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The Kidney Transplant Process Model

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Problem Domain

- **There is a shortage of donor organs in the US** [1]
  - Over 120,000 Americans are on the waiting list for an organ

	Current Candidates	2013 Additions	2013 Transplants	Median Wait Time (months)
Kidney	100,880	36,395	16,895	60*
Liver	1,185	11,527	6,455	11*
Pancreas	2,051	550	256	24*
Kidney/Pancreas	15,724	1,219	762	18*
Heart	255	3,911	2,531	4*
Lung	3,992	2,474	1,923	4*
Heart / Lung	1,608	46	23	N/A
Intestine	53	175	109	4+

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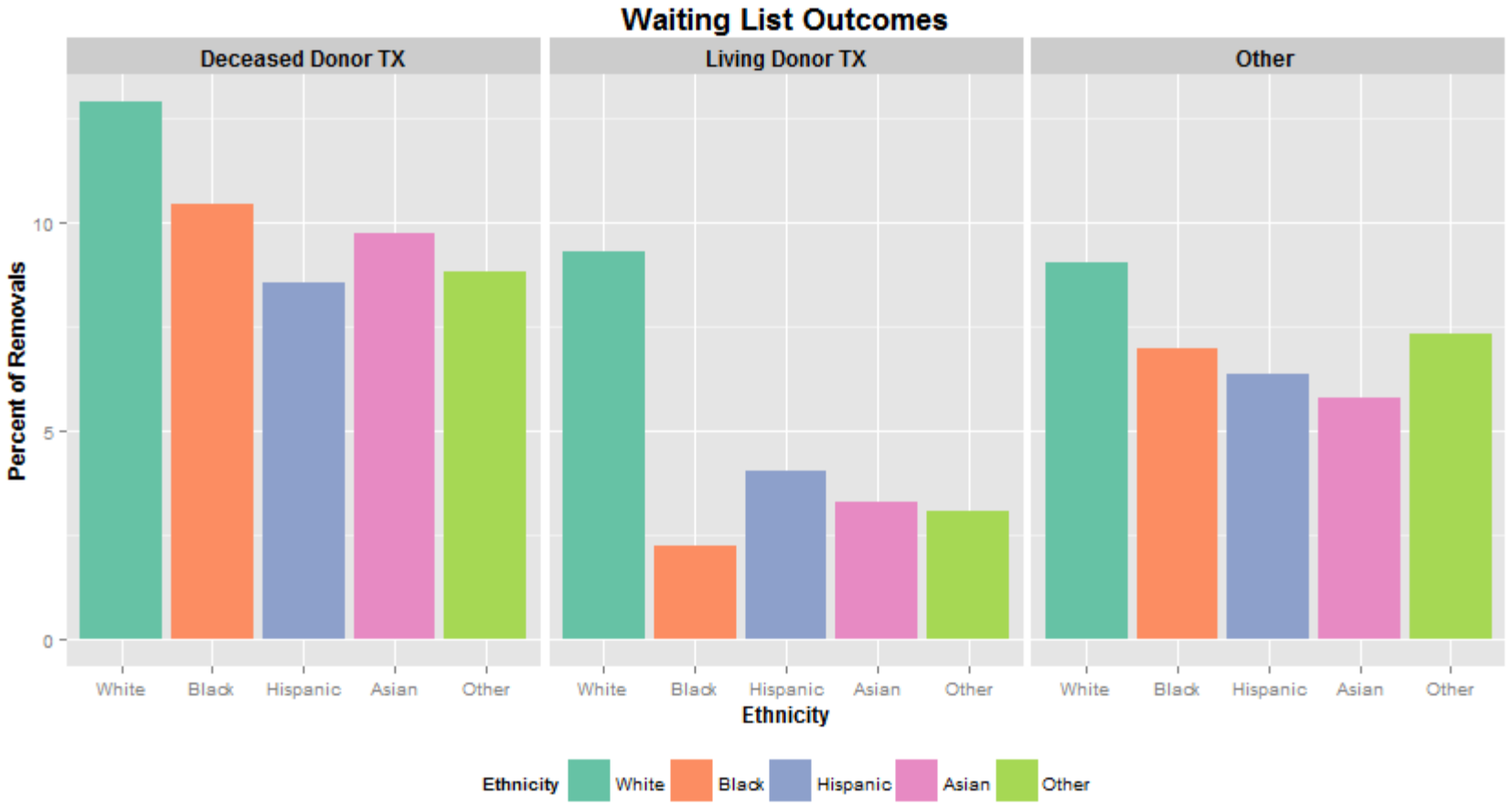
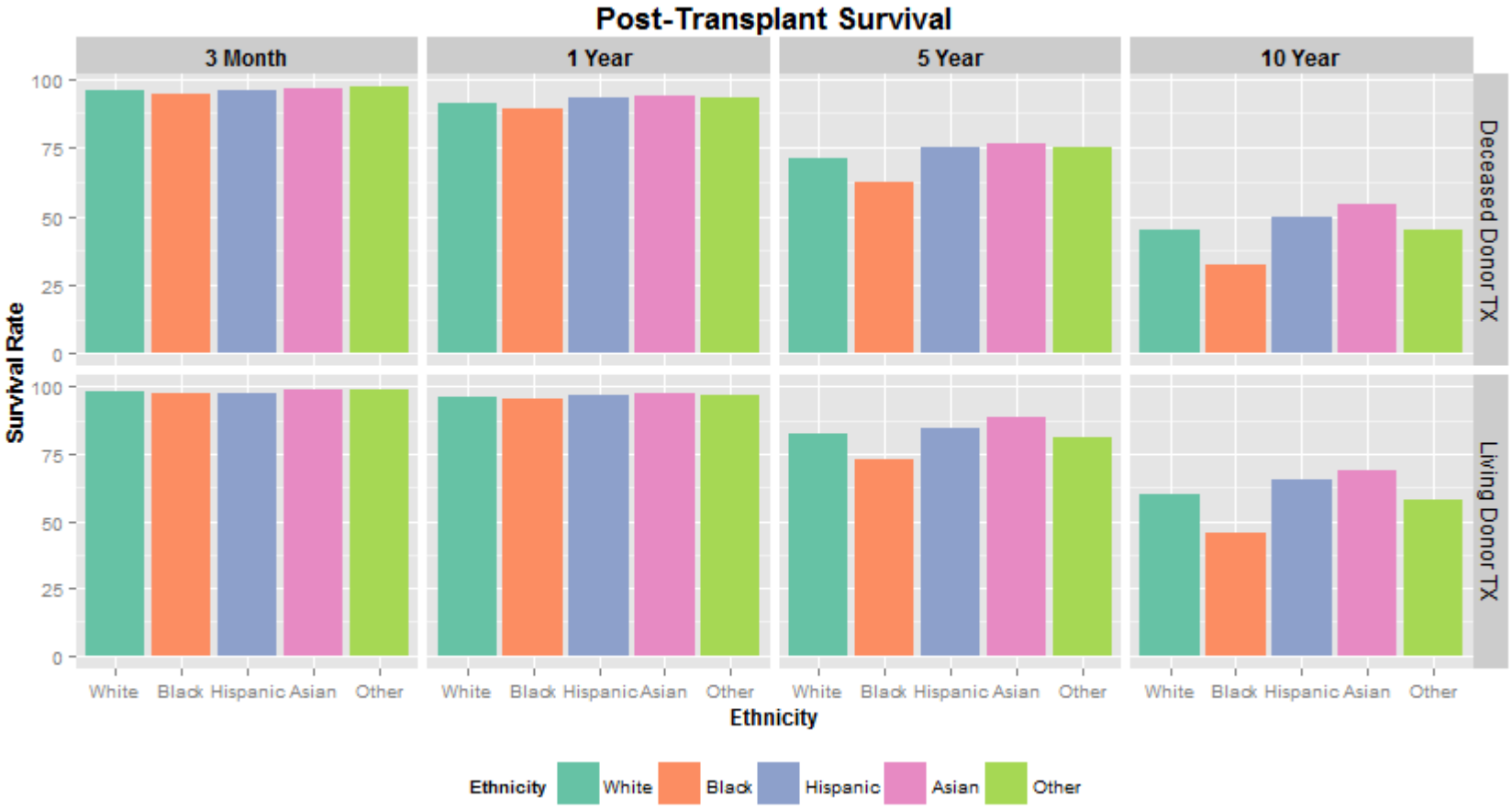
Problem Domain

- **The shortage of organs affects demographic groups of Americans in different ways** [1]



Problem Domain



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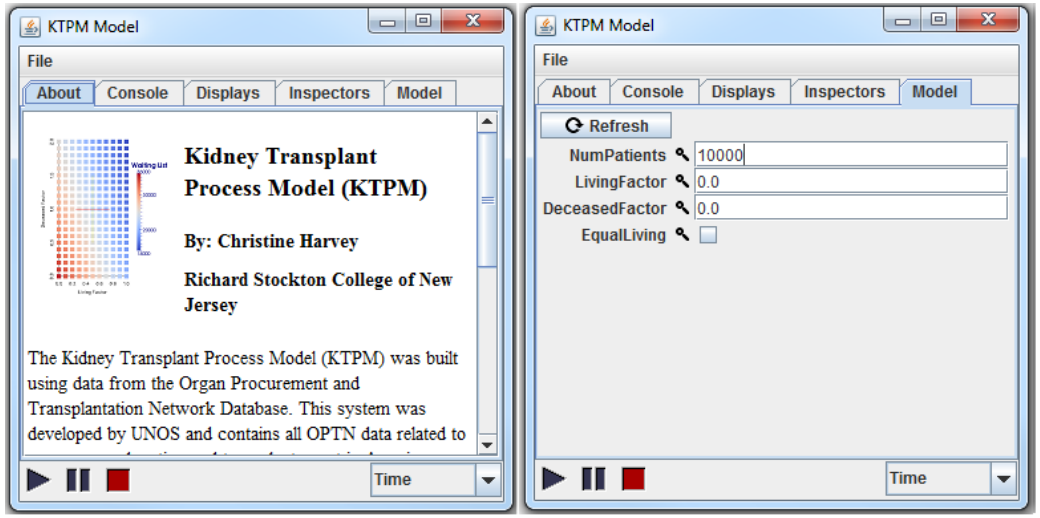
The KTPM - Overview

- **Built using data from the OPTN Database**
  - The OPTN is managed by the United Network for Organ Sharing (UNOS) and tracks every transplant performed in the US since 1987
- **Model was developed using MASON**
- **Demonstrates the kidney transplant process from the initial waiting list to post-transplant survival**
- **Provides analysis for the effects of increased organ availability**



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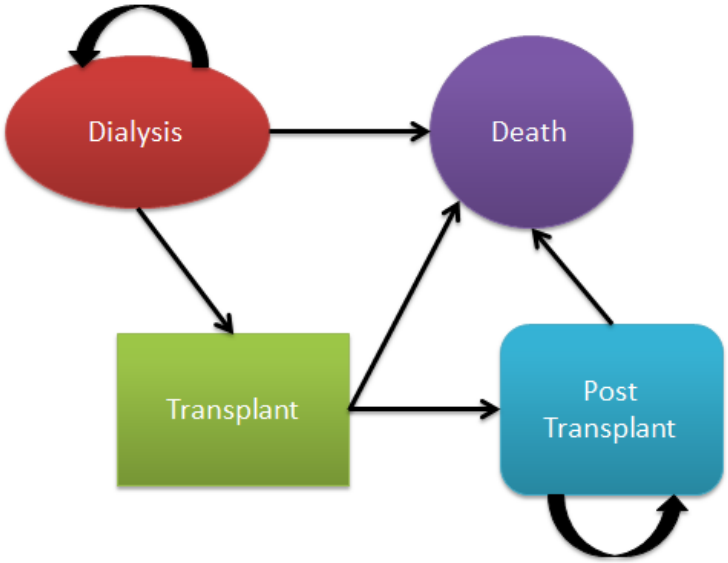
The KTPM - Overview

- **Consists of agents (patients) that are experiencing the transplant process**
  - Waiting List Patients
  - Post-Transplant Patients
  - Deceased/Removed Patients

- **Patients are assigned attributes (age/race)**



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The KTPM – Design Concepts

- **The model has two primary outputs**
  - Individual patients survival/outcome data
  - Overall statistics for the state of the transplant system
- **The probability of an agent receiving a transplant varies with the size of the waiting list**
- **Stochastic processes are used in the initial determination of age/race for the patient and to determine patients outcomes**

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Experiments

- **Experiment I**
  - Investigate increasing the number of living and deceased donors within their own age/race groups

Parameter	Min	Max	Step Size
Living Factor	0.0	2.0	0.1
Deceased Factor	0.0	1.0	0.1

- **Experiment II**
  - Investigate effects of equalizing living transplant probabilities across all racial groups

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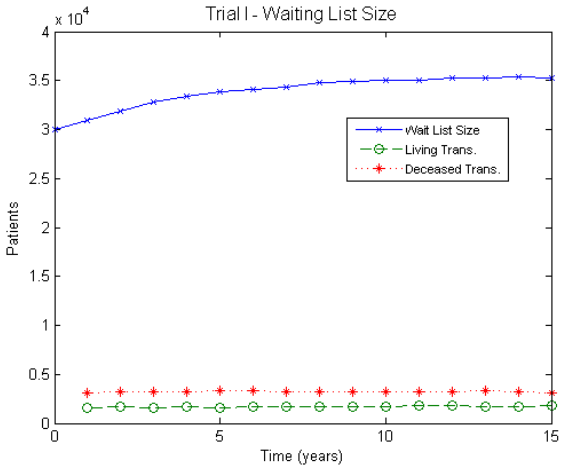
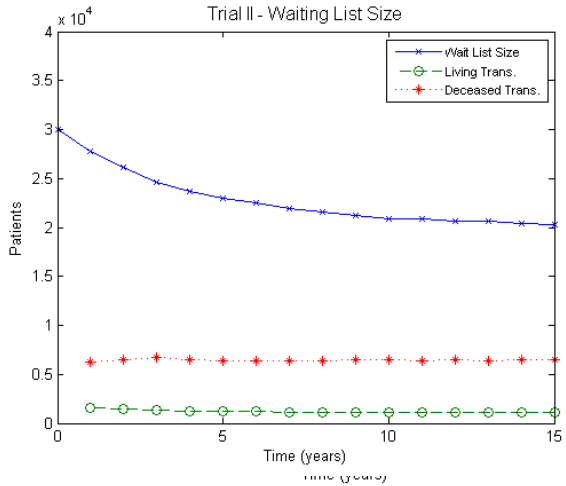
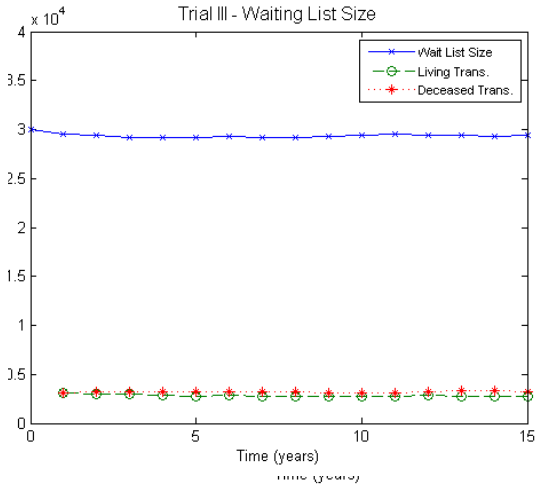
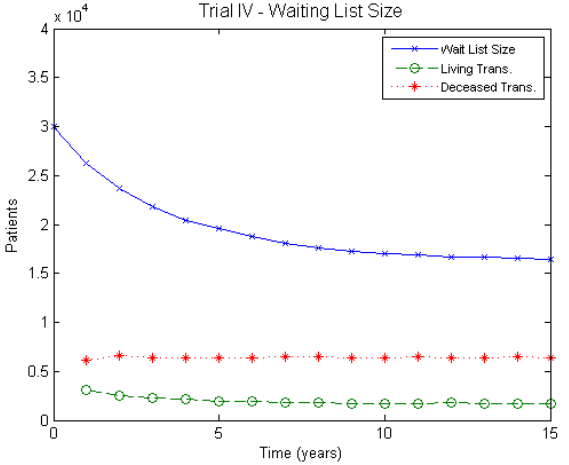
Results – Experiment I







Trial	Living Factor	Deceased Factor	Change in Waiting List
Trial I	0.0	0.0	+18%
Trial II	0.0	1.0	-33%
Trial III	1.0	0.0	-2%
Trial IV	1.0	1.0	-45%



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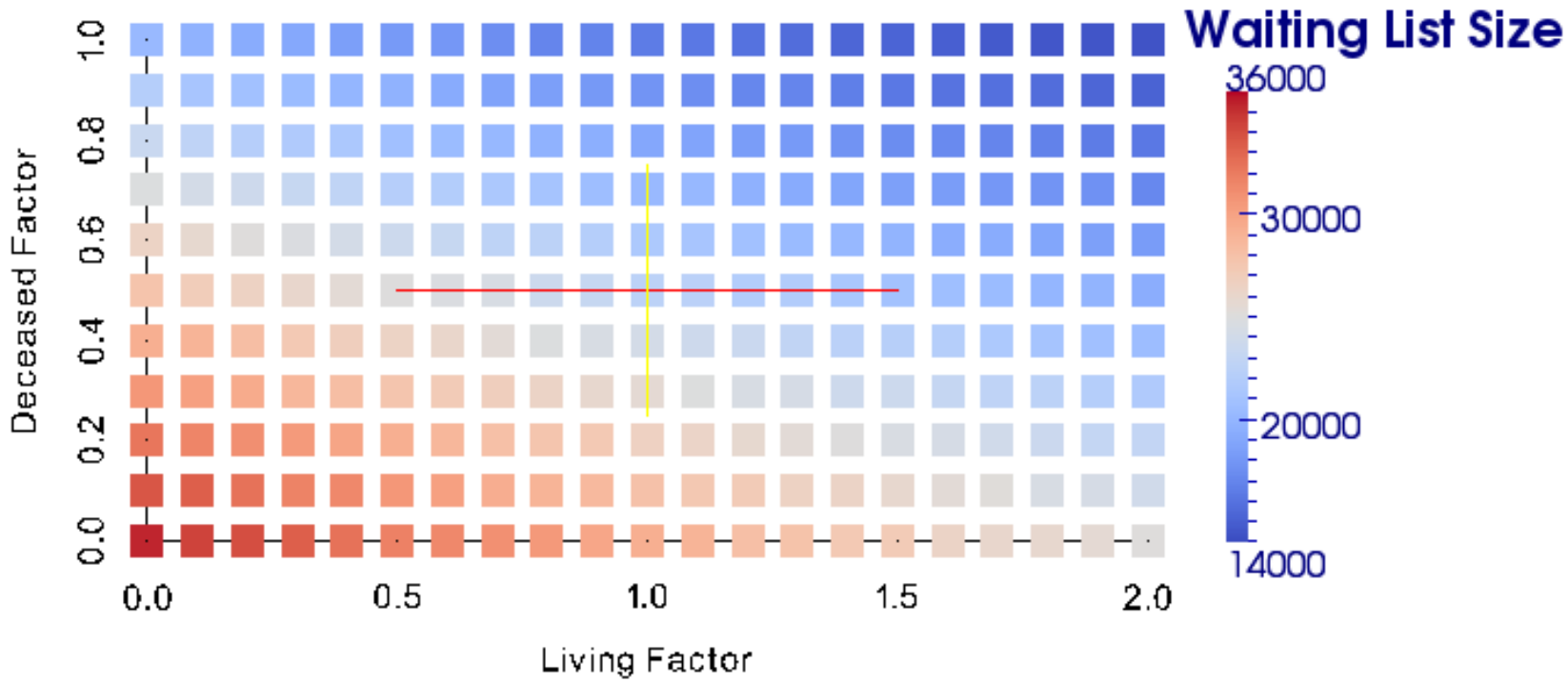
Results – Experiment I

- **Waiting list size after 15 years - range of Experiment I variables**
  - 213 Experiments total



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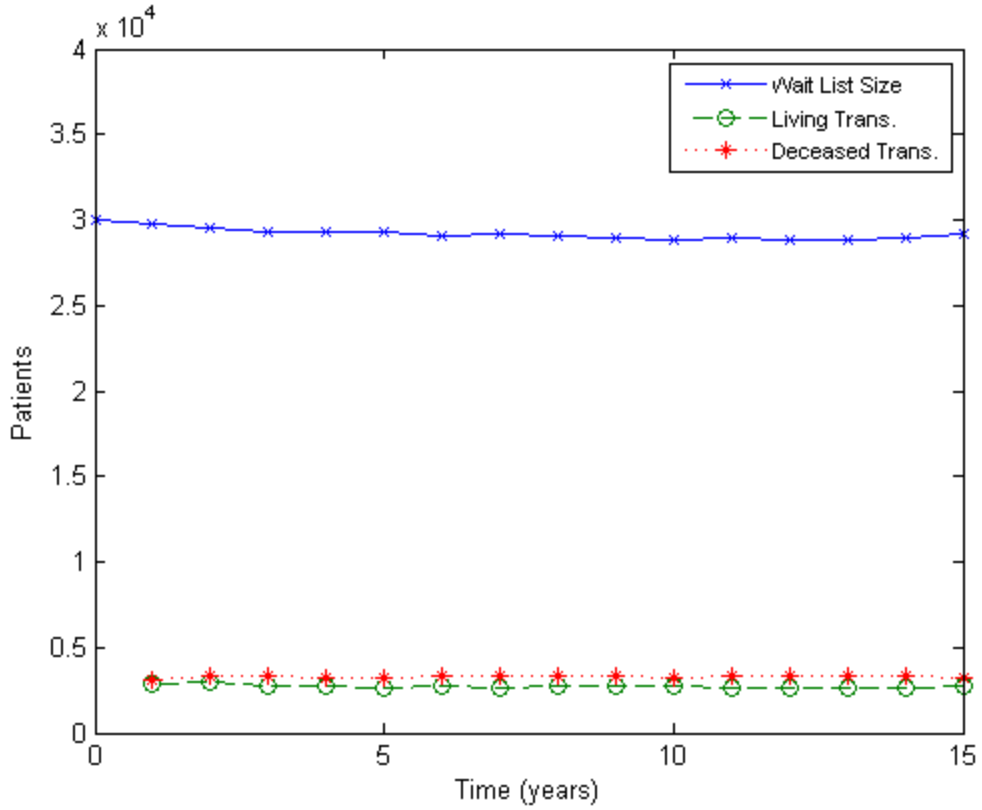
Results – Experiment II

- **Outcome if Living Donation was increased to highest racial rate**
  - Decrease in Waiting List size of 3.5% over 15 years



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Conclusions

- **Increasing donors is necessary to keep the transplant waiting list from growing**
- **Significant increases in living and deceased donation will help solve and decrease this problem**
  - Both types of donation need to be increased
- **Policy and cultural changes are necessary to change the state of the system**

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Future Work

- **Expand model to include more sub-groups of the population**
  - Blood Type
  - Region
  - Education Level

- **Simulate system to explore changes in policy/laws and incentivizations to organ donation**
  - Living/Deceased Donor Incentives
  - Mandatory education programs
  - Social media/advertising campaigns

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References

- [1] Organ Procurement and Transplantation Network, "Organ Procurement and Transplantation Network," 22 July 2014. [Online]. Available: http://optn.transplant.hrsa.gov/.
- [2] Data Collected from the 2009 OPTN Annual Report

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Questions?


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