

## **Prospectus**

### **Racial Disparities as a Barrier to Influenza Vaccination Uptake during Pregnancy in Virginia and Brazil** (Technical Topic)

### **Improving Global Health Provisions by Focusing on Brazil** (STS Topic)

By

Simone Herron

November 3, 2020

Technical Project Team Members:

Hunter Newland  
Kunaal Sarnaik

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: \_\_\_\_\_ Simone Herron

Technical Advisor: Sean Moore, MD, MS (PI); Irene Mathieu, MD (Co-PI); Jason Papin, PhD (Co-PI)

STS Advisor: \_\_\_\_\_ Sean Ferguson

## **Introduction**

The influenza vaccine can help prevent problems that occur during pregnancy due to influenza infection that effect the health of the mother and the infant; however, there are racial disparities in who receives the vaccine. Our capstone project will focus on quantifying the racial disparities surrounding influenza vaccine uptake in pregnant women in Virginia and Brazil. We will ultimately use our finding to aid in the creation of a computational model to analyze the spread of influenza outbreaks and predict the optimal timing of influenza vaccine delivery for pregnant women in Virginia and Brazil. The United States and Brazil were chosen as countries to focus on due to their shared history of colonialization and systematic racism which we believe may contribute to the racial disparities in the healthcare systems in these countries. Virginia specifically shares a large diversity of races like Brazil. However, there are notable differences between the current vaccine campaigns in Virginia and Brazil that can be attributed to the developed country status of the United States and the developing country status of Brazil. Using this thought for the sociotechnical portion of the thesis I plan to focus on the portability of global health provisions between countries with different economic standings and resource availability. I will also explore the applicability of techniques and methods of other countries with limited resources to Brazil. Throughout my thesis I will investigate how techniques that are intended to improve global health can be created in a way that considers the needs of the countries they are being used in.

## **Technical Topic**

Pregnant women have a higher likelihood of contracting influenza than women that are not pregnant (Yudin, 2014). Additionally, influenza infection has been linked to

a higher chance of unfavorable birth outcomes such as premature birth and low birth weight (Rasmussen et al., 2012). Proper scheduling of vaccine campaigns is important to mitigate the occurrence of large outbreaks. Additionally, these campaigns must reach all in order to be most effective. In Brazil's north east region, their current vaccine campaign does not align with the usual timing of the first influenza outbreaks in this region (Filho et al., 2020). In the United States, studies have shown black Americans are less likely to get the influenza vaccine as well as receive recommendations from their healthcare providers than white Americans (Arnold et al., 2019; Lindley et al., 2006).

Hunter Newland, Kunaal Sarnaik, and I are working under the direction of Sean Moore, MD, MS, Assistant Professor of Pediatrics (PI); Irene Mathieu, MD, Assistant Professor of Pediatrics (Co-PI); and Jason Papin, PhD, Professor of Biomedical Engineering (Co-PI), with assistance from Gabriel Hanson, Biomedical Engineering PhD candidate. My capstone group's project will build on previous work our advisors have conducted to identify and quantify racial disparities in influenza vaccine uptake in Brazil. We will be continuing their work and expanding to analyze more regions in Brazil as well as include Virginia. My capstone group will be investigating and quantifying the racial disparities surrounding influenza vaccine uptake to ultimately design a schedule for optimal vaccine uptake targeted to pregnant women.

### *Racial Disparities Quantification*

Currently, the effect of racial health disparities in influenza vaccine uptake among pregnant women in terms of birth outcomes has yet to be quantified. For our Virginia quantification method, we will identify data on influenza vaccination

uptake, influenza vaccination recommendations from a healthcare provider, and birth outcomes by utilizing medical databases to analysis de-identified medical records. For Brazil, we will be analyzing influenza vaccination uptake and birth databases to locate information regarding birth outcomes as well. We will use R and/or Python for data visualization purposes to identify trends in birth outcomes in both localities relating to racial disparities. Finally, we will use statistical analysis software to determine the effect and quantitative significance race plays in the birth outcomes following vaccine receipt versus non receipt.

#### *Optimal Influenza Vaccine Timing Modeling*

We will be using our quantification analysis to guide us in the creation of seasonal models for influenza spread that will ultimately be used to create a schedule for the optimal timing for vaccine uptake in Brazil and Virginia. Our models will incorporate the timing of both the first instances of influenza as well as the general peak times of infection in each locality. Brazil and Virginia will each have their own respective models due to variations in the flu season timing in the two localities, differences in regional sizes, and accessibility to data resources constraints. Due to the aforementioned limitations, Brazil's model will employ a comprehensive population-based modeling technique while Virginia will use an agent-based modeling approach. Trends have shown in one portion of Brazil birth weights are lower during flu season (Filho et al., 2020). This indicates possible widespread influenza infection. We plan to use machine learning techniques to create simulations using R and/or Python to allow visualization of predicted influenza spread when a large portion of the Virginia and Brazil populations receive the vaccine versus when they do not at various periods during the year. From this

information we will be able determine what time periods vaccine administration would be most effective at reducing significant influenza spread. By creating this schedule, we expect to encourage Virginians and Brazilians to seek out the influenza vaccine to reduce the spread of influenza thereby reducing the negative birth outcomes attributed to influenza infection.

### **STS Topic**

For my sociotechnical topic, I will discuss how global health provisions can be affected by the developmental state of the country they are used in. Global health provisions are generally designed with the intention of benefiting all countries; however, these benefits can be disproportionate due to country specific issues. I will examine examples of this disproportionality and methods that can help address and improve the discrepancy. This topic needs to be further researched because it is important that developing countries have health provisions that meet their countries' needs. The health system and related attributes must be properly analyzed to discover where improvements are needed.

The United States proposed a six year program for a new Global Health Initiative in 2009 (Bendavid & Miller, 2010). The initiative was innovative in comparison to past global health initiatives because it sought to improve the healthcare systems in lower income countries by providing funding to improve their primary healthcare agendas (Bendavid & Miller, 2010). Unfortunately, the initiative's goals did not materialize to the extent that was hoped; however, it did open up much needed conversations centering around the state of global health and established a framework for factors future initiatives should incorporate (Alcorn, 2012).

Developing countries generally lack the resources necessary to imitate the health provisions seen in developed countries. This can be attributed to economic reasons or systematic reasons affecting the country at whole. Many times, healthcare personnel from developed countries visit developing countries with the intent of helping; however, they may be doing more harm than good. Kung et al. (2016) found there were conflicting opinions from low- income country (LIC) healthcare personnel in India and Bolivia regarding whether high income country (HIC) medical students visiting their countries to volunteer was actually helpful to the country they visited. Some LIC healthcare personnel felt their presence benefited the LIC by helping boost the perceived prestige of the LIC physicians within the community. Others felt the medical students lack of interaction with the patients, lack of displayed care, and short time in the programs overall were major drawbacks to these initiatives. Kung et al. (2016) specifically addressed the benefits and drawbacks associated with HIC medical students; however, these medical students will shortly become physicians with a considerable impact on the future of the healthcare field. This article illustrates that work needs to done on both sides to make global health initiatives effective.

#### *Actor Network Theory Applicability*

I plan to delve deeper into how improvements can be made that benefit all involved. The actor network theory will be used throughout my research into this topic. If one actor or actant is ineffective, it can affect the entire global health network. Other considerations would need to be made to stabilize the imbalance. By approaching this topic from multiple angles, it gives more options for recourses. Brazil itself faces many internal problems that hinder its ability to improve its health

system without assistance. Government systems can be considered a major actor in global health. Massuda et al. (2018) discusses how political and economic instability can be a large contributor to instability in healthcare systems. In 2002, Brazil was accomplishing major strides in its healthcare reform; however, its healthcare budget was significantly reduced after a recession in 2014 and the election of a new President. Though Brazil has a universal healthcare system, due to its low budget for healthcare, many still have to pay out-of-pocket which puts low-income Brazilians at a great disadvantage to receiving treatment when needed. A lot of the research previously conducted discusses where the problems lay. I want to explore exactly what can reasonably be done to create solutions. For future exploration of this topic I will attempt to locate more scholarly articles focusing on Brazil to obtain a more accurate depiction of the problem from the people that are most affected by it. I plan to identify areas where improvement may help lower mortality, fatality, and morbidity and suggest solutions. I will find and analyze examples in which developed countries have successfully applied their techniques in developing countries and assess how their methods can be applied to Brazil.

### *Case Study Analysis*

Throughout my analysis I will have to consider that collective efforts between multiple countries sometimes focus more heavily on the work of the countries with more resources (Parker & Kingori, 2016). Countries with less resources and economic means are sometimes characterized as less trusted because they have limited prior work and experience in collaborations; therefore, their contributions are diminished. Due to this, I also will be analyzing cases where developing and less developed countries have devised innovative solutions to the health problem

themselves and explore their applicability to Brazil. For example, Williams & Woodson (2012) detail how an organization in India, Aravind Eye Care System, created an innovative system that allows the lack of funds to not be a major hindrance to economically impoverished South Indians seeking optometric services. Aravind created a method that allows patients facing poverty to get free services while more economically advantaged patients pay more but also get better services. They have been able to successfully apply their model to assist other healthcare organizations in South India in helping their economically disadvantaged communities. Aravind has also been a model organization for developing countries in that it was involved in the creation of a much more affordable domestically produced alternative to western intraocular lenses. I intend to explore how cases of this nature can be applied in Brazil.

### **Next Steps**

My research projects have the common goal of improving healthcare for those that are at a disadvantage. Through my research, I expect to bring greater awareness to the improvements needed in the network encompassing healthcare systems. I will accomplish this by analyzing existing actors and actants through the exploration of my sociotechnical topic. Through case studies I will be able to identify the areas Brazil can improve in and initiatives they could attempt by analyzing other countries efforts. Through my capstone project I will introduce new actants that can improve the network's core structure. My group's analysis of racial disparities can potentially bring a greater awareness in the medical community and the pregnant population towards the impact the influenza vaccine can have and its benefit to uptake. The schedule potentially may have a large impact in the medical



community by providing an easily interpretable data source to reference vaccine recommendations.

| Projected timeline | Technical Task  | STS Task  |
|--------------------|---|---|
| November 2020      | <ul style="list-style-type: none"> <li>• Submit capstone project proposal</li> <li>• Finalize access to necessary databases</li> </ul>                    | <ul style="list-style-type: none"> <li>• Submit Prospectus</li> <li>• Receive approval from capstone and STS advisor</li> </ul> |
| December 2020      | <ul style="list-style-type: none"> <li>• Capstone Fall Progress Update</li> </ul>   |   |
| February 2021      | <ul style="list-style-type: none"> <li>• Finalization of racial disparities assessment</li> <li>• Starting creation of influenza spread models</li> </ul> | <ul style="list-style-type: none"> <li>• Case study analysis</li> </ul>   |
| March 2021         | <ul style="list-style-type: none"> <li>• Finalization of influenza spread models</li> <li>• Starting creation of optimal timing schedule</li> </ul>       | <ul style="list-style-type: none"> <li>• Thesis draft submission</li> </ul>   |
| April 2021         | <ul style="list-style-type: none"> <li>• Finalization of optimal timing schedule</li> <li>• Finalization of technical report</li> </ul>                   | <ul style="list-style-type: none"> <li>• Final Thesis submission</li> </ul>   |
| May 2021           | <ul style="list-style-type: none"> <li>• Submission of work to medical journal</li> </ul>   |   |

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