

# Identifying a Bottleneck in the Integrated Transplantation Network

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## Introduction

- Organ transplantation is a modern marvel of medicine. Removing and replacing diseased organs allows for the improvement in the quality and longevity of life.
- The major components that are addressed in this research are organ procurement organizations (OPOs), non-profit organizations (NPOs), transplant hospitals (TH), and pharmaceutical companies.
  - The project analyzes the components of the Integrated Transplantation Network to determine the extent to which they play a part in the transplantation rates for the region.
  - Supplying the organs for transplantation are registered organ donors who provide nearly 60% of all organ transplantations.
  - Thousands of people die every year waiting on the organ transplantation list.
  - Factors that were once considered absolute barriers are no longer significant issues in the ability to receive an organ.
  - The rate of organ transplantation varies from state to state for several reasons.
  - The Integrated Transplantation Network models the supply and demand of organs.

## Research Problem

The Transplantation Network Model suggests an even distribution of supply and demand. However, as the number of available organs increase, the number of successful transplants do not increase at the same rate. This research shows that organ procurement organization and transplant hospitals are the source of a bottleneck in the Transplantation Network model.

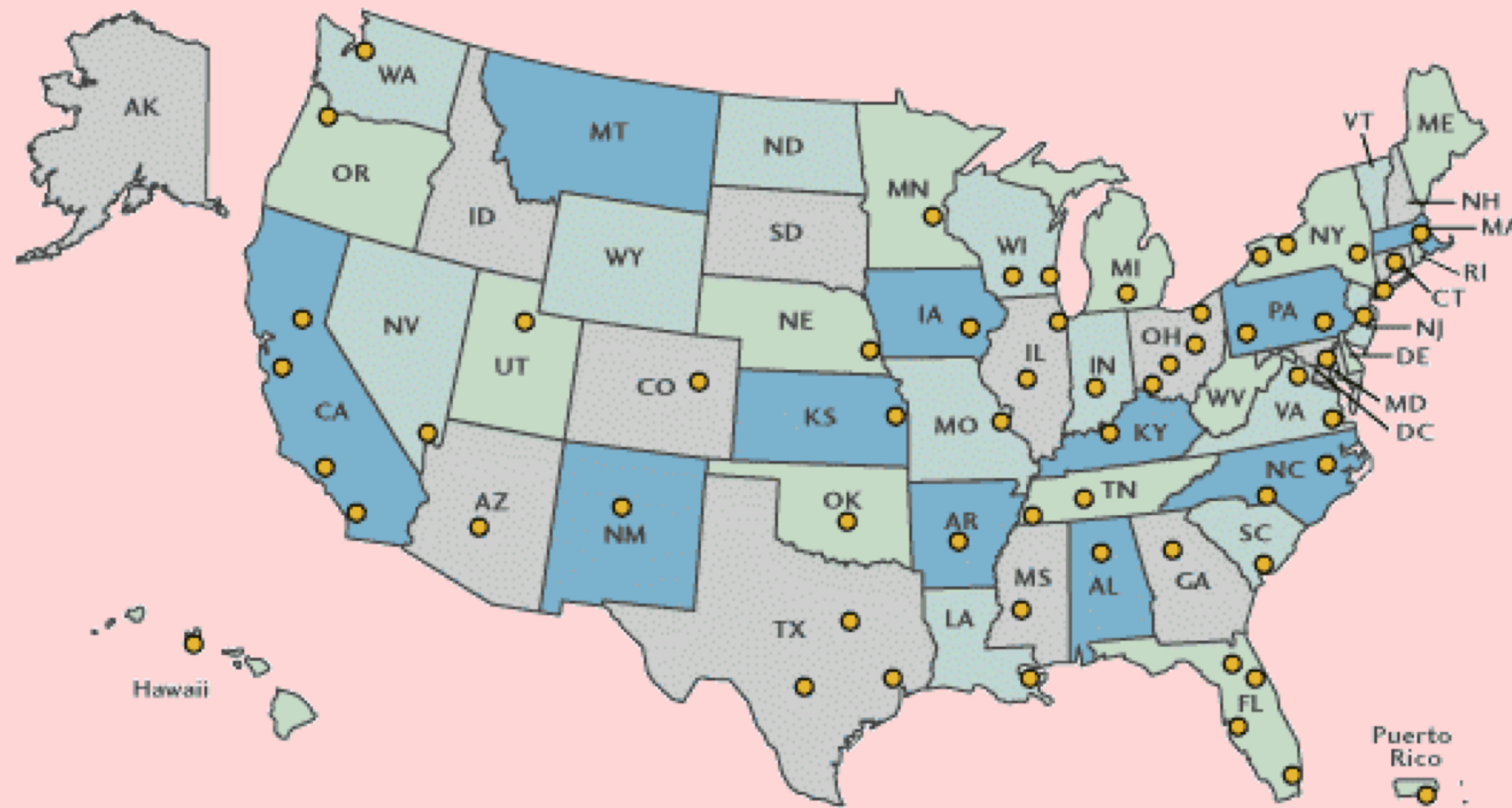


Figure 1: OPO Location in the United States

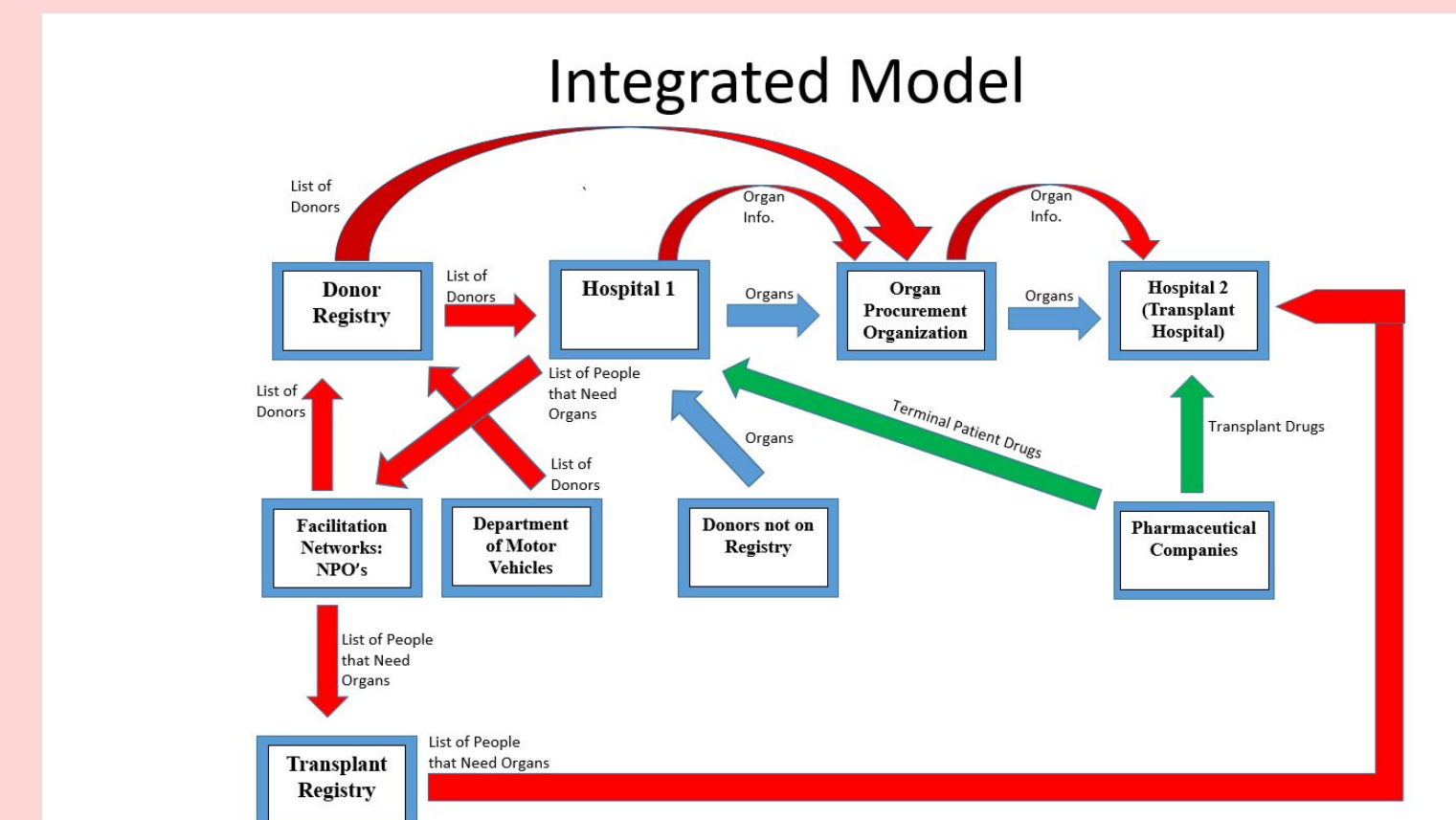
## Factors

- Organ Procurement Organization
- Transplant Hospitals
- Non-Profit Organizations
- Pharmaceutical Companies
- Donor Demographics

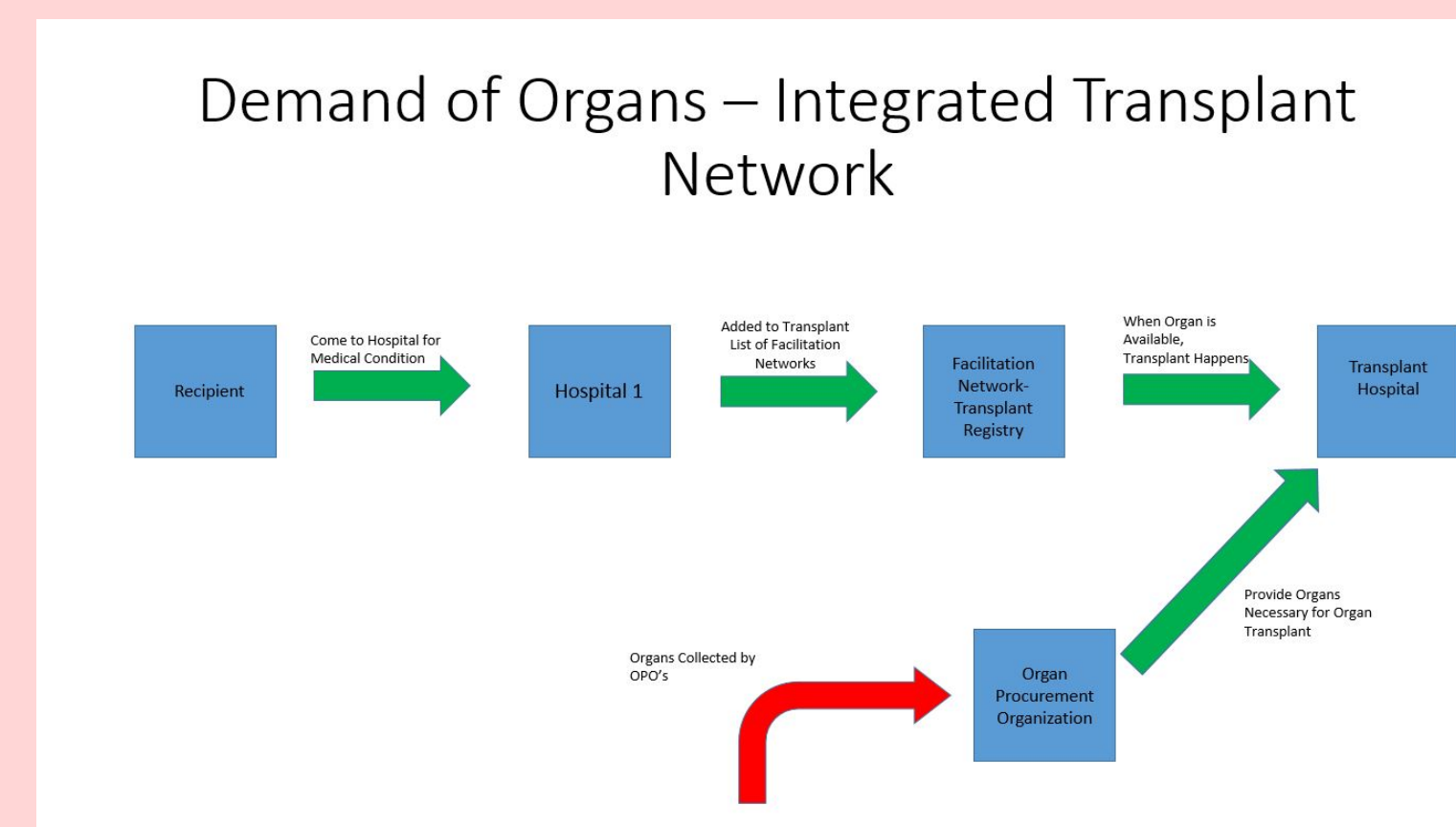
## Methods

- Compile and compare data on NPO registries with actual donors
- Compile donor and transplant rates by political, religious, racial, sex, and other demographic categories.
- Compile data on organs procured by OPOs and available organs
- Compile data on transplantable organs and successfully transplanted organs by Transplant Hospitals.
- Analyze Pharmaceutical presence by spending per state.
- Using statistical measure  $R^2$  to compare the relative correlation between factors to provide a comparison between the components of the Integrated Transplantation Network Model.

## Models

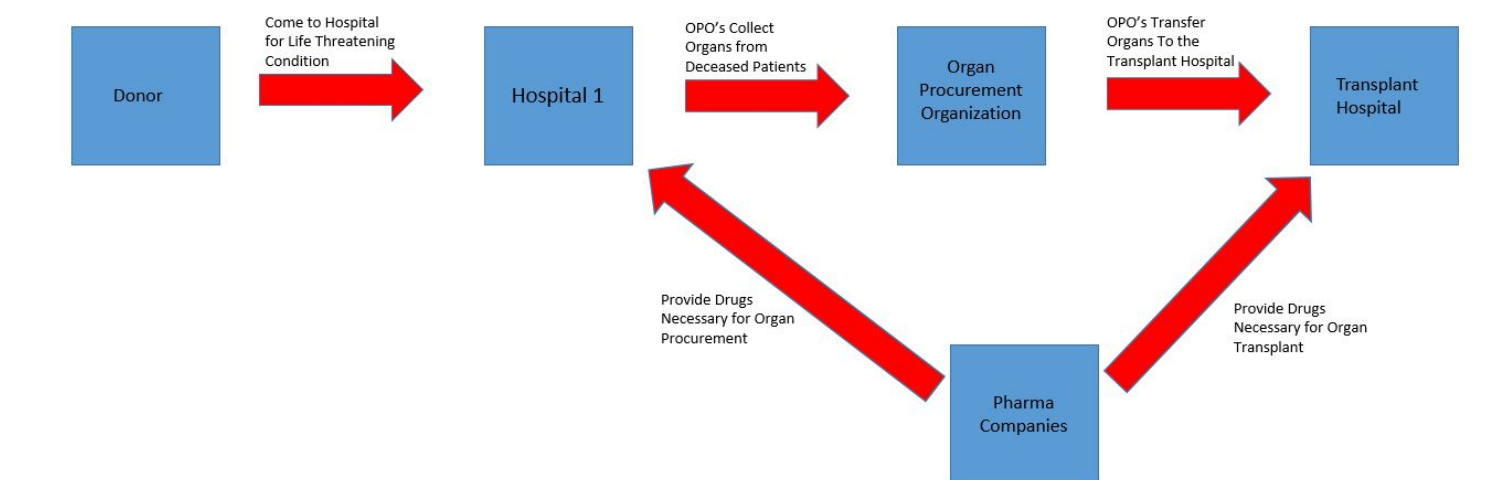


Model 1: Integrated Transplantation Network  
This Model shows how organ transplantation occurs, taking account of the transfer of information, organs, and the major players in this transplantation network.



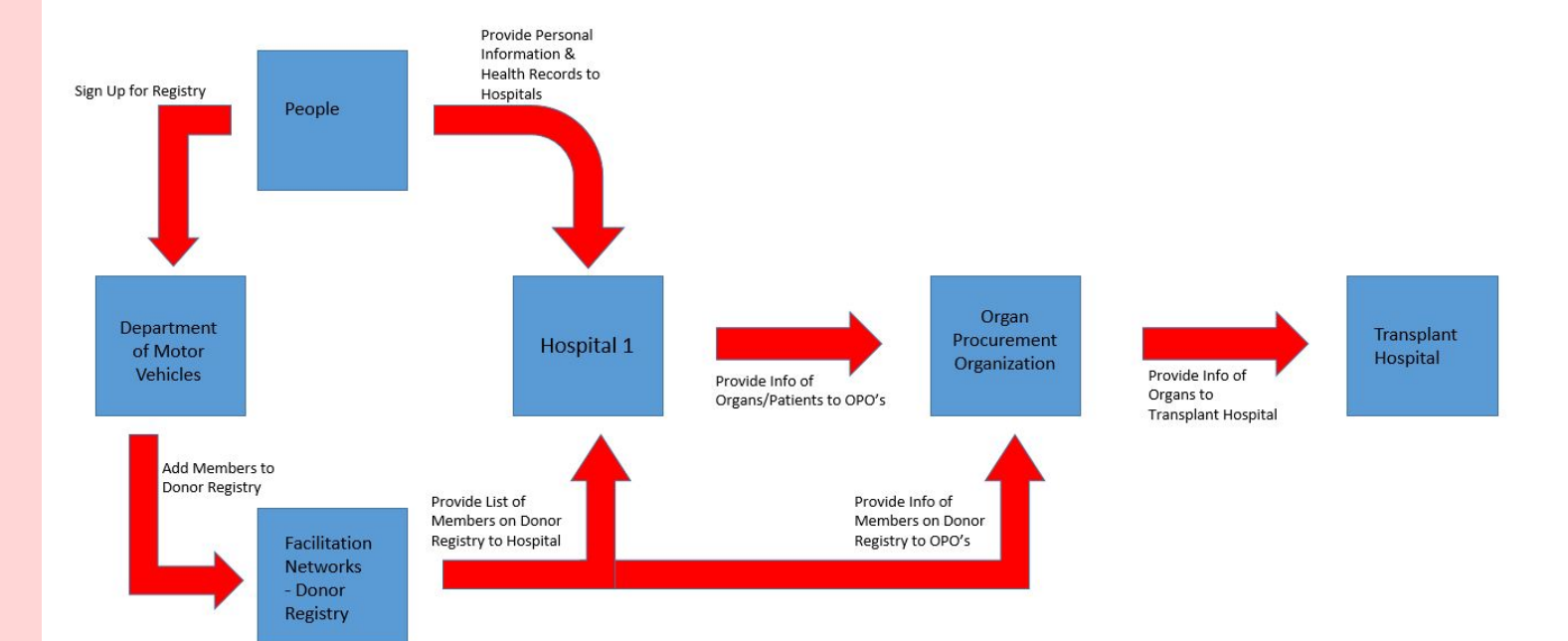
Model 2: Demand of Organs  
This Model of the Integrated Transplantation Network Looks at the Demand of organs, and the various components of the transplantation network that oversees the demand for organs.

### Supply of Organs: Organs/Material Transfer



Model 3: Supply of Organs (Organs/Material Transfer)  
This model looks at the supply of organs and the drugs that are necessary for the transplant. It involves the physical transfer of organs. It also shows the major members of the transplantation network that are vital for the supply of organs.

### Supply of Organs: Information Transfer



Model 4: Supply of Organs (Information Transfer)  
This model looks at the information transfer that is associated with supply of organs. It also provides a look at the various members of the transplantation network that make the transfer of information possible.

## Data

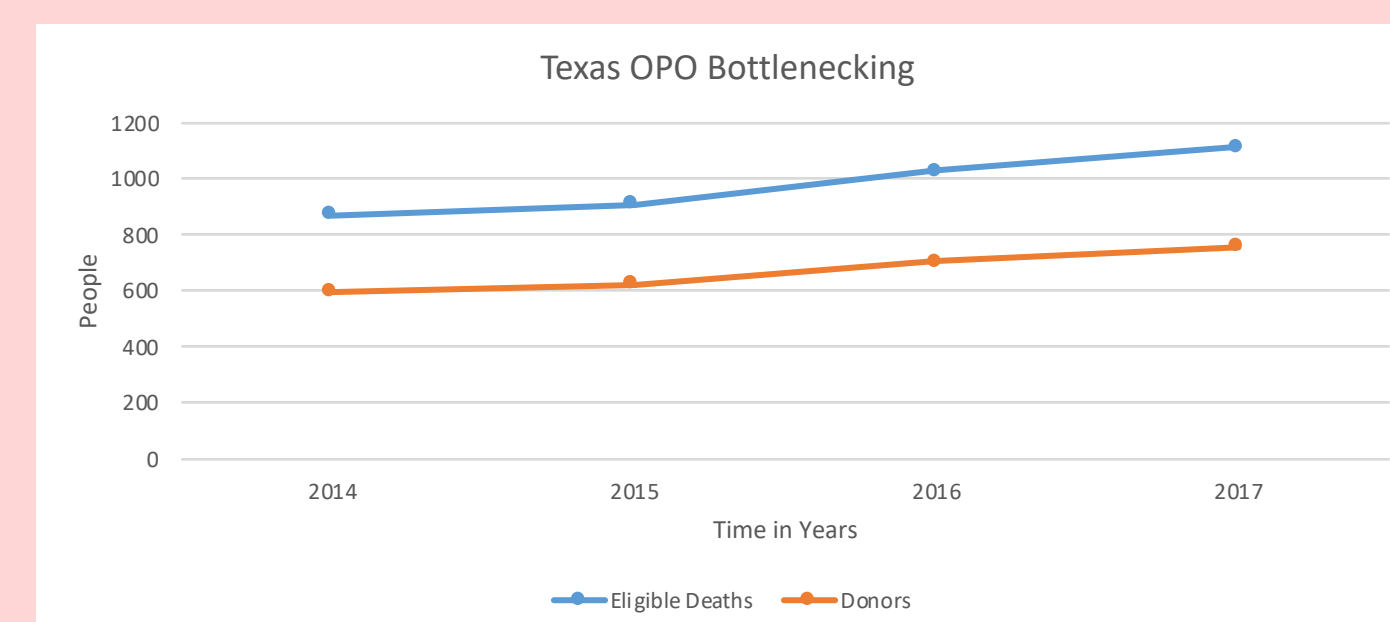


Figure 1:  
This graph shows the OPO bottleneck effect in the state of Texas. Between 2014 and 2017 the number of deaths that were eligible for organ procurement has been significantly higher than the number of deaths that were utilized for organ procurement.

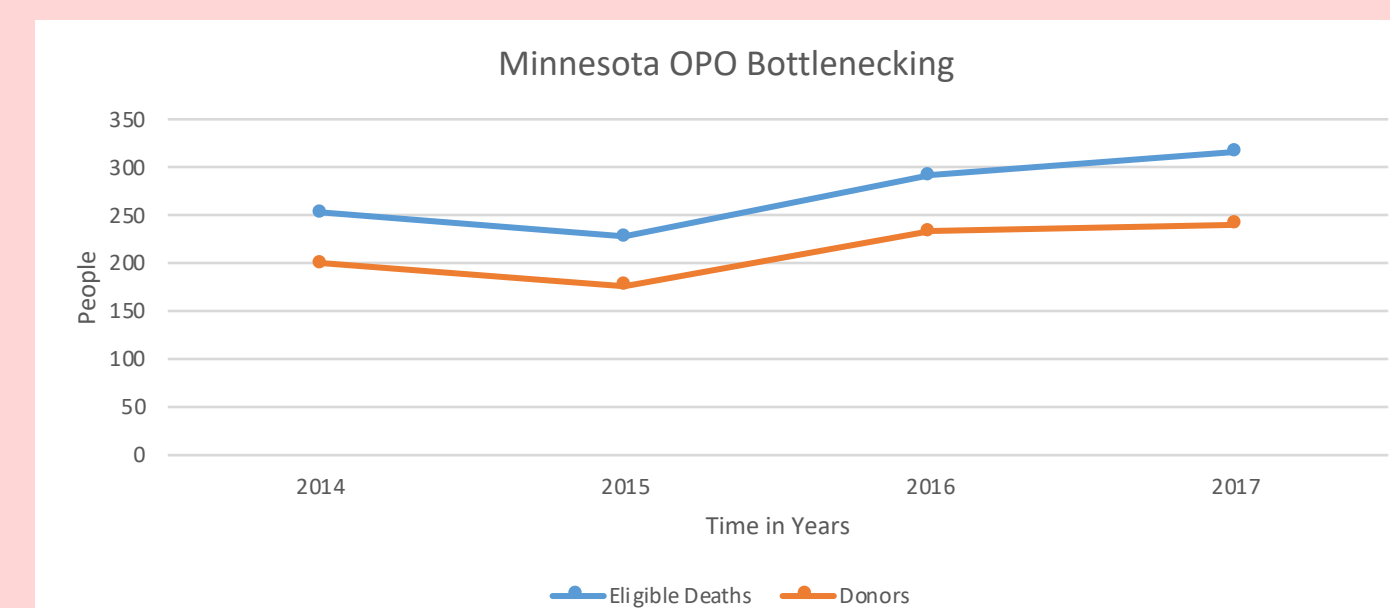


Figure 2:  
This graph shows the OPO bottleneck effect in the state of Minnesota. Between 2014 and 2017 the number of deaths that were eligible for organ procurement has been significantly higher than the number of deaths that were utilized for organ procurement.

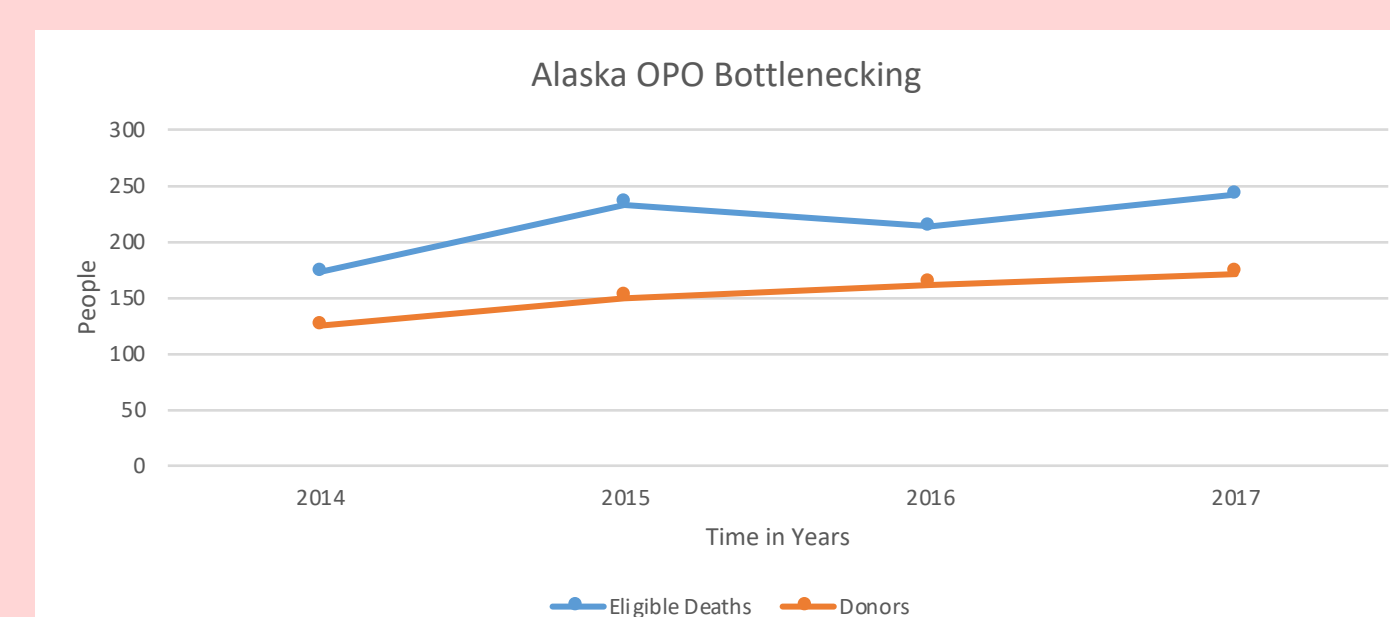


Figure 3:  
This graph shows the OPO bottleneck effect in the state of Texas. Between 2014 and 2017 the number of deaths that were eligible for organ procurement has been significantly higher than the number of deaths that were utilized for organ procurement.

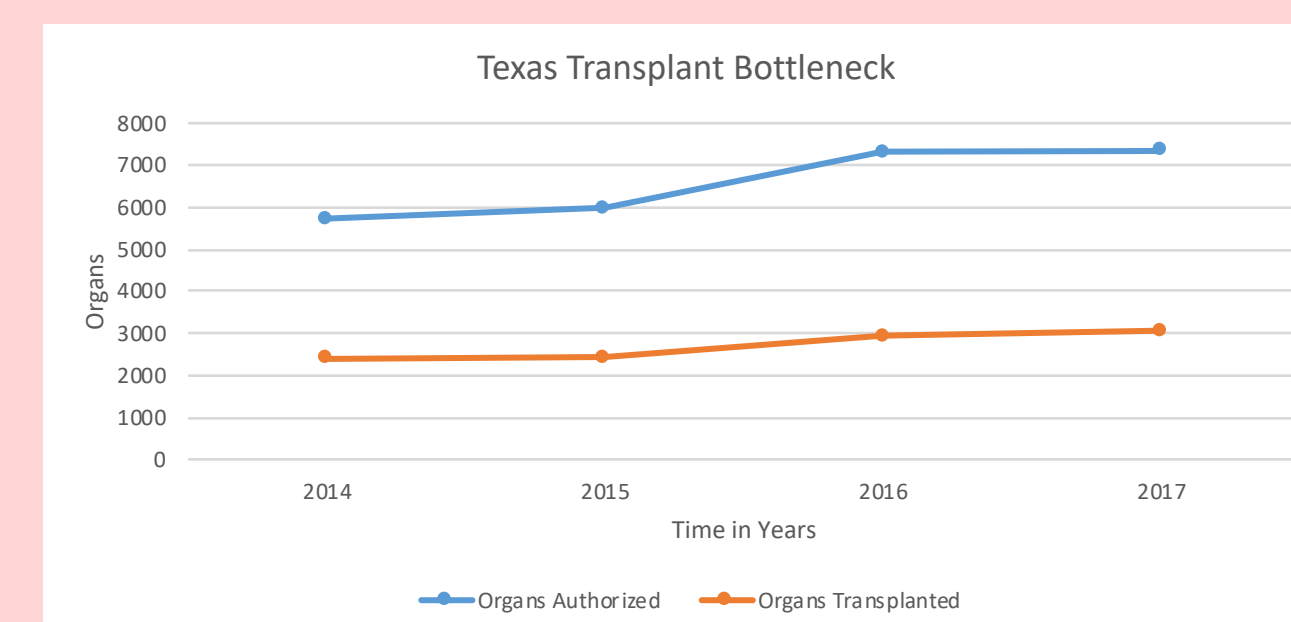


Figure 4:  
This graph shows the Transplant Hospital bottleneck effect in the state of Texas. Between 2014 and 2017 the number of organs authorized for transplantation has been significantly higher than the number of organs transplanted.

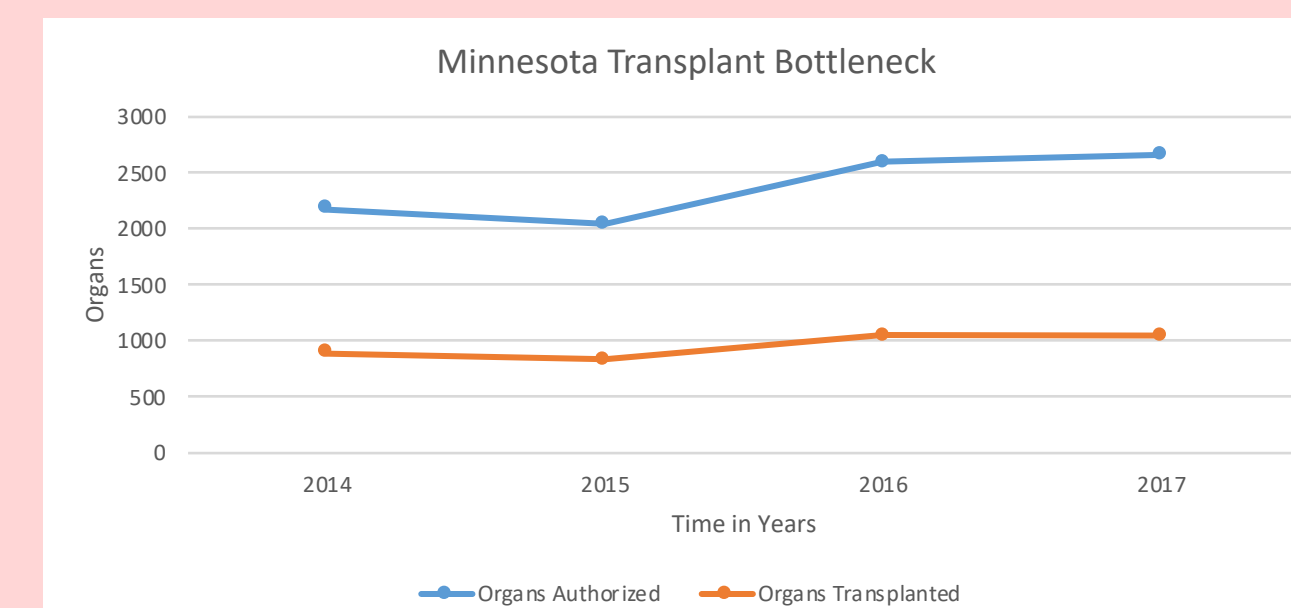


Figure 5:  
This graph shows the Transplant Hospital bottleneck effect in the state of Minnesota. Between 2014 and 2017 the number of organs authorized for transplantation has been significantly higher than the number of organs transplanted.

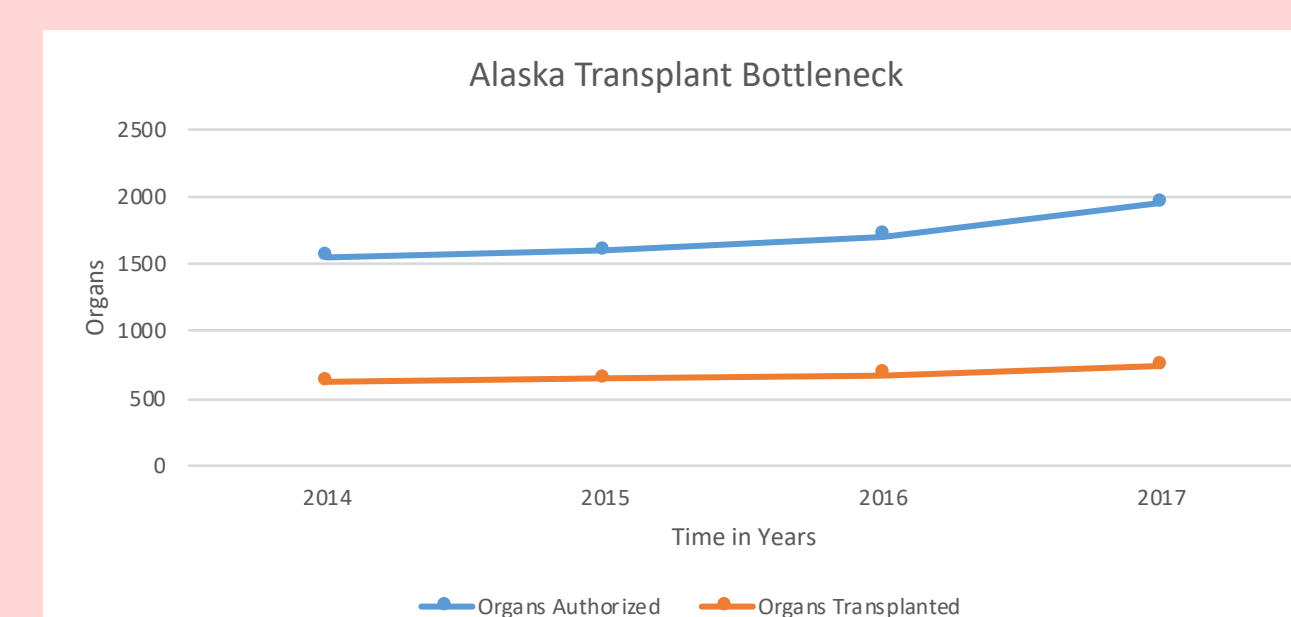


Figure 6:  
This graph shows the Transplant Hospital bottleneck effect in the state of Alaska. Between 2014 and 2017 the number of organs authorized for transplantation has been significantly higher than the number of organs transplanted.

## Conclusion

- The factors involved in the Integrated Transplantation Network includes organ procurement organizations, transplant hospitals, non-profit organizations, pharmaceutical companies, and donor demographics.
- The Integrated Transplantation Network involves transfer of both organs and information.
- There is a significant bottleneck caused by OPOs in all three states (Texas, Minnesota, Alaska) between 2014 and 2017.
- There is a significant bottleneck caused by transplant hospitals (Texas, Minnesota, Alaska) between 2014 and 2017.
- An understanding of what components of the transplantation network are inefficient is critical for targeted improvements.
- There are a series of best practices that help decrease the bottleneck of the individual members of the Integrated Transplantation Network.

## Acknowledgements

I would like to thank Dr. Michelle Belco and Dr. Dan Price for their guidance and their help with the research.