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An Examination of Factors Affecting Incidence and Survival in Respiratory Cancers

In the United States and worldwide, respiratory cancers are a leading cause of cancer-related deaths for both men and women. According to the American Cancer Society, lung cancer in particular accounts for approximately 27% of all cancer deaths. The Surveillance, Epidemiology, and End Results (SEER) Program provides data on all incident cancer cases from 1973 to 2012 in certain regions of the United States. The goal of this study is to use data provided from SEER to (1) determine which demographic variables distinguish between types of respiratory cancers and (2) determine which variables affect survival of patients with various types of respiratory cancers. In addition, we combine the SEER data set with an additional data set from the National Cancer Institute's Small Area Estimates for Cancer Risk Factors and Screening Behaviors which contains smoking prevalence data by county for the years 1997 to 1999 and 2000 to 2003 to determine what characteristics of county populations affect respiratory cancer incidence rates. In this study, we use machine learning techniques and ecological and survival analysis on SEER cancer data and National Cancer Institute data to estimate survival for respiratory cancer patients and to approximate the prevalence of respiratory cancers by age, sex, and race. We observe that the most commonly reported respiratory cancer is lung cancer for both men and women. Elderly people are at a higher risk for developing respiratory cancers, and their survival prognosis is worse. In addition, males have a higher incidence of most respiratory cancers than females, and survival rates for males are lower than females for most respiratory cancers. One of the best predictors for survival analysis is tumor grade. The SEER data contains a race category called Other which consists of American Indian/AK Natives and Asian/Pacific Islanders. Blacks and Other are at a higher risk for all respiratory cancers than whites. Furthermore, blacks have the worst survival prognosis, while Other has the best survival prognosis for all respiratory cancers.

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The Consequences of Cluster Randomization in Phase III Clinical Trial Interim Analyses

During phase 3 clinical trials, interim analyses are performed in order to assess whether there is sufficient evidence for early stopping due to either efficacy or futility. Phase 3 cluster randomized clinical trials often make use of interim analysis methods designed for subject-level randomization. Such interim analyses do not account for the within-cluster correlation that occurs because of cluster randomization. Our research investigates the consequences of using these traditional methods in the cluster randomization setting. Via simulation we compared the type I error within cluster randomized sampling versus that within individualized random sampling. We also examined the probability of rejection at each interim analysis. The simulation revealed that, when applying traditional interim analysis methods to the cluster randomized setting, we are conservative when deciding whether or not to continue a trial.

Mentor of Research Group

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Effect of Distraction and Alzheimer’s Disease in Simulated Driving Based on Four Methods of Data Reduction

Using data collected from a driving simulator at the University of Iowa Hospital and Clinics, we were able to apply four methods of reducing lateral lane position data observed during a 53 second stretch of straight road driving. The four reduction methods were a) counting the standard deviation of the lane position, b) counting the number of lane departures, c) integrating the area lane departures, and d) the re-centering parameter based on the model proposed by Dawson et al (2010). Data were available from 69 drivers with Alzheimer’s disease (AD) and 129 healthy older drivers without. The drivers were exposed to two segments, one control segment meant to be free of distractions, and another segment where the drivers were asked to perform the Paced Auditory Sequential Addition Task (PASAT). Overall, we found that drivers with AD performed worse than healthy subjects, and that the PASAT task influenced driving, but it was unclear whether the effect of PASAT was different between groups.

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The PReclampsia Early Determination for Intervention, Cure, and Therapeutics by Vasopressin (PREDICTV) Study

Preeclampsia is a pregnancy disorder and one of the leading causes of maternal and fetal death. This condition may lead to maternal organ damage, fetal growth restriction, premature birth and many other pregnancy complications. Fatality is most common in rural and developing countries, owing to a lack of knowledge and experience with the disorder. It has been found that 92% of deaths from this disorder are due to a delay in diagnosis (Snydal, 2014). Early detection is therefore imperative so treatment and special care be taken to reduce the mortality rate due to preeclampsia. It has been hypothesized that plasma copeptin, a stable biomarker for vasopressin, can be a good prognostic factor for detecting preeclampsia as early as six weeks into gestation. Our research validates this prognostic factor and investigates other maternal factors that are associated with the risk of preeclampsia. Our research also focused on finding threshold levels of first trimester plasma copeptin which may be used to classify preeclampsia categories. In addition, we suggest a first trimester urine copeptin level that discriminates preeclampsia status—should plasma tests become invasive and costly. This latter finding will be useful in developing countries where plasma copeptin tests may be inexistent.

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Platelet counts and their effect on patient outcomes with patent ductus arteriosus (PDA)

As a fetus develops, blood passes from the heart through an open aorta to the not yet functional lungs. Once the baby has been delivered, it is expected that the heart closes off the aorta from the pulmonary artery, separating the oxygenated and deoxygenated blood. Sometimes this does not occur, causing a circulatory disorder called patent ductus arteriosus (PDA). This research focuses on premature newborns, who have a higher prevalence of this disorder. Currently, it is unclear to doctors what is the best approach to treating PDA: letting the aorta close on its own, administering medicine (indomethacin), or performing surgery.

Data for 405 preterm newborns was collected at the University of Iowa Hospitals and Clinics.

We used logistic regression to examine the relationship between platelet counts in the first 7 days of life and other factors on three clinical outcomes: development of PDA, recovery without intervention, and successful indomethacin treatment. We found a positive correlation between higher platelet counts and better clinical outcomes for the patients. There were interesting dynamics between the early, later, and average platelet counts and their importance in our predictive models.

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An Analysis of Factors Related to Alcohol, Tobacco, Marijuana, and Drug Use among Adolescents Based on the Iowa Youth Survey

The Iowa Youth Survey (IYS) is a tool used to measure the experiences of students in the 6th, 8th, and 11th grades regarding various forms of violence, substance abuse, and other high risk behaviors. The survey also provides information regarding students' views of themselves, their peers, and their surrounding environment. Based on IYS data collected in 2005, 2008, and 2010, this research analyzes the relationship between select factors and outcomes pertaining to alcohol, tobacco, marijuana, and drug use. Both simple and multiple logistic regression modeling frameworks are employed. Graphically, we present the changes in the odds ratios of each outcome with respect to the levels of each factor. We gauge the relative strength of each association by referencing the differences in the Bayesian Information Criterion (BIC) between models with and without given factors.

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Investigating Disease Epidemics through Simulation with a focus on Chikungunya in the Americas

An agent-based model (ABM) is a computational model that simulates the actions and interactions of autonomous agents to observe the effects on a system. Agents can take a number of forms, depending on the granularity of the available data, and computational feasibility. For example, agents could represent individual members of a population, administrative regions, farms, or other domain specific units of interest. The goal of the ABM is then to see how the infectious disease spreads through the agents in a population over time. We will discuss some simple examples of ABMs as well as the Susceptible, Infectious, Removed compartments commonly used in infectious disease research. Finally, our research focuses on the Chikungunya Virus and describing how it has spread in the Americas. We showcase our ABM for epidemic spread, and highlight some simulations for the spread of the Chikungunya Virus during 2014. Ultimately, we will predict how the Chikungunya disease will continue to spread with the hope that these techniques may influence future public health research in this area.

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