



# Lung Transplantation: Overview from Candidacy to Transplant Surgery

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Ambalavanan Arunachalam MD MS



# Disclosures

- None

## Outline

- Patient selection with disease specific consideration: When to refer? When to list?
- Contraindications for transplant
- Relative risk factors that impact candidacy
- Process of transplant evaluation and listing at NMH
- Survival after transplant
- NMH outcomes data compared to regional centers

# Timing of transplant referral

“Transplant Window”



- High (>50%) risk of death from lung disease within 2 years if lung transplantation is not performed
- High (>80%) likelihood of 5-year post-transplant survival from a general medical perspective provided that there is adequate graft function

## Timing of transplant referral

- Sick enough to justify the risks of transplantation, BUT healthy enough to survive transplant surgery
- **Referral should be initiated before the need for transplant becomes urgent**

# Advantages of Early referral

“Referral  $\neq$  transplant listing”

- Provide comprehensive transplant education and setting expectation - discussing risk vs benefit of transplant
- Address modifiable barriers – obesity, malnutrition, medical comorbidities, psychosocial concerns, rehab
- Comprehensive assessment of other organ functions
- Rule out occult malignancies
- Vaccination

## Absolute contraindications for transplant

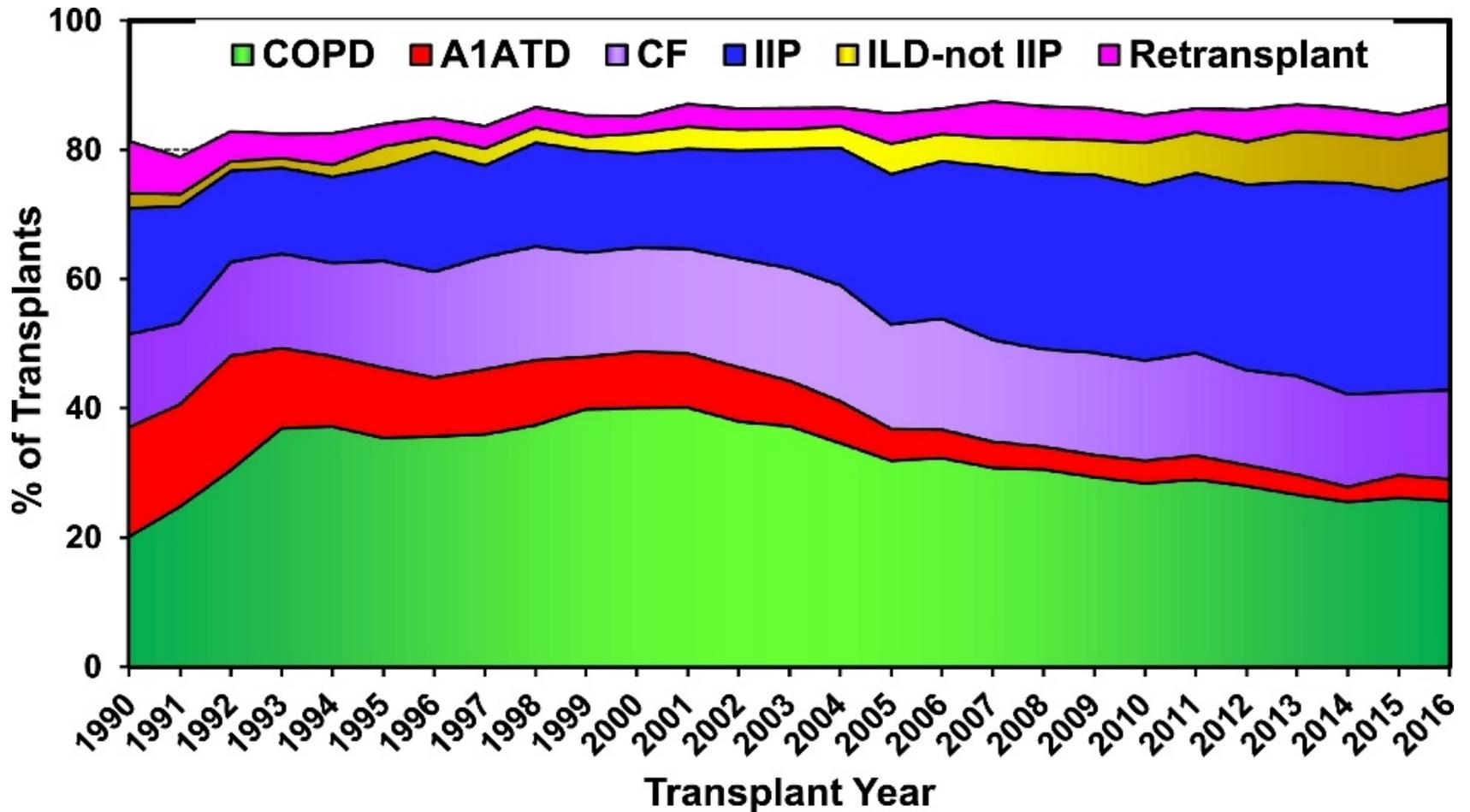
- Critical or unstable medical condition
- No significant organ dysfunction
- Pan resistant organisms
- Obesity BMI>32 (for COVID ARDS BMI<35) or BMI<17
- Smoking/Substance abuse
- Active malignancy within 2 years (5 years for some tumors)
- Active HIV, Hep B, Hep C with liver dysfunction
- Symptomatic osteoporosis
- Psychosocial concerns – non adherence, lack of support, etc

# Risk factors that impact transplant candidacy

Variable criteria based on transplant center and experience

- Age >70 years
- Multi vessel CAD that requires bypass during transplant
- BMI >35 or BMI <16
- Esophageal dysmotility
- Chest wall deformity
- LVEF<40%
- Limited potential for post transplant rehabilitation

# Who is a candidate? Indications for Transplant



# Chronic obstructive pulmonary disease

## Guidance for referral

- BODE index cited as the prognostic model of choice by ISHLT
- BODE score 5-6 with additional risk factors: frequent exacerbations, increase in BODE $>1$  over 2 years, FEV<sub>1</sub> 20-25% pred
- Poor QOL

**Table 2.** Variables and Point Values Used for the Computation of the Body-Mass Index, Degree of Airflow Obstruction and Dyspnea, and Exercise Capacity (BODE) Index.\*

Variable	Points on BODE Index			
	0	1	2	3
FEV <sub>1</sub> (% of predicted) <sup>†</sup>	≥65	50–64	36–49	≤35
Distance walked in 6 min (m)	≥350	250–349	150–249	≤149
MMRC dyspnea scale <sup>‡</sup>	0–1	2	3	4
Body-mass index <sup>§</sup>	>21	≤21		

# Chronic obstructive pulmonary disease

## Indications for listing

- BODE score 7-10
- FEV<sub>1</sub><20% pred
- Presence of moderate to severe pulmonary hypertension
- Three or more severe exacerbations over the past year
- Chronic hypercapnia (Paco<sub>2</sub>>50mmHg)

# Special consideration for COPD

## Simultaneous referral for LVR and transplant

- Lung volume reduction (LVR) either surgical or bronchoscopic approach
- Optimize patients suitability as a future transplant candidate
- Prior LVRS can pose technical challenges due to adhesions
- No major difference in post-transplant survival outcomes compared to patients who had undergone transplant alone

# Interstitial lung disease

Referral should be made at the time of diagnosis

- Idiopathic pulmonary fibrosis (IPF) 3-5 year survival after diagnosis when untreated
- Non IPF ILD: variable prognosis based on histological dx or HRCT patterns
- Clinical predictors for survival in non- IPF ILD: FVC and DLCo decline, Hospitalization, frailty, o2 use and functional symptoms

# Interstitial lung disease

## Transplant listing

- Any form of pulmonary fibrosis with one of the following in 6 months:
  - decline in FVC >10%
  - decline in DLCo>10%
  - decline in FVC>5% with CT progression
  - >50m decline in six minute walk
- Desaturation <88% on 6 minute walk
- PH on echo or RHC
- Hospitalization for acute exacerbation
- Pneumothorax



# Interstitial lung disease

## Special consideration

- Close attention to extra pulmonary manifestation
- Renal disease
- GI motility disorders
- Occult malignancies
- Familial disorders - telemeropathy

# Cystic fibrosis and non CF bronchiectasis

## Mortality predictors and referral

- FEV1 is the best individual predictor of mortality
- CF Median survival of 6.6 yrs after reaching FEV1<30%
- Other predictors of mortality: Infections, BMI<18, female sex, DM, >1 exacerbation per year, hemoptysis, malnutrition, co2 retention
- Predictors of survival may need re-evaluation with use of highly effective CFTR modulators

# Cystic Fibrosis and non CF bronchiectasis

## Transplant listing

- FEV1<25%
- >30% decline in lung function in FEV1 over 12 months
- Recurrent exacerbation requiring IV antibiotics
- PH on echo and/or right heart catheterization
- FEV1<40% with one of the following: 6 mwd <400m, paco<sub>2</sub>>50mmHg, hypoxia, PH, malnutrition, hemoptysis, pneumothorax

# Cystic Fibrosis and non CF bronchiectasis

## Special consideration

- Infections with resistant organisms – especially Burkholderia cepacia complex, nontuberculous mycobacteria, and fungal
- Non CF bronchiectasis prognosis is variable compared to CF
- Extra pulmonary manifestation of disease – nutrition, diabetes, sinus, occult malignancies
- Lower threshold for referral and listing for females and those with short stature, diabetes, or increasing antibiotic resistance

# Pulmonary arterial hypertension

## Guidance for referral

- Serial risk assessment and response to vasodilator therapy
- REVEAL 2.0 score of >8 despite appropriate therapy
- 2015 ESC/ERS with “intermediate” or “high risk” category
- Unable to achieve “low risk” status despite maximal PAH therapy within 6-months
- RV dysfunction on echo
- IV or SC prostacyclin therapy initiation
- Scleroderma associated PAH

# Pulmonary arterial hypertension

## Transplant listing

- ESC/ERS high risk category or REVEAL risk score  $>10$  on appropriate PAH therapy
- Progressive hypoxemia
- Renal dysfunction (early) due to PAH

# COVID ARDS and Post-COVID pulmonary fibrosis

Evolving area for transplant consideration – Referral/listing

- ~4-6 weeks of maximal support with evidence of irreversible lung damage
- Single organ failure
- BMI < 35
- Awake, participating in physical therapy
- Cleared COVID with 2 negative PCR samples from BAL
- Rehab potential
- Assess routine comorbidities

## Challenges with COVID ARDS

- ECMO complications
- Psychosocial burden
- Malnutrition associated with critical illness
- Critical illness myopathy
- HAP/VAP organisms
- Bleeding complications related to pleural adhesions
- Highly sensitized patients partly due to blood product requirement during critical illness
- Prolonged rehab course and vent dependence post transplant

# Transplant work up process at NMH

## 5 day evaluation

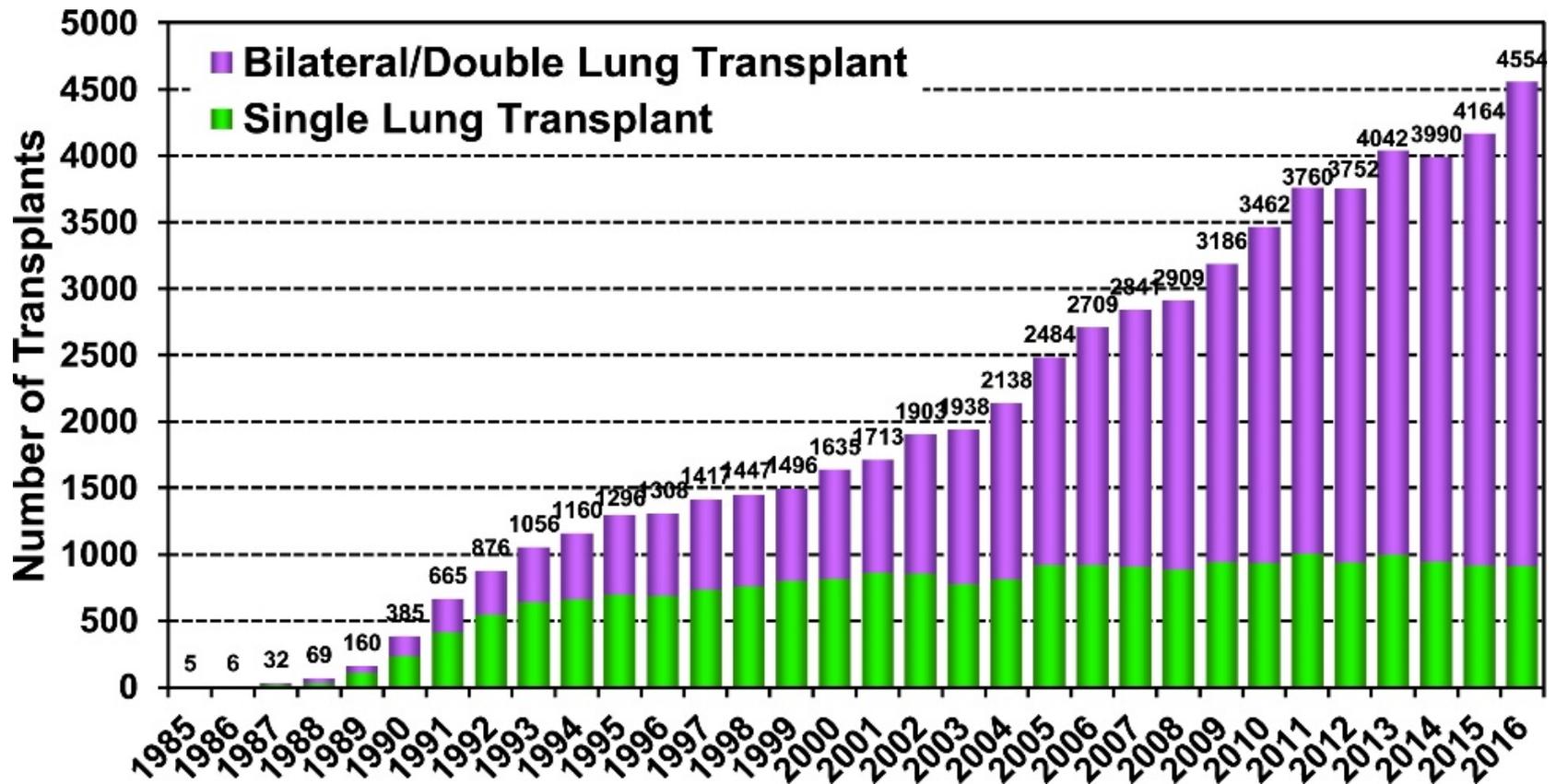
- Initiate 5 day evaluation after in person consultation
- Routine blood work, viral and hepatitis serologies
- Cardiac: Echo, right/left heart cath, +/- cardiac MRI
- GI: esophageal manometry or esophagram
- PFT, CT chest, +/- Sinus CT, sniff test, +/- diaphragm USG
- Bone densitometry
- Routine age appropriate cancer screening
- Consultation: transplant ID, thoracic surgery, dental, dermatology, GI, cardiology, HLA lab

# Transplant listing and lung allocation score

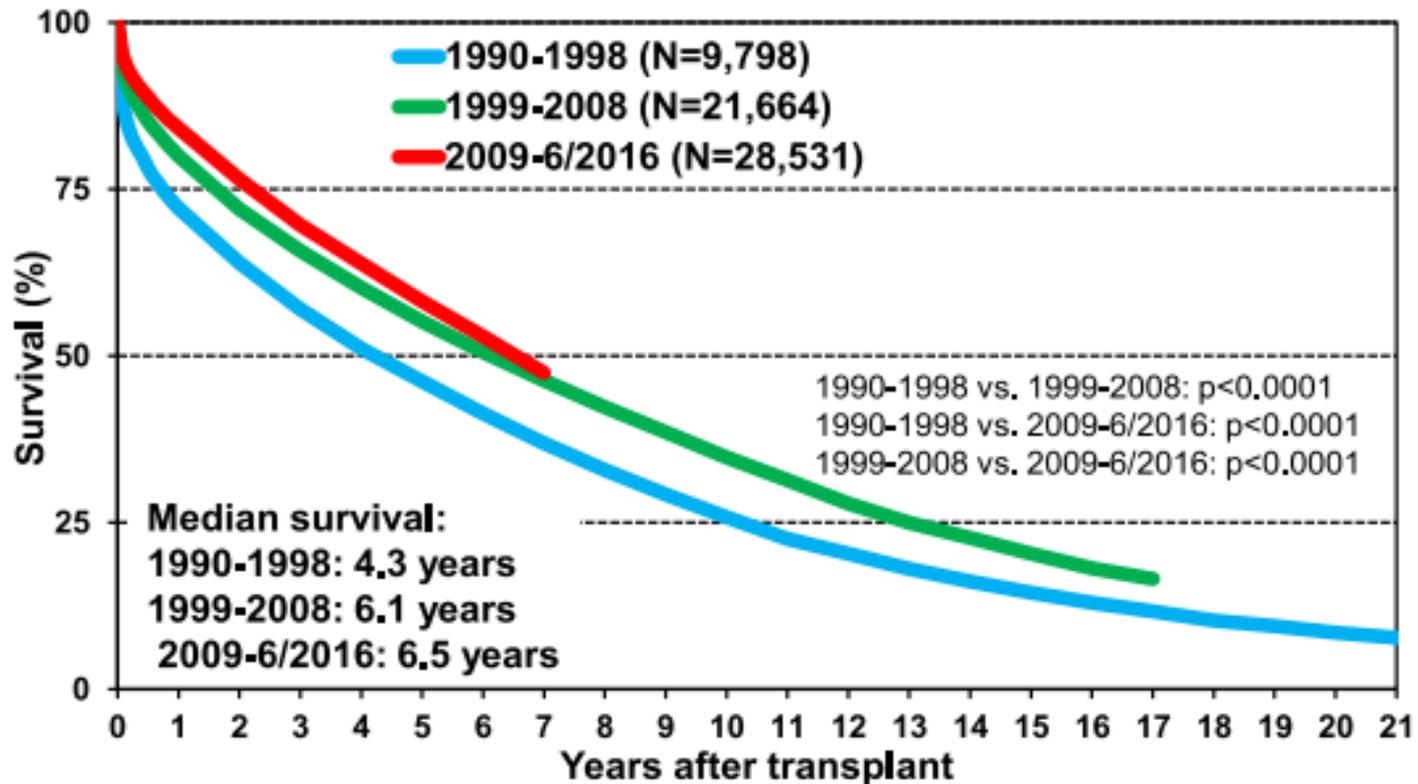
MDM discussion for listing

- Lung diagnosis
- Date of birth
- New York Heart Association Class
- Assisted ventilation
- Height and weight
- Diabetes
- Supplemental oxygen
- Percent predicted FVC
- Six minute walk distance
- Serum creatinine
- Right atrial pressure
- Mean pulmonary artery pressure
- Cardiac index

# Number of lung transplants by year and type

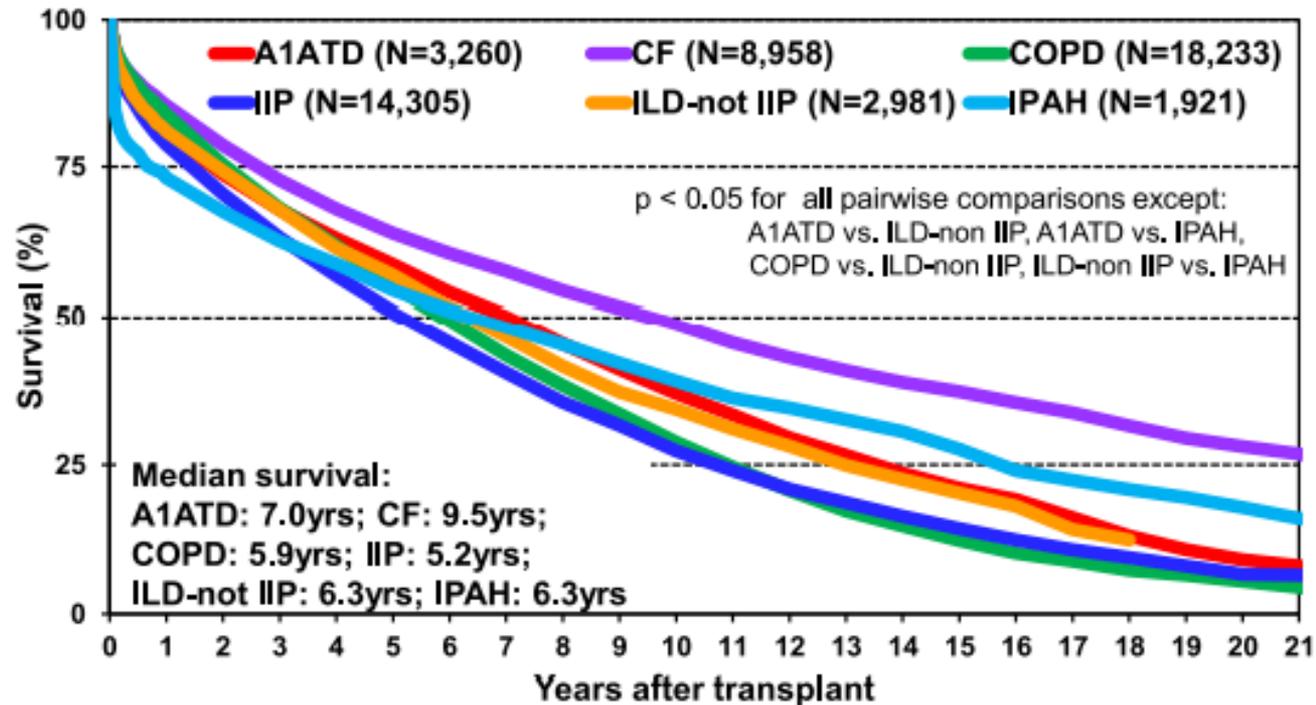


# Transplant survival



For recipients who survived to 1 year, the median survival is 8.7 years

# Disease specific transplant survival



## Transplant survival

- infection and “graft failure” remain the leading causes of death in the first post-transplant year
- death after 5 years is predominantly from chronic rejection, malignancy, and infection

# UNOS data – Regional centers

## Transplant volume

Center	2021	2020
<b>Northwestern</b>	<b>58</b>	<b>49</b>
Loyola	27	34
University of Chicago	17	7
University of Wisconsin	26	31
Henry Ford	16	22
Spectrum Health	34	48
University of Michigan	28	55
Indiana University	24	42
University of Iowa	21	23

## SRTR data – Regional outcomes

- **Northwestern 89.8% 1 year survival**
- Loyola 80.9% 1 year survival
- University of Wisconsin 87.8 % 1 year survival
- University of Michigan 87.1 % 1 year survival
- University of Iowa 88.7 % 1 year survival
- Henry Ford 86.1 % 1 year survival
- Indiana 87% 1 year survival

## SRTR data - national outcomes (50 and above)

- **Northwestern 89.8% 1 year survival**
- Duke University 87.9% 1 year survival
- Cleveland Clinic 88.8% 1 year survival
- Temple 88.1% 1 year survival
- Stanford 90.4% 1 year survival

Questions?



Thank You

Email: [arunachalam@northwestern.edu](mailto:arunachalam@northwestern.edu)

