

Investigating the Kidney Shortage In the U.S. and Current Methods of Providing Kidneys and Proposing 3D Bioprinting as a Solution

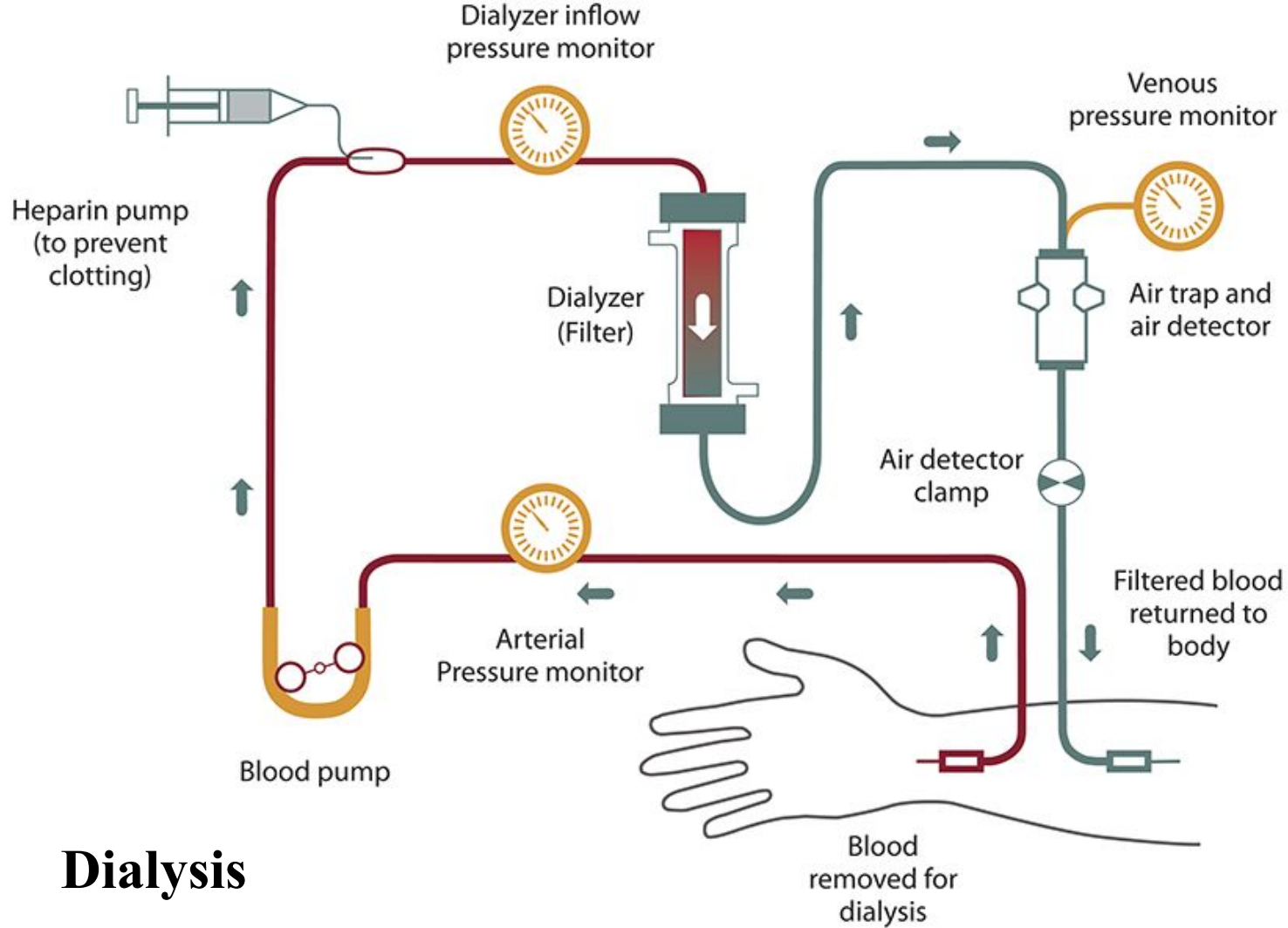
Noah Burr

Background

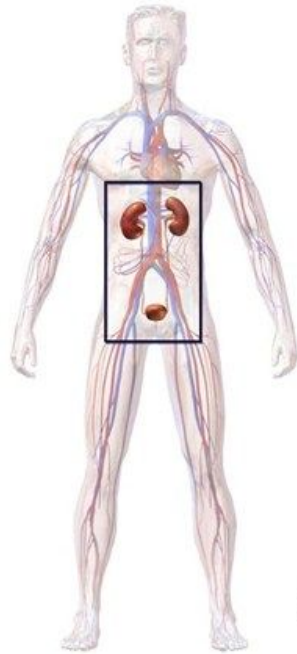
Background

- 661,000 Americans have kidney failure
- National Organ Transplant Act 1984
- Treatment options
 - Dialysis
 - Transplant

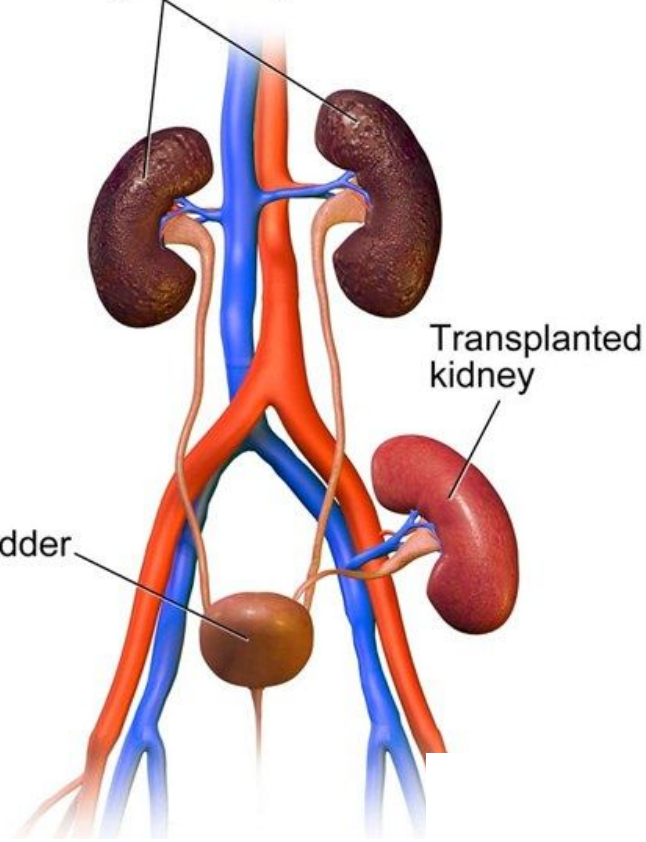




Dialysis



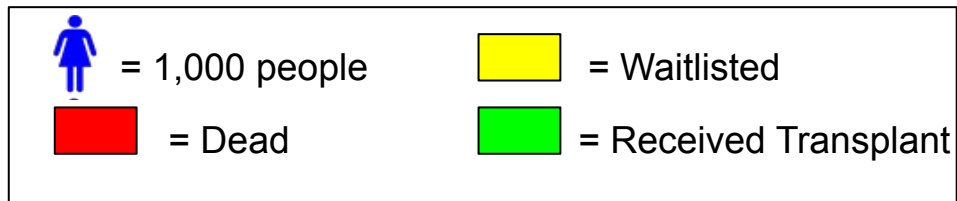
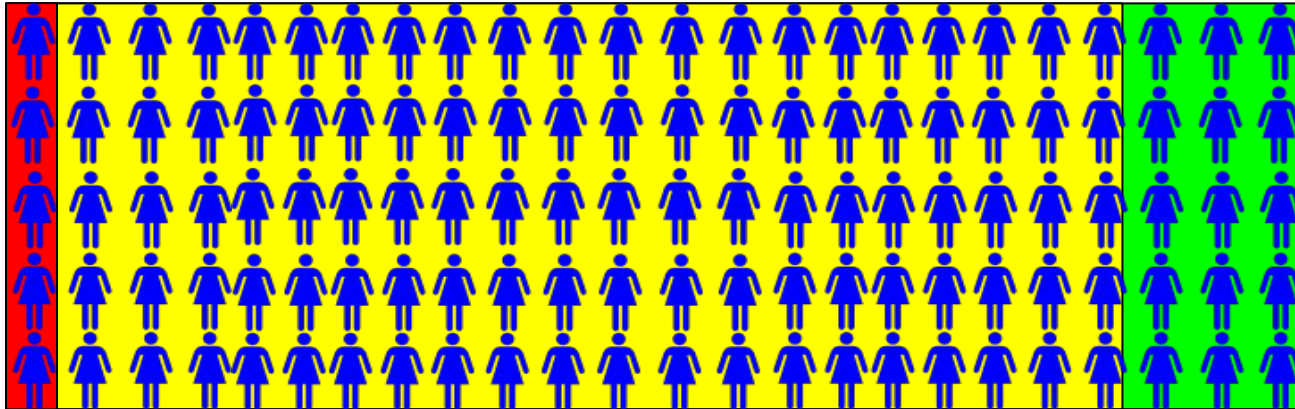
Damaged kidneys



Kidney Transplant

Background

- Annually 121,678 people in need of kidney transplants



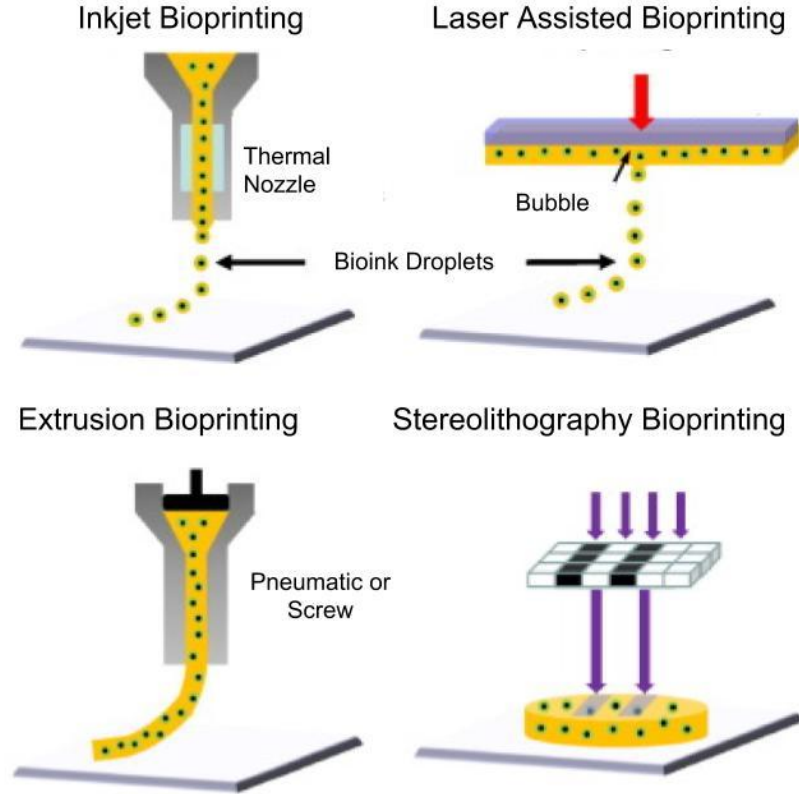
Introduction

Introduction

- Transplant is currently the most viable method
- Live Donor Kidney Transplantation (LDKN)
- Deceased donor transplantation
 - Expanded Criteria Donors (ECD)

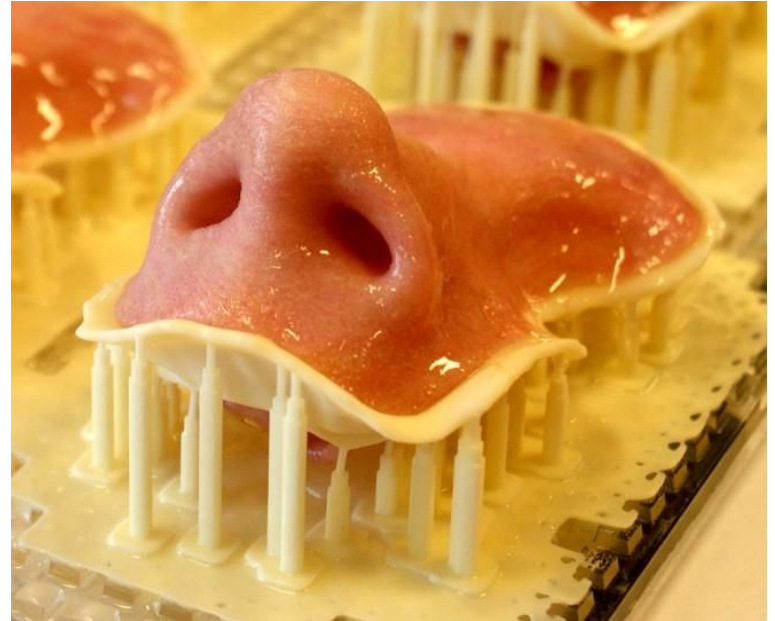
Introduction

- Charles Hull
- 3D Bioprinting
 - Inkjet
 - Laser Assisted
 - Extrusion
 - Stereolithography



Introduction

- Current Medical Uses of 3D bioprinting
 - Bone and cartilage
 - Epithelial tissue
 - Skin
 - Lungs
 - Inside of mouth
 - Partial kidney tissue



Purpose

Purpose

- Research possible kidney shortage
- Analyze current solutions
- Access 3D bioprinting as a solution

Research Question

Research Question

Are the current methods of providing kidneys effective and would 3D bioprinting provide a more efficient means of supplying organs to reduce the shortage in the United States?

Hypothesis Alternative/Null

Hypothesis, Alternative/Null

Alternative Hypothesis: The current methods of providing kidneys for transplantation are not sufficient and 3D bioprinting is the most efficient way of providing donor kidneys to future recipients in the United States.

Null Hypothesis: 3D bioprinting will not provide a more efficient way to acquire kidneys for transplant and will not reduce the kidney shortage in the United States.

Methods

Methods



- Systematic Literature Review
- Secondary Data Analysis

- UNOS
- PubMed
- Google Scholar
- Research Gate
- National Kidney Foundation
- Canadian International Health Institute
- National Kidney Registry
- Organ Procurement and Transplantation Network

- Kidney Transplant Donation Data
- Annual Types of Kidney Transplants
- Viability of Living versus Deceased Donor Kidneys
- Survival Rate of Kidneys Post Transplant

Results

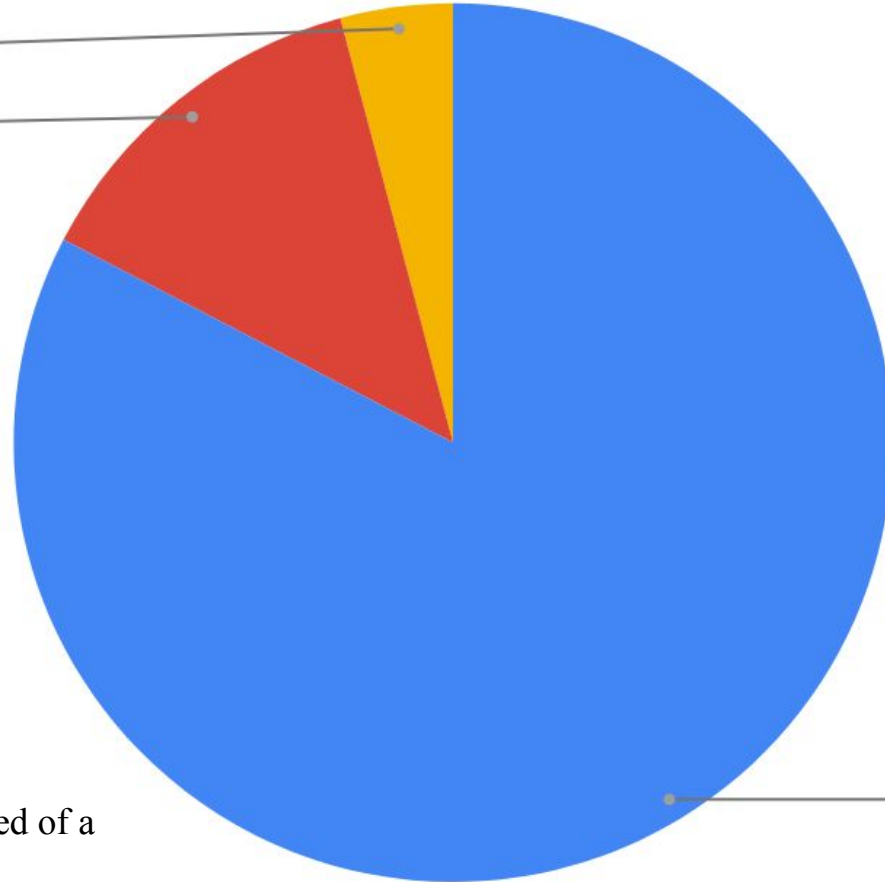
Annual Kidney Transplant Donation Data

Deaths per year

4.1%

Recieved

13.2%



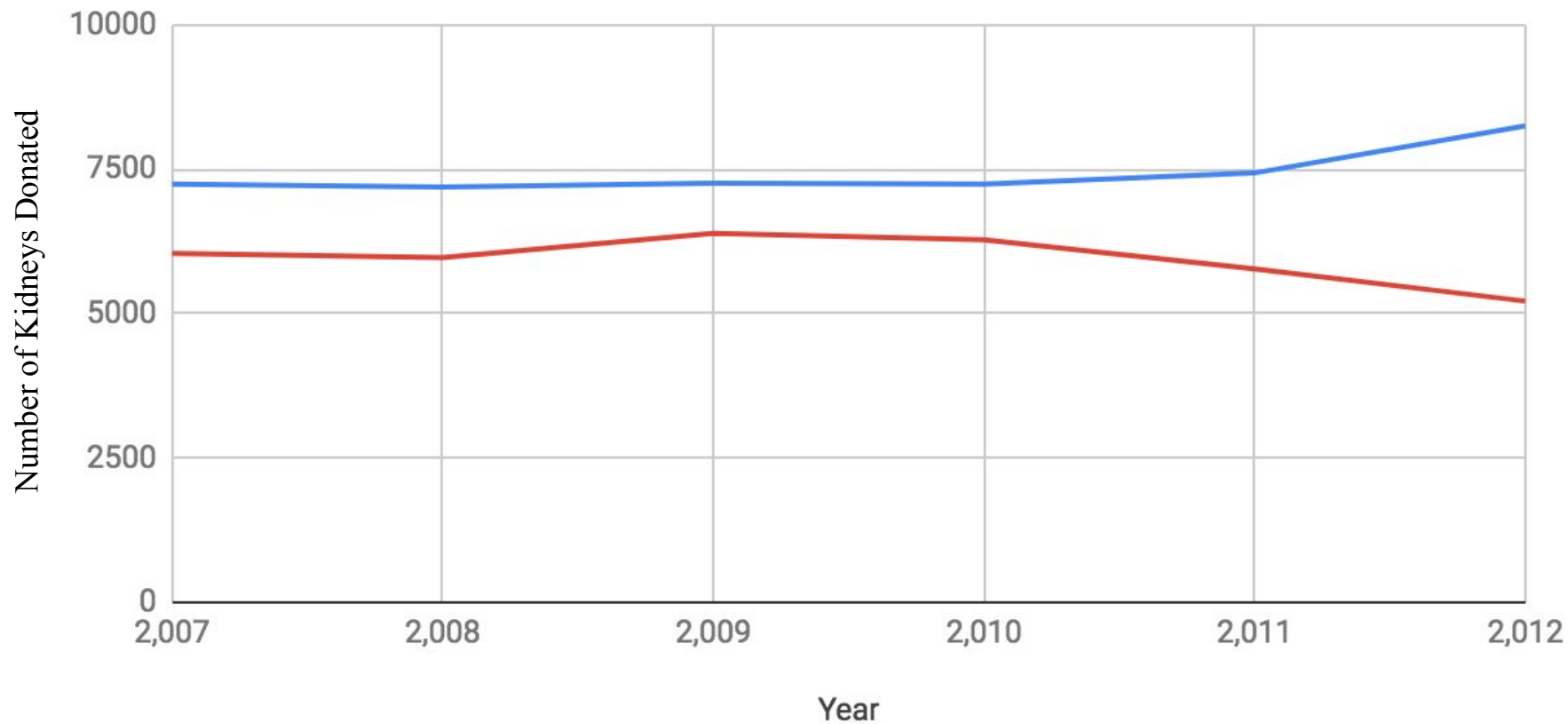
Waitlisted

82.6%

Total Number of Patients In Need of a Kidney Transplant 121,678

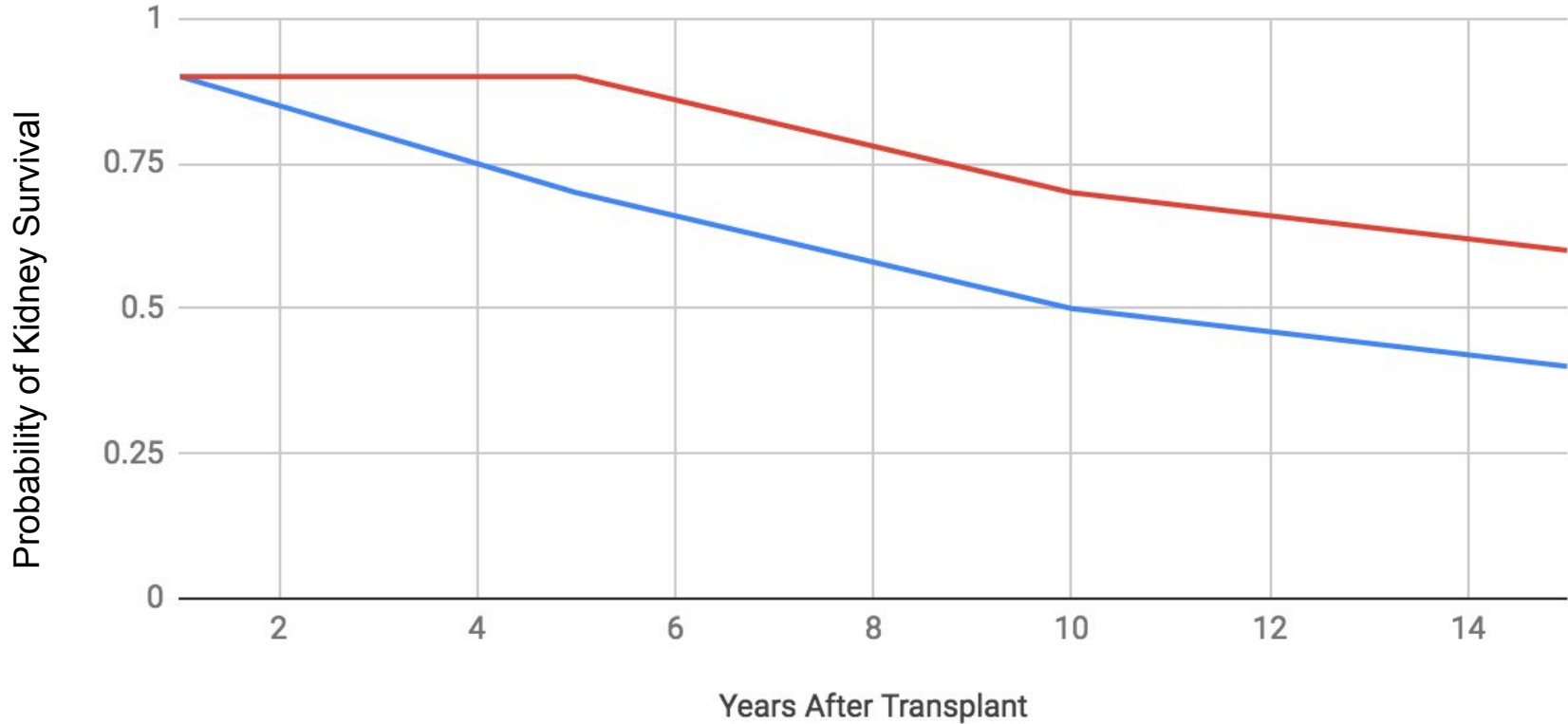
Kidneys Donated Per Year

— Deceased Donor — Living Donor



Probability of Post Transplant Kidney Survival

Deceased Donor Living Donor



Discussion

Discussion

- Prevalent kidney shortage
- Steady increase of deceased donors
- Citizens no longer willing to give kidneys
- Living kidney recipients have greater chances of living in the years after their transplants

Limitations

Limitations

- No published experiments in which entire functioning organs have been printed
- 3D Bioprinting technology is still immature
- 3D Bioprinting data is kept confidential by researchers in private institutions/industry
- 3D Bioprinted kidneys are assumed to be similar in survival rates and viability of LDKT

Conclusions

Conclusions

- Current methods are insufficient
- Bioprinting will be more viable in the future
- Bioprinting eliminates long wait times by fabricating kidneys on demand
 - Projected 8 weeks for 3D bioprinting
 - 6-12 months for LKDT or Deceased Donor/ECD

Further Work

Further Work

- Acquire and assess more recent kidney transplantation statistics
- Locate and review academic studies based on actual experiments comparing 3D bioprinted kidneys to living and deceased ones
- Gather additional information on bioinks technology and its utilization in other fields of commercial medicine

Acknowledgements

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Current Methods of Kidney Transplantation in the U.S and Bioprinting as an Alternate Method

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