DO SOCIOECONOMIC FACTORS CONTRIBUTE TO A PATIENT HAVING A HOSPITAL AQUIRED INFECTION IN WASHINGTON

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ABSTRACT: Throughout history there has been a strong link between healthcare outcomes and socioeconomic status. In spite of this during our research we found little to no data discussing how socioeconomic status affects hospital infection rates, even while hospital acquired antibiotic resistant infections become a greater threat each year. To investigate this relationship we propose a broad sampling of 10 Washington State hospitals, randomly selecting patients admitted at the time of the study. Patients selected who agree to participate would be given a questionnaire regarding socioeconomic status in the hospital and a brief follow up afterward to determine if they contracted an infection resulting from their hospital stay. It is imperative that we continue to investigate and better understand the role socioeconomic status plays on our health and we believe this proposal is an important step in doing so.

Introduction

Since the inception of hospitals, hospital acquired infections (HAI) have been a serious issue. In the 18th Century, some physicians recognized the rates at which their patients were contracting HAIs and as a result, some began to approach procedures differently. In 1846, the physician Ignaz Semmelweis was the first to practice hand hygiene before every procedure and it was through this practice that hospitals were able to start decreasing the rates of HAI by 70 to 90 percent (Sherman, 2007). Today it is estimated that two million HAIs occur each year in United States hospitals, resulting in nearly 100,000 deaths (Klevens, Edwards, & Richards, 2017). Even with improvements in modern medicine and our understanding of germ theory, HAI is still a major threat, especially now as antibiotic resistance becomes ever more common. Most studies pertain to either HAI rates or how socio-economic status (SES) affects overall health, but does not evaluate if SES affects rates of HAI. Our goal is to identify socioeconomic factors that may increase the likelihood of HAIs in the hopes of identifying people at greater risk so care plans can be developed to avoid dangerous and costly infections.

The development of antibiotics has played a large role in combating many diseases, but over time some strains of bacteria have adapted to become resistant to antibiotic treatment, raising the danger of HAIs. The increasing rates of antibiotic and antimicrobial resistance results in greater likelihood of contracting an infection while at the hospital (Yokoe & Classen, 2008). These types of infections can be difficult to treat and are one of the world's most pressing medical issues (Dobson, 2015). Fifty-one percent of deaths due to HAI are attributed to resistant strains of bacteria with the leading contributor being Methicillin-Resistant Staphylococcus Aureus (MRSA) (Ventola, 2015). Many of these infections require newer antibiotics for effective treatment at greater cost, frequently creating an even greater burden amongst people in lower socioeconomic status (SES), (Kangovi et al., 2013).

Throughout history there has been a strong link between healthcare outcomes and SES. When puerperal fever was at an all-time high

in maternity wards in the 18th century, the hospitals with the highest death rates were run as charitable institutions offered to women that were poor or unmarried (Dobson, 2015). The wealthy have always had advantages when it comes to treatments and health outcomes due to their ability to obtain the best treatments, products and physicians. In modern times it is estimated that the average person over the course of their lifetime will spend over $316,000 on healthcare (Alemayehu, & Warner, 2004). Treatments for infections caused by antibiotic and antimicrobial resistant strains of bacteria due to HAI can cost as much as $1,000 to $3,000 per course and cancer chemotherapy can cost tens of thousands of dollars (Ventola, 2015). The price of many medical treatments and procedures carry a heavier burden on those of lower SES with many going into debt and adding preventable strain to the healthcare system itself.

Increased individual medical debt forces the healthcare system to in turn make up for this gap in patient income and cost through elevated spending. Associated costs due to Central Line Infections (CLI) were estimated to cost between $30,919 and $65,245 on a per case basis (Zimlichman et al., 2013). In total, the annual costs of the five major HAIs on the healthcare system was between $8.3 and $11.5 billion with surgical site infections contributing the most to overall costs (Zimlichman et al., 2013). Reducing HAI and the associated costs specifically for low SES patients, has the potential to save significant amounts of money for a vulnerable population while also reducing the costs to the healthcare system overall.

Direct patient care is necessary in a hospital setting and many cases of HAI are due to this direct interaction. Studies of healthcare workers on a coronary care unit and intensive care unit (ICU) showed that of 134 screened healthcare workers, five members or 3.7 percent were MRSA colonized (Papastergiou & Tsiouli, 2018). In healthcare settings the healthcare workers themselves are a reservoir for HAI and a potential source of transmission to the patients that they care for (Papastergiou & Tsiouli, 2018). Another source of HAI has been through colonization of multidrug resistant strains on healthcare workers' mobile phones. In a 15 bed ICU, bacterial colonization was assessed on 56 healthcare workers' mobile phones and 46 administrative employees' phones. After analysis, the healthcare workers' phones had a higher number of different species of bacteria per phone (Missri et al., 2018). With recognition that healthcare workers are a major factor for HAI in hospitals, we are able to account for them when considering other, less obvious causes such as SES. Beyond the healthcare workers, many procedures themselves come with increased risks of HAI.

The Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) have listed the most common and significant HAI as surgical site infections, bloodstream infections due to the use of central lines, antibiotic resistant bacteria, ventilator associated pneumonias, and urinary tract infections due to indwelling bladder catheters (Yokoe & Classen, 2008). It is estimated that between 5 and 10 percent of hospitalized patients develop an HAI from these procedures (Klevens & Richards, 2007). Low SES patients are twice as likely as high SES patients to require urgent emergency department (ED) visits and four times more likely to require admission to the hospital (Kangovi et al., 2013). People of low SES are possibly the population most impacted by HAI, both due to their experiencing the majority of complications from procedures and comprise the majority of ED visits.

No matter the route or severity of the HAI its effects can be costly in multiple ways to individuals of low SES. HAIs not only cause emotional stress but, in some cases, lead to disabling conditions that reduce the quality of life (Weinstein, 1998). Healthcare costs can increase to debilitating levels for daily life and function through extra procedures which can be difficult to recover from (Weinstein, 1998). Depending on the age of the patient and the severity of the

infection, individual effects will vary. The most pressing concern is not the extended stays in hospitals, but the compounding effects an HAI has on one's life, family, and finances.

Increased length of hospital stays and medical complications due to HAI can cause significant and lasting complications for patients. Approximately 2.6 percent of operations performed each year are complicated by Surgical Site Infections (SSI) (Mangram, Horan, Pearson, Silver, & Jarvis, 1999). Treatment for an SSI prolongs hospitalization an average of seven days and creates an average of $3,000 in additional medical costs (Mangram et al., 1999). Patients with HAI were at greater risk of readmission compared to patients that didn't contract an HAI; of the total days spent in the hospital 9.3 percent were considered to be excess days attributed by these infections (Rahmqvist, Samuelsson, Bastami, & Rutberg, 2016). These excess days place a population already at an increased risk of financial burden at an even greater risk due to the associated costs of more time spent in the hospital.

Certain individuals are at higher risk of contracting a HAI which also parallels people's SES. Factors that are also included in the increased risks of HAI include the elderly, the young, and the immunocompromised population (Ducel, Fabry, & Nicolle, 2002). The data shows that rates of HAI in the elderly are nearly double that compared younger patients (Avci, Ozgenc, Coskuner, & Olut, 2011). The more that we can understand about the risks, risk factors, routes of transmission and the people or groups that are most affected by HAI, the better we can combat it and relieve its burden not only on individuals but on the healthcare system itself. Do socioeconomic factors contribute to a patient having a hospital acquired infection in Washington? The hypothesis that lower SES increases the likelihood of a HAI does appear to have some validity to it but requires further research.

Method

Design

The research performed will be a cohort study of 10 Washington hospitals using cluster sampling with each hospital being its own cluster.

Sampling

Our Target population will be all patients, newborn and older, admitted to hospitals in Washington State. Hospitals will be selected by weighting primarily for the percentage of the state population in their service area. To do so we will use the population data of the most recent state census for the counties in that service area. This would be followed by evenly distributing hospitals involved across the state, to account for the greater density of population in western Washington.

Quotas will be set for each hospital based on their average weekly admittance. This approach will be used to prevent skewing of data to either more populated areas due to higher admittance rates or lower population areas if the same quota was applied to all the hospitals.

The administration of each hospital we select for this study will be approached individually, where we will explain the design, purpose, and goals of the study. If a hospital declines to be part of the study we will select another that most closely matches it using the same criteria. After the hospital administration has approved of the study, we will notify the staff via emails and flyers in the break and work areas of the hospital.

To collect this data, a researcher will be placed at the given hospital and will randomly select newly admitted patients. The researcher will notify the patient or guardians of the study. Each individual will give written consent to participate and access to their medical records for this hospital visit. Following the participant's consent, they will be given a questionnaire about their demographic information and have their contact information collected for a follow up survey. One month following their initial questionnaire participants will be given a phone interview to confirm if they contracted an HAI, what they were treated for, and

what treatments were provided. If participants are still in the hospital at the time of the follow up a second phone interview will be attempted one month later. If the participant is still in the hospital two months after the initial contact they will be marked as, "Still receiving treatment" and the interview will be completed.

Measures and Variables

For this study, our interest is the difference in socioeconomic factors between patients who do and do not contract an HAI resulting from a hospital visit. Therefore, the independent variable will be the socioeconomic factors reported by each patient such as ethnicity, age, income, etc. The dependent variable will be contraction of an HAI by a participant during their hospital stay. In addition to the independent and dependent variables being examined we will also be examining the purpose for the participants visit and what care was provided. The care provided and reason for the participant's visit while not directly related to the study at hand could affect the resultant data, thus qualitative categories will be created for each. To better understand how SES might affect HAI outcomes it is important that we account for both of these confounding variables.

Analysis

The data will be broken down using qualitative methods. Answers to survey questions will be multiple choice, (e.g. "What is your ethnicity? Select below", "What is your annual income?", etc.) with quantitative questions such as income being broken down into number ranges of 4 to 5 answer for participants to choose from. This is being done to make data entry and analysis of this large data set much easier. This ease will be necessary as we will be using multivariate analysis. All participants are a combination of many socioeconomic factors all of which play differing priority in that person's health outcome. To simplify and normalize the two confounding variables of, "reason for visit" and "treatment provided while there" for the study we will create general qualitative categories for both such as:

- admitted to hospital for: upper respiratory infection, trauma (major/minor), myocardial infarction, stroke, etc.
- Treatment provided: steroid, antibiotic, surgery (major/minor, planned/emergency), etc.

Again, this will allow us to still account for these important factors but not focus overly on either factor.

Ethics

This study will require Institutional Review Board, (IRB) approval from the University of Washington along with each hospital to ensure the privacy and participants' rights throughout the study. Participants will be given both a verbal and written explanation of their rights while involved in the study. In addition, patients or their guardian will sign a release form giving their informed consent, with participants between the ages of 14 to 18 signing an additional assent form. Patients under the age of 14 will not require assent due to their age.

This study will be confidential since we will collect participants' medical, demographic, and contact information. To ensure the participants' right to privacy we will create separate databases, one for their socioeconomic and medical information, and a second for their name and contact information. Both databases will be encrypted following all Health Insurance Portability and Accountability Act, (HIPAA) and National Institute of Health, (NIH) or other appropriate oversight body guidelines.

Discussions

Limitations

We have worked extremely hard to reduce the expected limitations of this proposal, though we have found some. It is important to note this study will only be a snapshot of what occurred in those hospitals in Washington state during the study. While the study will likely be a strong representation of Washington and the United States as a whole, it likely will become less representative of other countries and regions the more dissimilar their demographics are due to difference in

socioeconomic factors and social structure in those areas. Since we are only taking a one-time look and will not track how socioeconomic factors change the outcome for each participant, a causational relationship between factors and outcomes will not be possible.

Future Research

Following this study it will be important to repeat it in another geographic area of the United States, though sample sizes would be determined using the same method as above and not based on the size of this study. This repetition should be done to confirm the validity of any statistically significant correlations found between specific socioeconomic factors and likelihood of contracting an HAI in a region with different but similar demographics. In addition to repeating the study, if statistically significant relationships are found between certain socioeconomic factors and an increase in HAIs follow up studies will need to be performed looking into possible causation.

Importance

We created this proposal because we found the available information to be somewhat lacking and wanted to design an exploratory study to look into how socioeconomic factors influenced the contraction of HAI. During our research we found there to be plenty of information regarding how socioeconomic status affects an individual's overall health and how hospitalization or treatment affected their likelihood of contracting an HAI, but none looked at both. As antibiotic resistance increases the need to be able to predict and target individuals at risk of infection rises. This study is a first step in identifying people at risk of HAI in order to develop better means of prevention.

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