Data Analytics and Visualization: Determining Factors Related to Poor Prognosis in COVID-19 Patients

Joel M. Gonzalez Hernández[1], Hiram Vera Mercado[2], Miguel A. Hernández Betancourt[1], Farnaz Mohammadi[3], Navid Amini[4]
[1]University of Puerto Rico, Rio Piedras Campus, [2]University of Puerto Rico, Arecibo Campus, [3]University of California, Los Angeles,
[4]California State University, Los Angeles

Abstract

Recently, a spillover event took place with a member of the coronavirus family, SARS-CoV-2, quickly turning into a global pandemic. Unprecedented economic and social damage have created an urgency to find methods to mitigate the disease's impact. This study aims to determine the independent predictive factors associated with poor prognoses in COVID19 patients. Medical records from Spanish facilities were analyzed using statistical tests and data visualization software. Results indicate that several factors have a significant positive association with poor outcomes in COVID19 patients.

Introduction

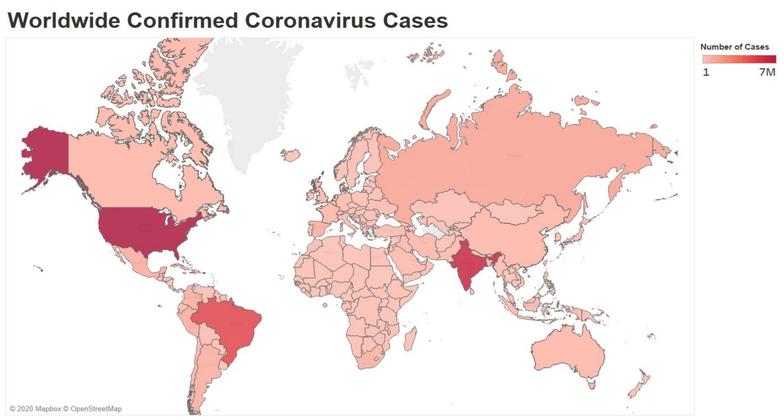

Fig. 1: Worldwide heatmap of confirmed coronavirus cases. Data until 09/29/2020.

- Coronavirus disease 2019 (COVID-19) is an illness caused by a virus known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- The virus is highly contagious, and has spread quickly. It was declared a global pandemic by the WHO in March.
- As of September 2020, there have been over 33 million confirmed cases and 1 million reported deaths.
- There are currently no effective treatments.

Problem statement

This study aims to determine the most significant predictors for death, ICU admission and hospitalization in COVID19 patients. Factors to investigate include physical characteristics (age and sex), symptoms, comorbidities, and test and examination results.

Data

Medical records for 322 COVID19 patients from three spanish medical institutions. Out of these patients, 50% were male, 37.5% were over 65 years of age, 49% were hospitalized, 13% entered intensive care and 5.6% perished.

Methodology

Chi-squared tests were used to determine which factors had greater association with each of the three outcomes. Afterwards, odds ratios were calculated to quantify the strength of association for variables that had high chi-squared values.

Results

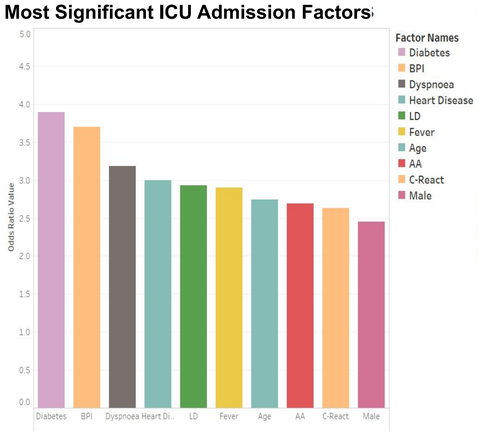

Fig. 2: Clinical predictors for ICU admission: Diabetes, BPI (Bilateral pulmonary infiltrates) , Dyspnoea (labored breathing), Heart Disease, Lactate Dehydrogenase (catalizer), Fever, Age (>=65), Auscultatory Alterations, C-React (elevated kinase protein), Gender (male).

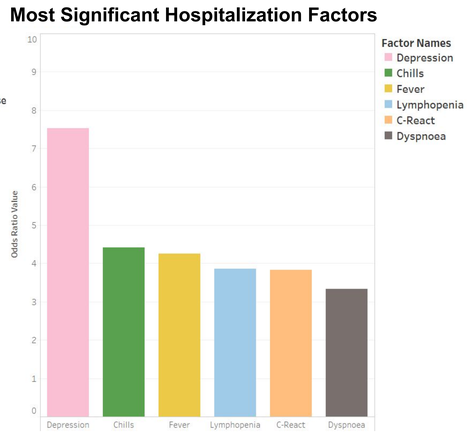

Fig. 3: Clinical predictors for hospitalization: Depression, Chills, Fever (>37.5 ℃), Lymphopenia (reduced white cell blood count), C-React (elevated kinase protein), Dyspnoea (labored breathing).

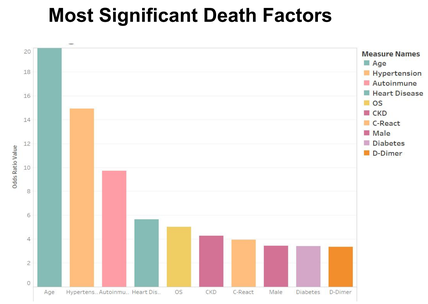

Fig. 4: Clinical predictors for death: Age (>=65), Hypertension (high blood pressure), Autoimmune Disease, Heart Disease, Oxygen Saturation (<92%), CKD (Chronic Kidney Disease), C-React (elevated c-react protein), Gender (male), Diabetes, D-Dimer (Elevated d-dimer protein).

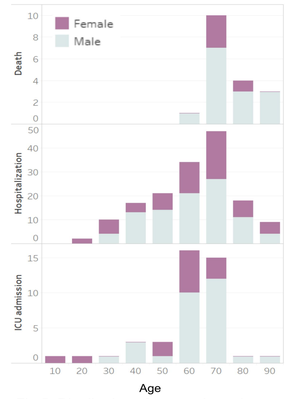

Fig 5. Distribution of age and gender for the three identified cases.

Conclusion

Several predictive factors for each of the three outcomes investigated were identified. In particular, male gender, having an age greater than or equal to 65, and the presence of comorbidities had significant positive association with poor prognosis in patients. Further research with larger datasets should help pinpoint which factors which are most important. The identification of such factors could potentially help protect the portion of the population that is most vulnerable, reducing the number of cases that end in tragedy.

Acknowledgments

This material is based upon work supported by the National Science Foundation under Grant No. 2034030. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

[1] Sisó-Almirall, Antoni, et al. "Prognostic factors in Spanish COVID-19 patients: A case series from Barcelona." *PloS one* 15.8 (2020)