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Prototype Demonstration – Extended Abstract

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Since the World Health Organization identified the novel coronavirus as a Public Health Emergency in Jan 2020, the surge of the global pandemic COVID 19 in the United States has crossed 42 million cases and 680 thousand deaths as per the data provided by the Center for Disease Control (CDC) (CDC, 2021). COVID-19 impacts existing health disparities rooted in structural determinants like closed community and long-term health care facilities such as nursing homes presenting significant risks for COVID-19 cases and deaths. As per the data provided by the Centers for Medicare and Medicaid Services (CMS), there were 681 thousand total residents confirmed cases and One hundred thirty-four thousand total residents' deaths. It clearly shows that COVID-19 has negatively impacted nursing homes across the nation.

Many potential factors impact the spread of COVID-19 in nursing homes. One of the significant factors is the increased susceptibility of nursing home patients. They commonly have underlying medical conditions that put them at greater risk than the general population. The research investigates different factors affecting the spread of COVID-19 in nursing homes through existing knowledge of health care practices combined with additional analysis of nursing home characteristics, personal protective equipment (PPE), community-level factors, and other socioeconomic factors. It is imperative to understand nursing home characteristics that will allow stakeholders to manage the spread of the virus and reduce the case and death count. Variables such as occupancy rates, infection rates amongst staff members, access to sufficient PPE (personal protective equipment), location of the facilities, staffing levels, county-level cases/deaths trends, demographic information are of great interest and relevance.

Much of the data are in disparate sources thus making it difficult for stakeholders to make informed decisions. The interactive dashboard developed in this study integrates the data from desperate sources (explained in Datasets section) to explore the impact of COVID-19 within nursing homes across the USA. It allows stakeholders to make informed decisions related to the spread of COVID-19 over a 14-month period starting May 2020. Stakeholders include nursing home administrators and directors, policymakers, such as state departments, public health care centers for Medicare, and Medicaid Services, owners of nursing homes, and individuals interested in learning about COVID-19 impact on nursing homes.

Analytics techniques are used to customize the dashboard and enhance its visualization and interactive capabilities. The design science research method was used to create the interactive dashboard as a design artifact to help stakeholders get answers to improve the livelihood conditions for residents in nursing homes. Use of this artifact improves access to information for policy makers and other stakeholders that could not have been possible without an integrated view. The information can inspire new policies for nursing home facilities to improve their situation in light of the pandemic.

Design Science Research

The development and evaluation of the design artifact developed in this study, follows the principles of design science research (DSR) (Hevner et al. 2004). The realm of IS research is at the confluence of people, organizations, and technology (Davis and Olson 1985; Lee 1999). During this creative process, the design science research must evolve both the design process and the design artifact as part of the research. As the first step in this project is aimed to improve quality and safety in Nursing homes, a system was needed that delivers real-time information regarding the development of cases from COVID 19.

Specific use cases were developed in consultation with a stakeholder (a licensed nursing home administrator). Use cases pertained to tracking infection rates, observing the standard of care, observing levels of compliance to safety standards, to view COVID-19 rates in facilities and help determine where assistance is needed. Examples of use cases or stakeholder questions addressed are:
- We need to know how our infection rates compare to other nursing homes in the region and visualize the factors that indicate the standard of care to improve policies and practices and minimize resident harm.
- Which nursing homes are experiencing a higher number of cases to determine if support or assistance is needed?
- What are the trends in COVID-19 infection rates and, if so, how to make appropriate changes to reduce the spread?
- COVID trends in the local nursing homes for discharge planning purposes.

Data Sets

The project scope is to provide insights at the state and county level. Various resources were used to obtain the datasets. The Nursing Home level data across the United States comes primarily from the Center of Medicare and Medicaid Services (CMS). The dataset used is updated weekly and contains 279 variables corresponding to over 15,000 nursing homes that decided to report information. The dataset was already cleaned, prepared, and had time-series data related to cumulative coronavirus cases, deaths, and new cases. Supplemental data used includes the United States confirmed cases, deaths, and county populations. Census data from the year 2019 obtained through the Census Bureau helped estimate census data to account for the demographics at the county level. For the dashboard, we use data over a period of 62 weeks starting from May 24, 2020 to July 18, 2021.

Design Artifact

The design artifact (prototype) can be viewed at https://msanalytics.github.io/NHDB/ The visualizations were developed using Tableau and the dashboard was deployed on Github. While four use cases were considered in developing the prototype, one use case is described below. Figure 1 below shows the top nursing homes by county showing resident/staff COVID-19 admissions, cases, and deaths.

When a user selects specific counties to examine, they can compare the total resident and staff cases in different counties across different states such as Cook county IL and San Bernardino County, CA. It could be gleaned that the staff cases a majority of the time were not too far behind the total resident cases. This relationship was also experienced somewhat with the Total Resident Deaths variable, however with significant variations. From the visualizations comparing the resident cases to deaths, it could be seen that many nursing homes had death counts that were close to or more than half of the total case counts. Others had high case counts but hardly any deaths. It is essential to consider the nursing home's location, such as the region of the country that it is in and whether or not the facility is in an urban area. By reviewing the information nursing home administrators and owners should consider managing the interactions between staff and patients, leading to fewer cases overall.
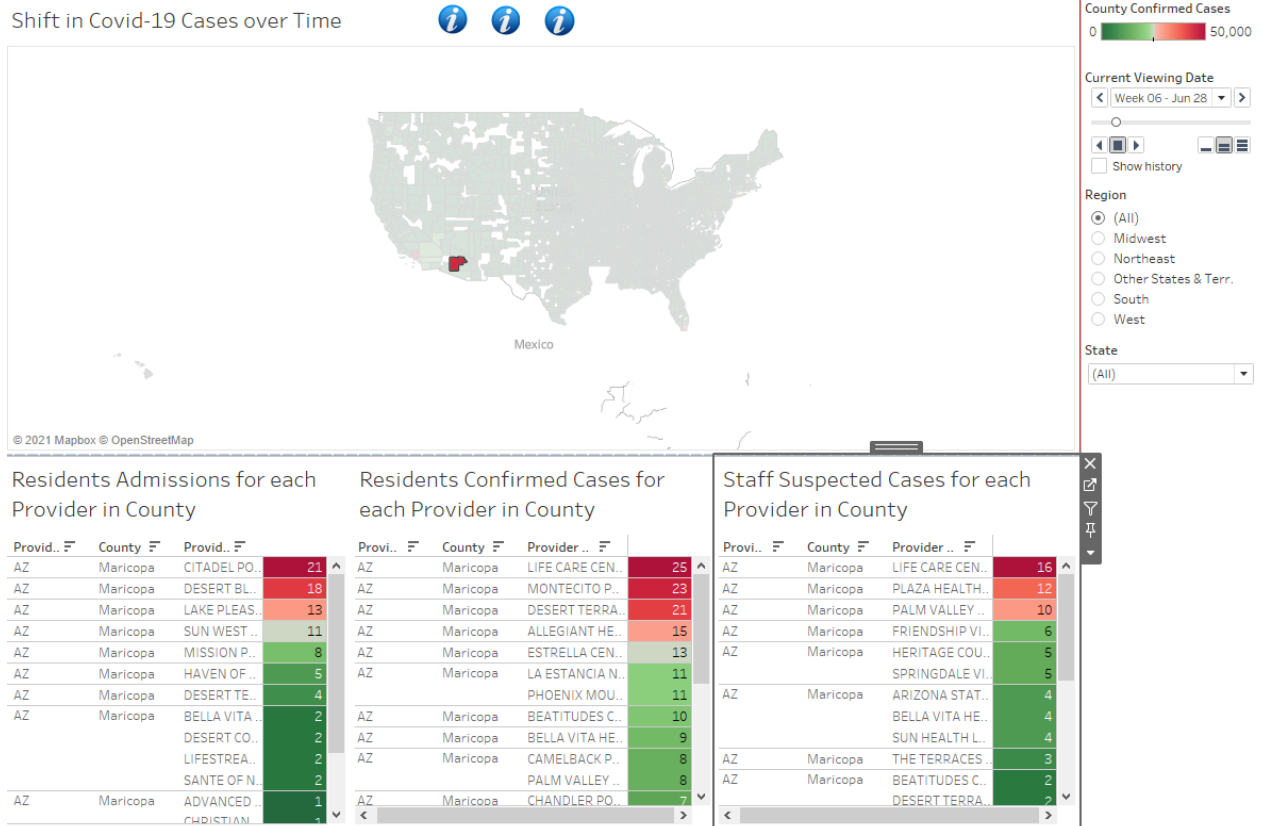
Figure 1: Top nursing homes by county showing resident/staff COVID-19 admissions, cases, and deaths.

Based on the literature provided (Shen 2020), it was found that outbreaks in nursing homes were linked to the types of neighborhoods that the staff resided in. Though more analysis should be done to determine whether or not the exact cause can be applied in a stakeholder's particular scenario, it is still worthwhile to consider the interaction reduction as the relationship strength is too much to ignore. Stakeholders should also consider placing the residents in separate rooms if they have not already done so. It only takes one staff member going into a room with multiple patients to spread to all of them potentially. Furthermore, the number of patients that each staff member interacts with should be reduced as much as possible. By this model's results, taking these actions specified above should reduce the spread of the virus. It should also be considered that latent factors have not been included in the model but also serve to further the spread of the virus. These factors should be discovered from the datasets and considered in business decisions as well.

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