And the researchers define healthcare not just by physical metrics, but also by quality metrics, like the level of customer satisfaction—measured by things like patient wait time.

To develop and test their framework, the researchers applied it to a virtual community called Centerville, which was developed as a research tool by researchers at the CSU Center for Risk-Based Community Resilience, a National Institute of Standards and Technology Center of Excellence of which Mahmoud and Hassan are contributing members. The researchers applied an earthquake scenario to Centerville—an imagined mid-sized U.S. community of 50,000 residents with commercial and industrial zones, schools, fire stations and hospitals—to see how it would fare. Using the virtual environment helped them highlight the capabilities of their model and the impact of decisions made as the community recovered.

Pandemic applications

The purpose of Mahmoud and Hassan's work is to define the parameters needed to be measured by communities to assess how prepared they are for <u>natural disasters</u>. In the wake of COVID-19, Mahmoud said, they have begun using their model to theorize and predict how <u>hospital</u> networks can better manage pandemics by identifying gaps in resources and potential bottlenecks according to different worst-case scenarios. They are now working with the National Center for Disaster Medicine and Public Health to further refine the <u>model</u> and apply it to pandemic



planning.

More information: Emad M. Hassan et al, An Integrated Socio-Technical Approach for Post-Earthquake Recovery of Interdependent Healthcare System, *Reliability Engineering & System Safety* (2020). DOI: 10.1016/j.ress.2020.106953

Provided by Colorado State University

Citation: Model can predict hospital resilience for natural disasters, pandemics (2020, April 29) retrieved 27 April 2024 from https://medicalxpress.com/news/2020-04-hospital-resilience-natural-disasters-pandemics.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.