

# The Medical Evaluation of Living Kidney Donors 2022

David Serur, MD  
Medical Director, Kidney Transplantation  
Hackensack Univ Med Ctr  
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ΑΙ ΔΕ ΠΟΛΙΤΕΣ  
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ΑΙΜΙΝ ΤΙΣ

# Hippocratic oath-5<sup>th</sup> century BC

- “I will use treatment to help the sick according to my ability and judgment, but never with a view to injury and wrong-doing”
- “I will abstain from all intentional wrong-doing and harm, especially from abusing the bodies of man or woman”

# More Modern

- “The eternal providence has appointed me to watch over the life and health of Thy creatures...lofty aim of doing good to Thy children” –Maimonides 12<sup>th</sup> century
- “primum non nocere” (Do no harm)—17<sup>th</sup> century
- “Practice two things in your dealings with disease: either help or do not harm the patient”—19<sup>th</sup> century surgeon Thomas Inman

# Risk to the Donor

- Immediate: Risk of death
- Immediate: Surgical Complication Risk
- Long term: ESRD risk
- What level of Risk is acceptable? 1%, 2%, 5% ?

## **Annual mortality risk (AMR)**

Grand Prix racing: 1 in 100

Motorbike racing: 1 in 1,000

Canoeing: 1 in 10,000

Soccer & rugby: 1 in 100,000

Running/jogging: 1 in 1 million

Swimming: 1 in 1 million

Risk of dying in a car accident: 1 in 6,700

Recreational climbing - Annual mortality risk of 1 in 1,750

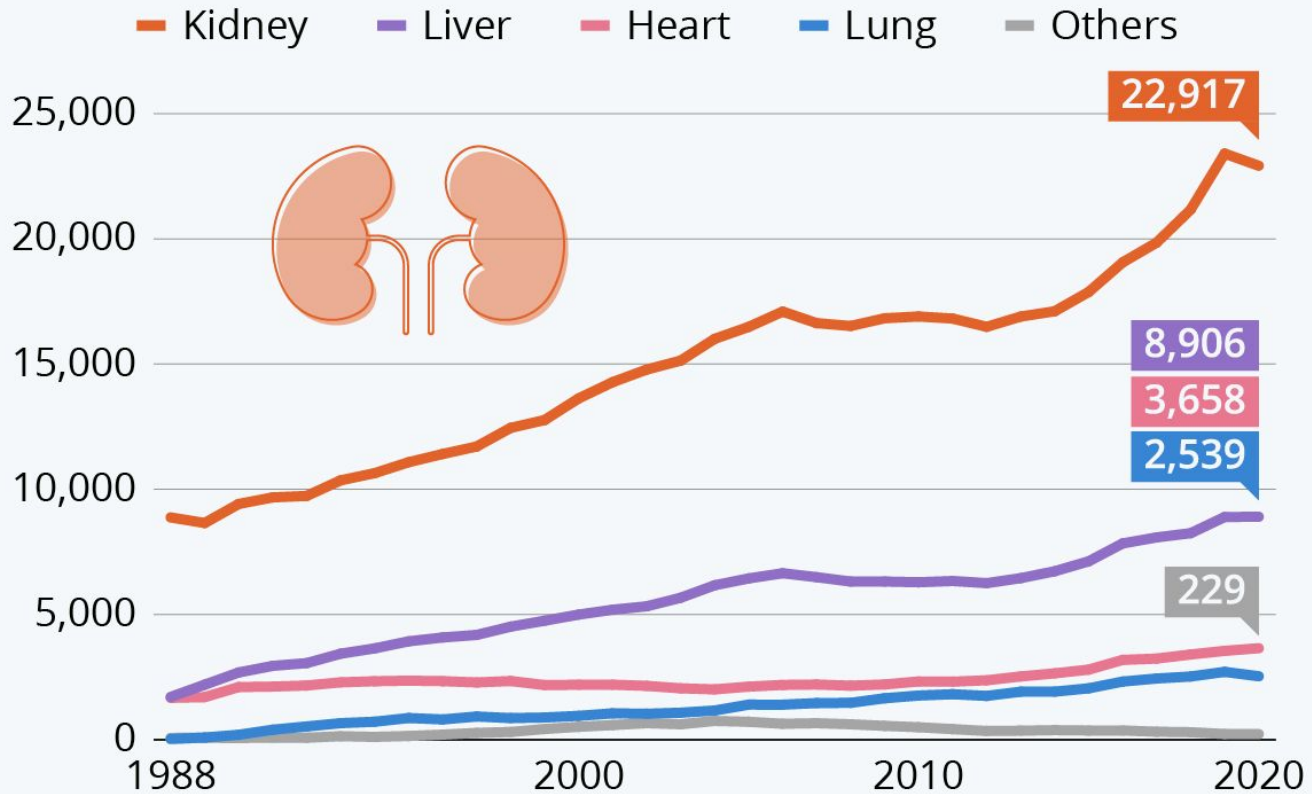
Expert mountain climbers: Annual mortality risk of 1 in 167

Boxing Mortality rate: 0.0455 (/100 participants)

Source: <http://www.besthealthdegrees.com/health-risks/>

# Kindney Transplants on the Rise

Number of organ transplants in the U.S. (1988-2020)



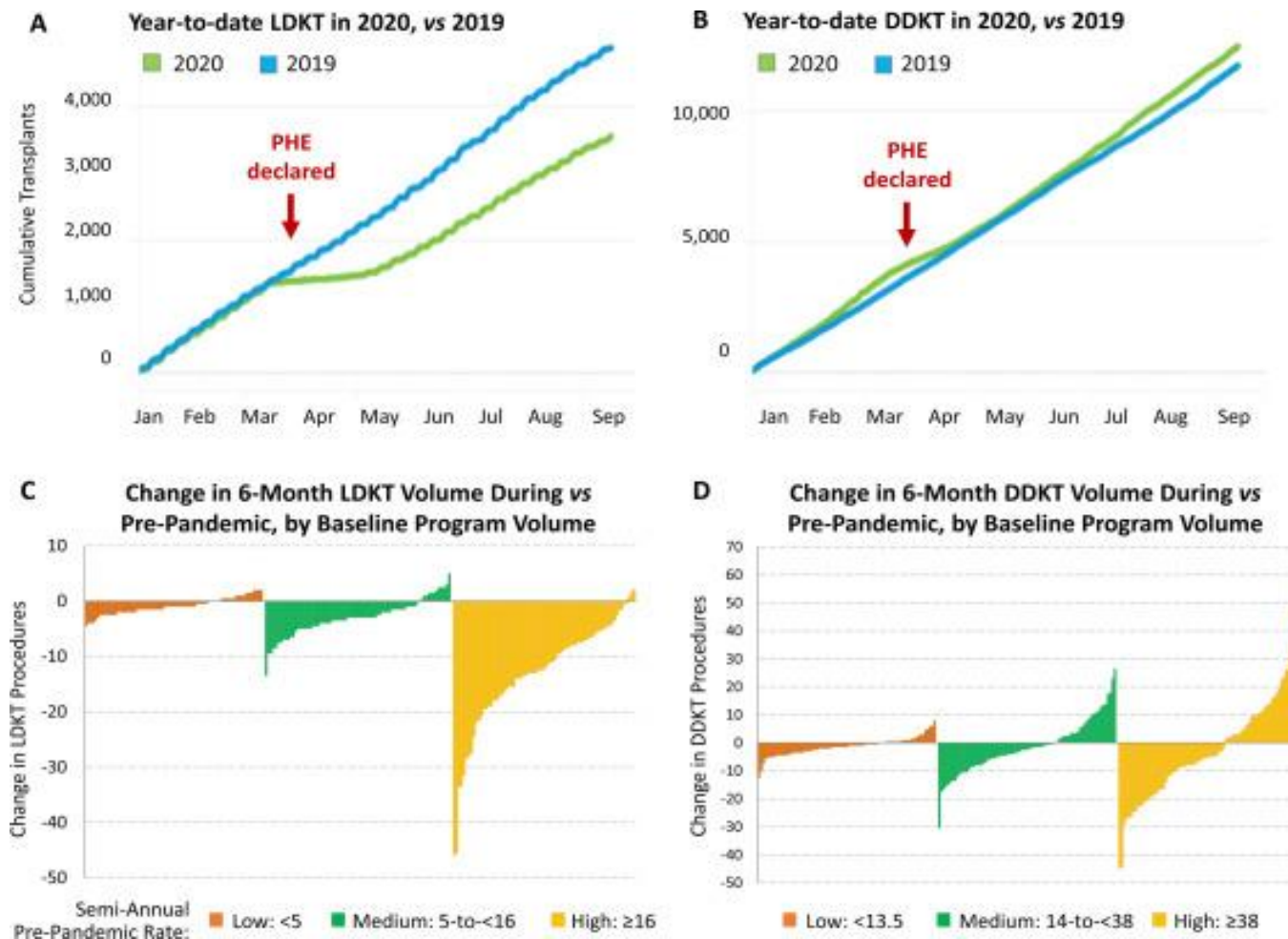
Source: U.S. Department of Health and Human Services



[https://docs.google.com/presentation/d/1LFXSfcopliYg\\_CjUnLRsCAzyanwbXO4-1cmzdferKRs/edit#slide=id.g10d5a8dd04e\\_0\\_0](https://docs.google.com/presentation/d/1LFXSfcopliYg_CjUnLRsCAzyanwbXO4-1cmzdferKRs/edit#slide=id.g10d5a8dd04e_0_0)

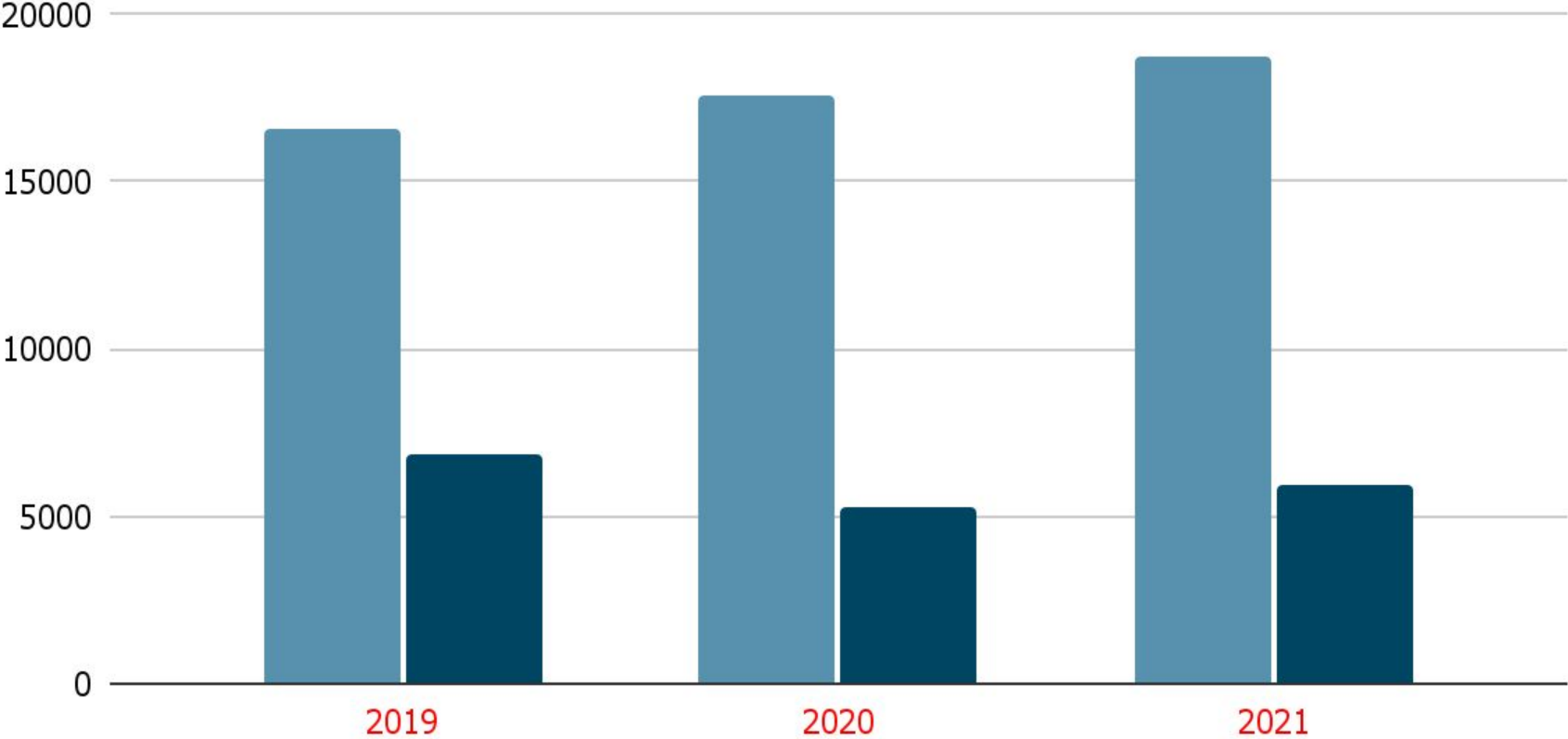


## Kidney Transplantation During the COVID-19 Pandemic



# US Transplants

Cad Living



UNOS 2022

# 2021 | Most lives ever saved in one year

More than  
**40,000**  
lifesaving  
transplants  
*—a first!*



Record numbers  
of **kidney, heart**  
& **liver** transplants\*

**11<sup>th</sup>**  
record year  
in a row for  
deceased  
donation

\*Based on OPTN data as of Jan. 10, 2022. Data subject to change based on future data submission or correction.



UNOS 2022

# Living Donor Evaluation (JSWG)

- Complete history and physical
- Height, weight, BMI
- BP at two different settings on different days
- General laboratory to assess:
  - hematologic status
  - coagulation
  - electrolytes
  - fasting lipids and glucose
  - liver status
- CXR
- ECG
- Age appropriate evaluation for cancer

# Kidney Evaluation

- Urinalysis with microscopy; UC
- 24 hour urine for albumin excretion and creatinine clearance
- Anatomic Testing for anatomy definition (CT, MRA)

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). She asks: What are my risks of dying? Complications? Kidney failure?

# Donor Mortality

0.03% (30 days)

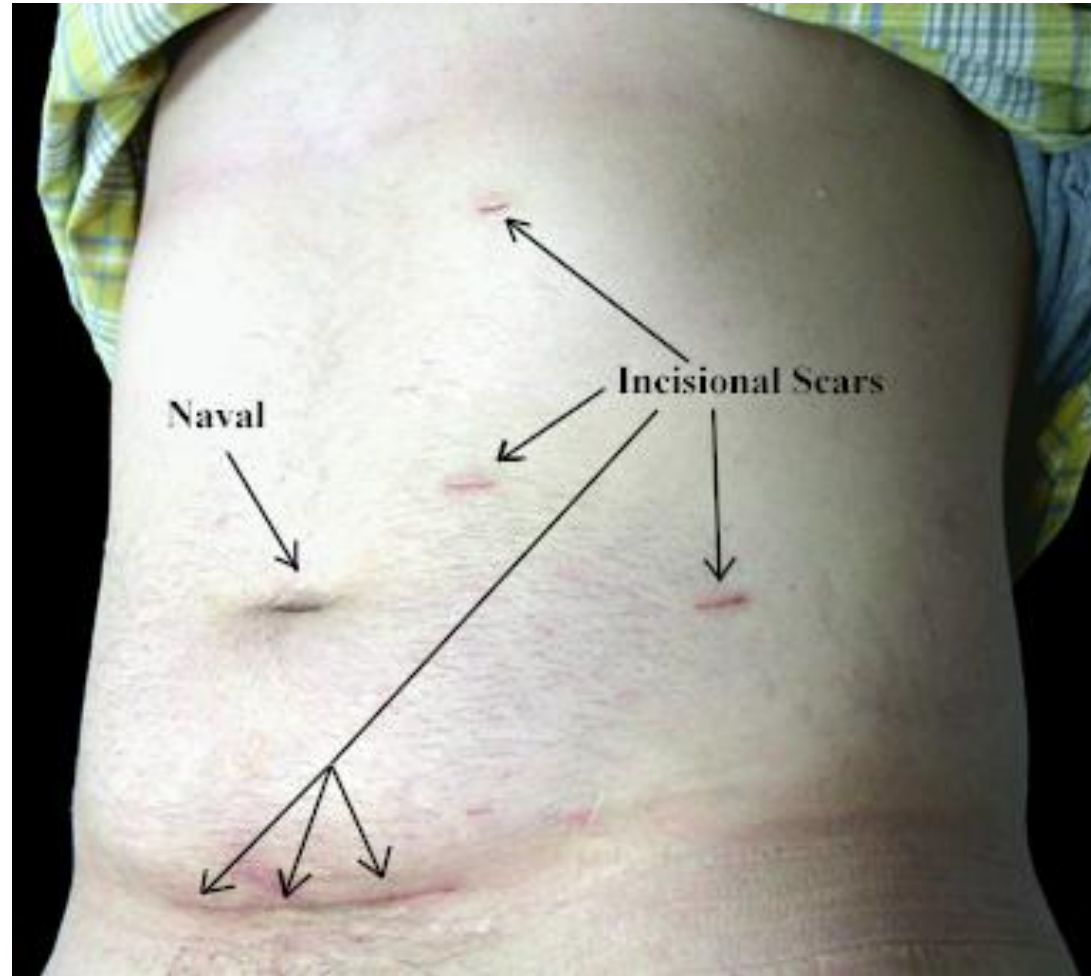
.007% (inpatient stay)

(appendectomy 0.2%, Choley 0.4%)

\*Davis, CL. Living Kidney Donors: Current State of Affairs. *Advances in Chronic Kidney Disease*, 2009;

\***Lentine, et al.** *American Journal of Transplantation*  
[Volume 16, Issue 6](#), pages 1848-1857, 10 MAR 2016

# Traditional Lap Nephrectomy



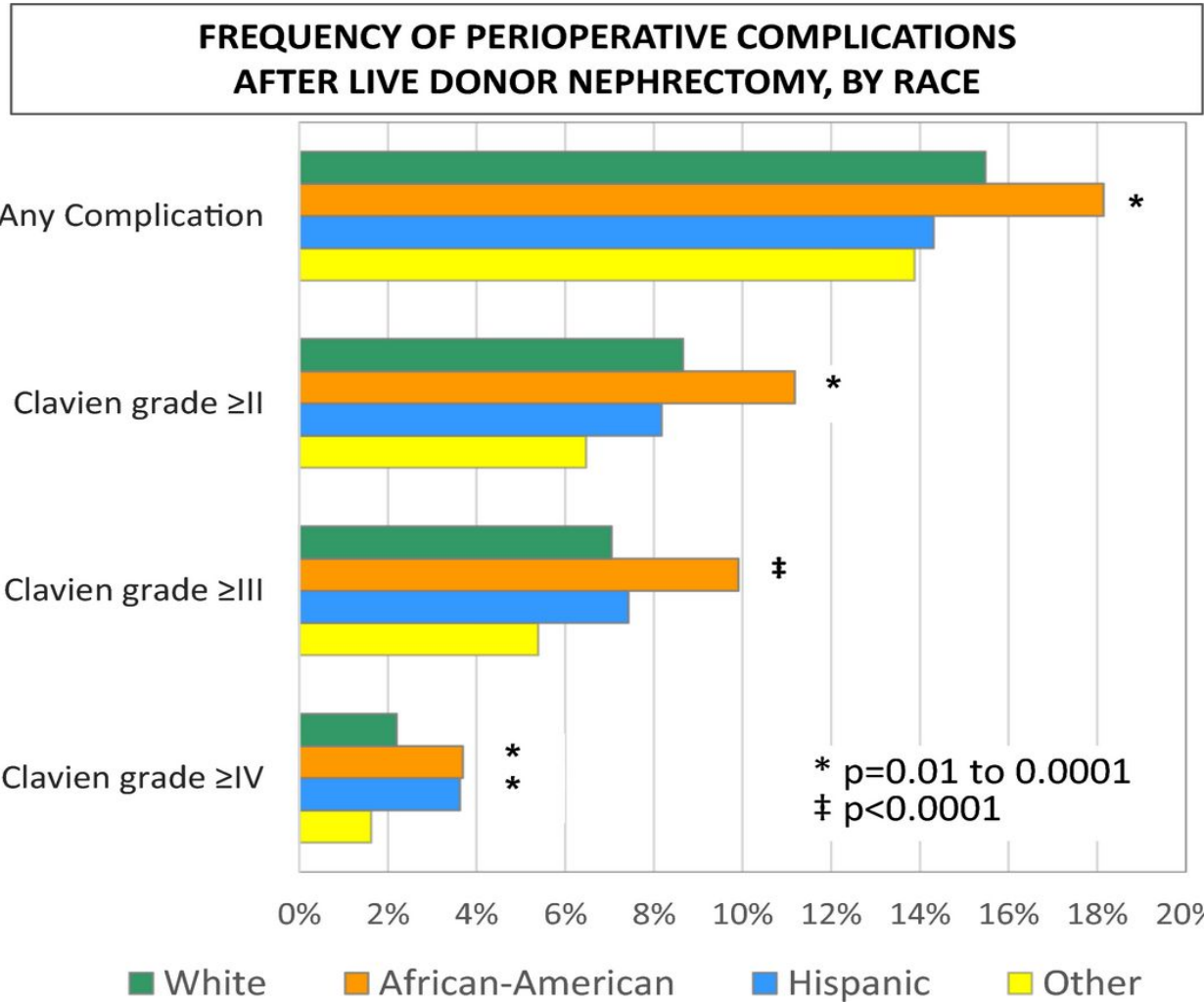


## Single Port Lap Nephrectomy



**Complications**

Perioperative Complications After Living Kidney Donation: 15 K pts (ICD codes), 7.3% clavien 3 or above (2.4% ICU, 0.007% inpatient mortality)



Clav 3: Re-op, endos, IR proced  
Clav 4: ICU, organ failure

TABLE 3. Donor complications*		
Complication	Comment	No.
<b>Major</b>		
Jejunal perforation	Reoperation day 10, intensive care, respirator	1
Ileum perforation	Reoperation day 5	1
Retained sponge	Reoperation day 2, pulmonary embolism	1
Retroperitoneal hematoma	Reoperation day 0, day 1 and day 4; pulmonary embolism (1)	3
Ureter stump bleeding	Reoperation day 7	1
Port bleeding	Reoperation day 0	1
Port hernia, incarcerated bowel	Reoperation day 6, no resection necessary	1
Pneumothorax	Chest drain	2
Wound rupture	Reoperation day 0	1
Wound infection	Reoperation in general (7) or local (5) anesthesia	12
Lymphocele	Reoperation day 14 (1); percutan drainage (1)	2
Postoperative hematemesis	Gastroscopy, blood transfusion, elevated cardiac enzymes	1
Incisional hernia	Reoperation month 14, month 15 and month 17	3
<i>Total major complications</i>		30
<b>Minor</b>		
Pneumothorax	No chest tube required	5
Pneumonia	No need for respiratory support	33
Wound infection	Only requiring antibiotics	26
Other skin infection	Subcutan epidural catheter abscess (2); erysipelas (1)	3
Urinary tract infection		103
Urinary retention		2
Blood transfusion		4
Cardiac arrhythmia	Atrial fibrillation (2), transient asymptomatic asystole (2)	4
Deep venous thrombosis	Double vena Cava (1)	1
Acute hepatitis	Possibly related to drug toxicity	1
<i>Total minor complications</i>		184
<i>Total complications</i>		214

2.9 % Major donor complications, Clavien 3 (reop, ICU, etc). Chart rev

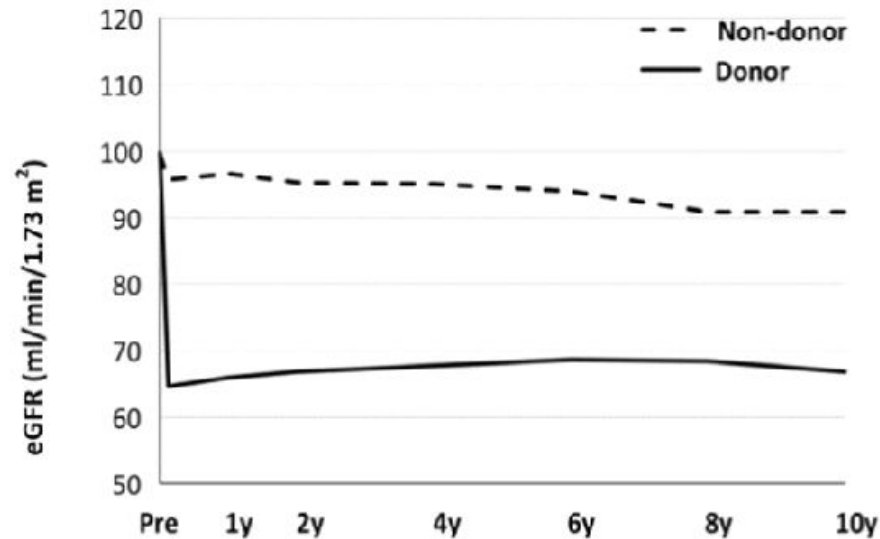
**Morbidity and Mortality in 1022 Consecutive Living Donor Nephrectomies: Benefits of a Living Donor Registry.**  
Mjoen, Geir; Oyen, Ole; Holdaas, Hallvard; Midtvedt, Karsten; Line, Pal-Dag  
Transplantation. 88(11):1273-1279, December 15, 2009.  
DOI: 10.1097/TP.0b013e3181bb44fd

\* If several complications occurred in one donor, only the most severe was recorded and graded.

# Changes in Kidney Function Following Living Donor Nephrectomy



604 living kidney donors  
matched to  
2,414 healthy non-donors  
from Alberta, Canada  
(2002-2016)



Non-donors:  
-0.85 mL/min/1.73 m<sup>2</sup>  
per year

Average annual change in  
eGFR over time

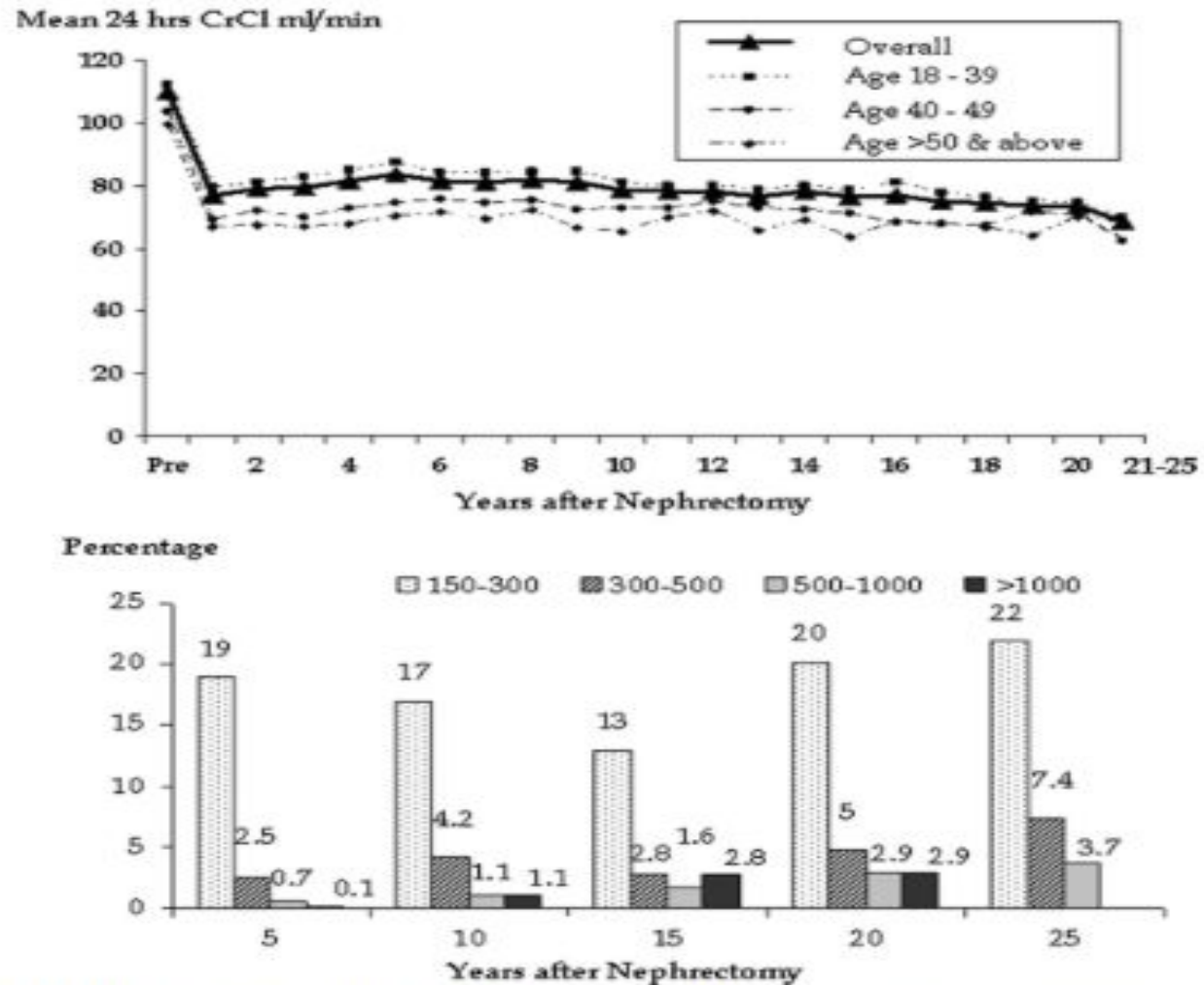
Donors:  
+0.35 mL/min/1.73 m<sup>2</sup>  
per year

6 weeks-2 years: +1.06  
2-5 years: +0.64  
≥5 years: -0.06

## CONCLUSION:

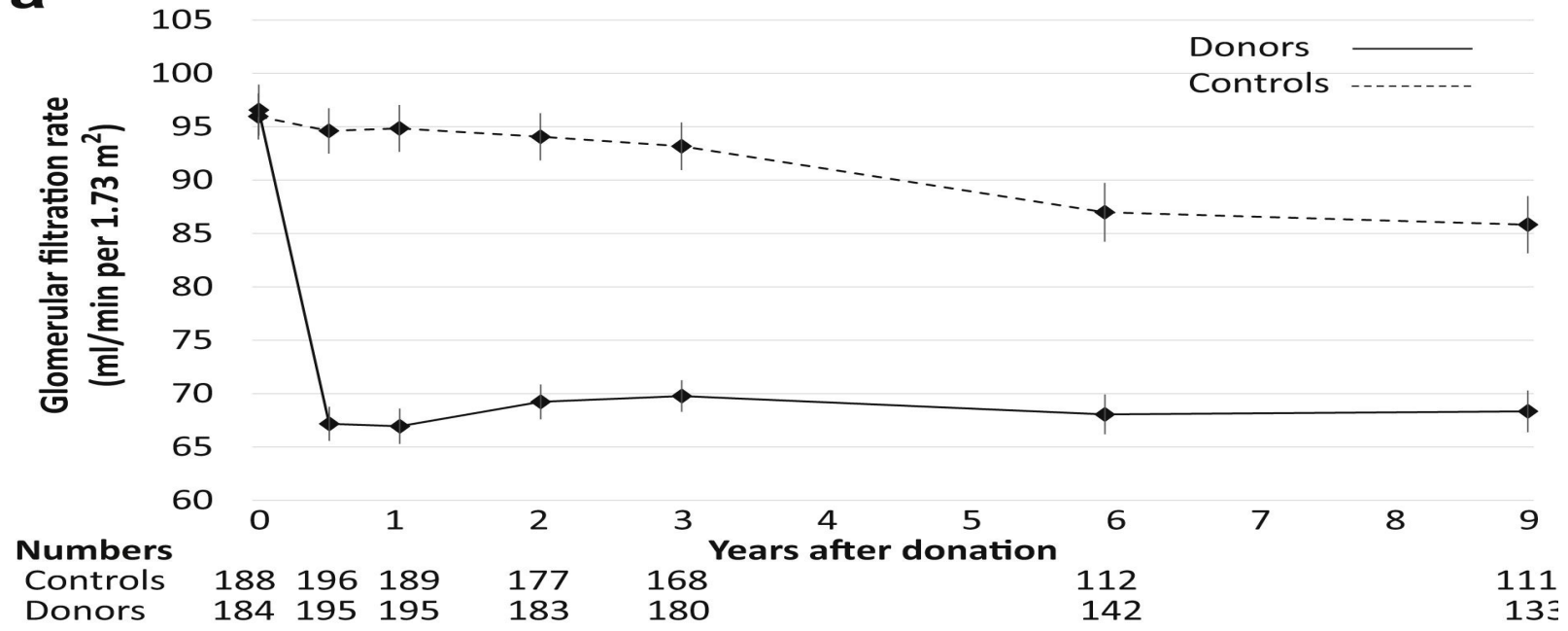
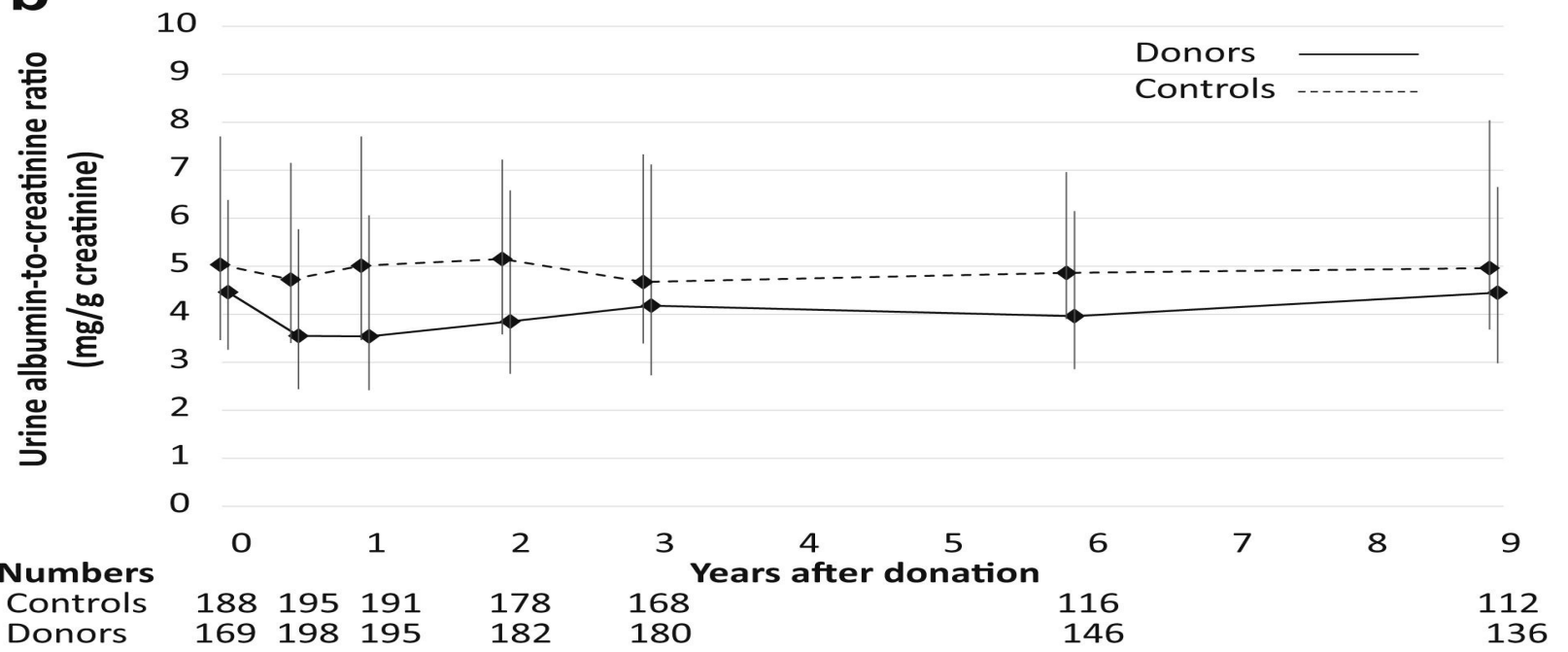
The function in the remaining kidney of a living donor on average initially increases by 1 mL/min/1.73 m<sup>2</sup> per year which we attribute to glomerular hyperfiltration; however, this begins to plateau by 5 years postdonation.

# Long Term GFR & proteinuria



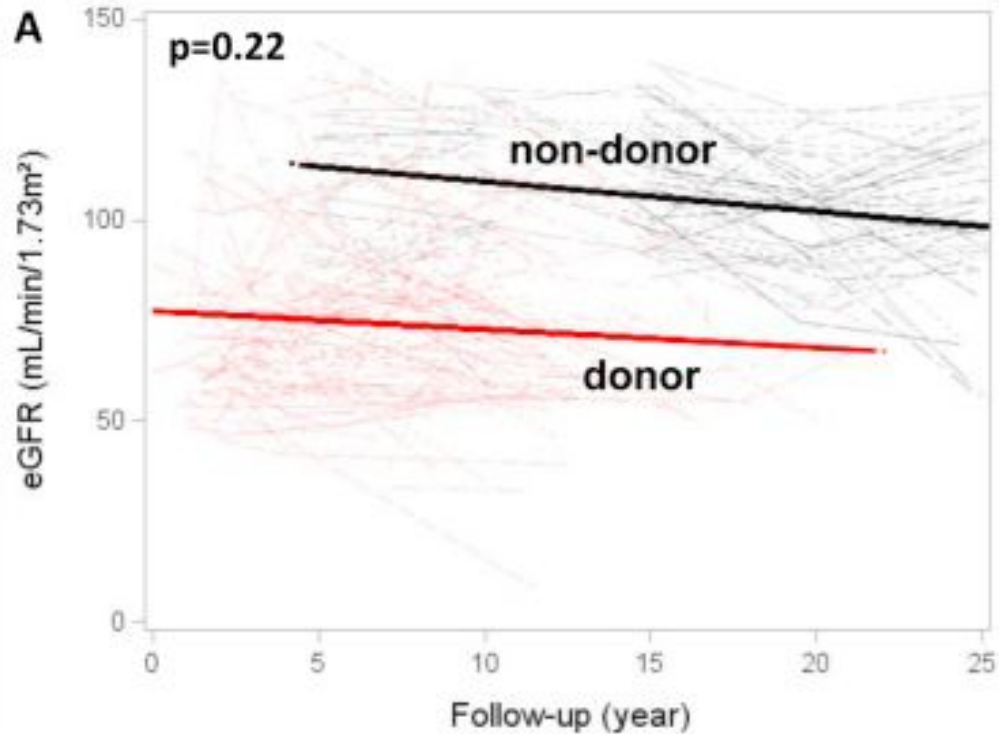
**FIGURE 2.** A, Serial GFR by creatinine clearance after nephrectomy (n = 2696). B, Range of proteinuria by years after nephrectomy (n = 2696).



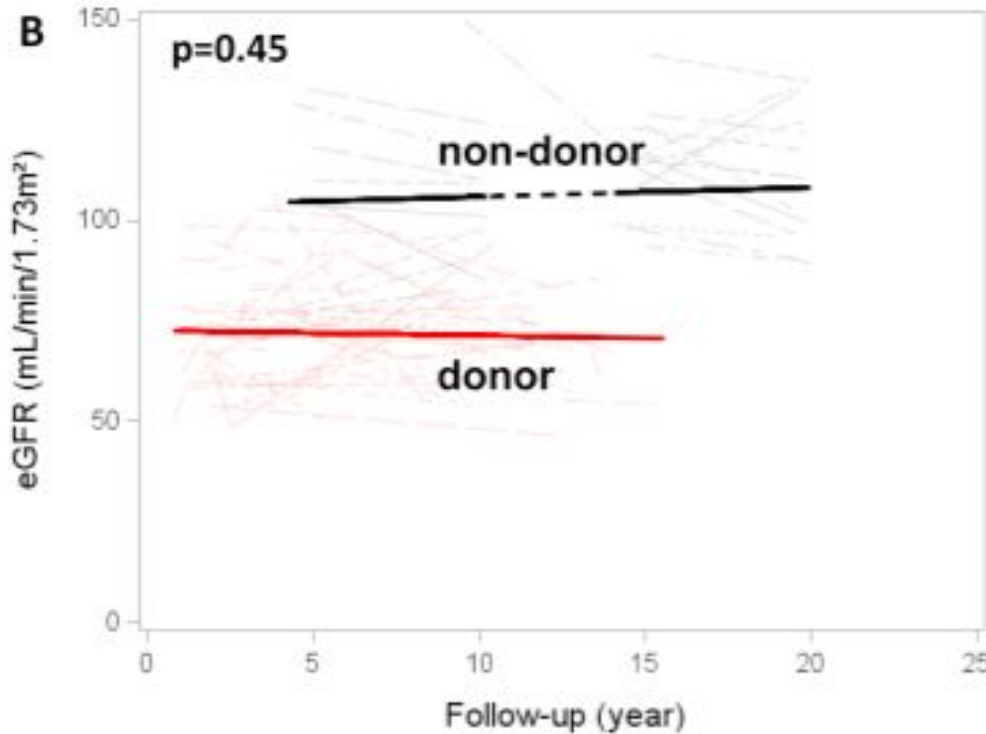
**a****b**

**Kasiske, et al, Kidney International**  
**July 2020**, Pages 168-175,  
 prospective 9 yr F/U. PTH and UA bit  
 higher, small artery elastic less

Family history of ESKD = Yes



Family history of ESKD = No



Ortigosa-Goggins M, Garg AX, Li L, Doshi MD. Donor Family History of ESKD and Long-term Outcomes Among African American Living Kidney Donors: A Retrospective Cohort Study. *Kidney Med.* 2021 Feb 6;3(2):223-230.e1.

139 AA donors with first degree relative with ESKD, 11 yr FU

# Risk of End-Stage Renal Disease Following Live Kidney Donation (97,000 donors vs healthy nondonors). USA Study

General population lifetime risk for  
ESRD: 3.2%

Donor ESRD: 0.9%

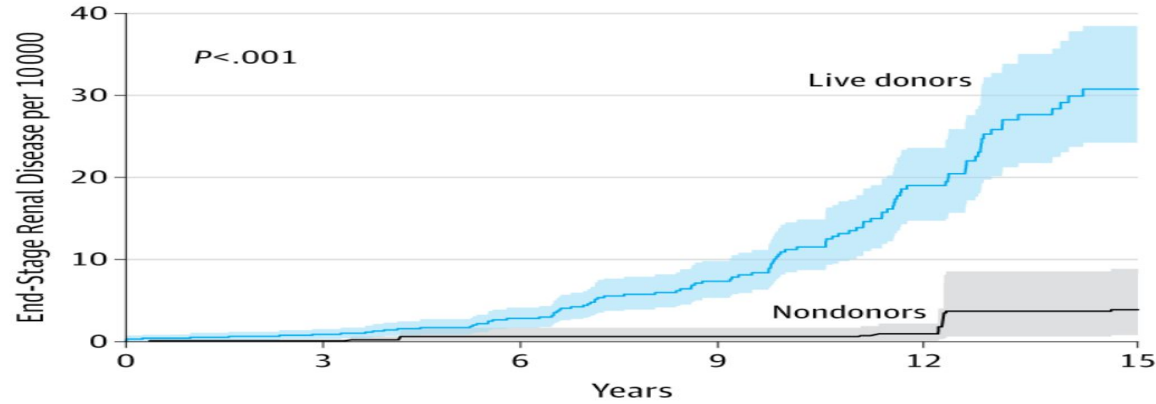
Nondonor ESRD: 0.14%

JAMA. 2014;311(6):579-586



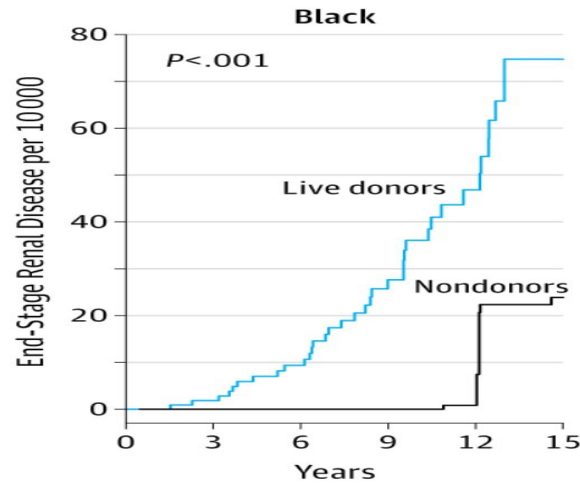
# Risk of End-Stage Renal Disease Following Live Kidney Donation (97,000 donors over 20 years vs nondonors)

**A** Cumulative incidence of end-stage renal disease

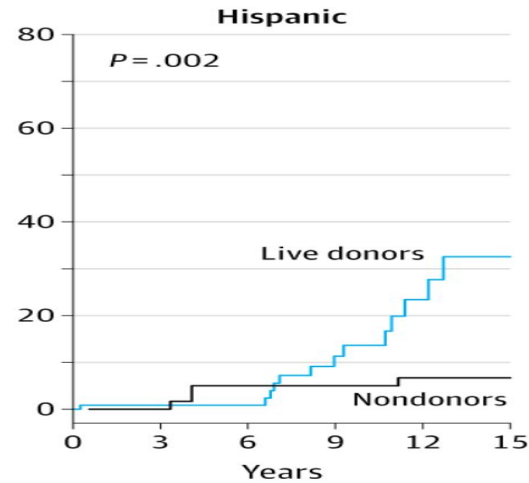


No. at risk	0	3	6	9	12	15
Live donors	96 217	77 587	58 979	39 231	21 573	8 781
Nondonors	96 217	95 930	95 422	94 734	94 199	50 124

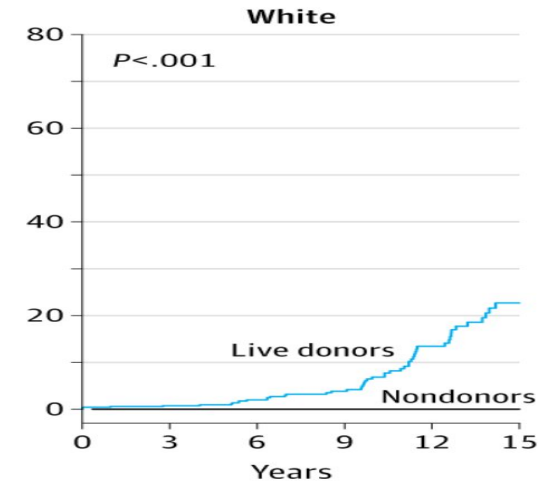
**B** Cumulative incidence of end-stage renal disease by race/ethnicity



No. at risk	0	3	6	9	12	15
Live donors	12 387	7 910	2 887			
Nondonors	12 387	12 256	12 093			

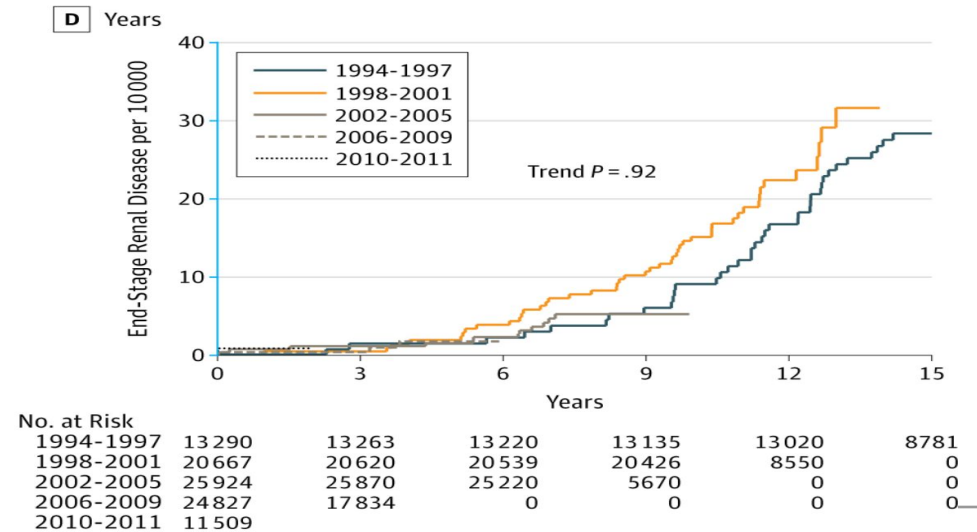
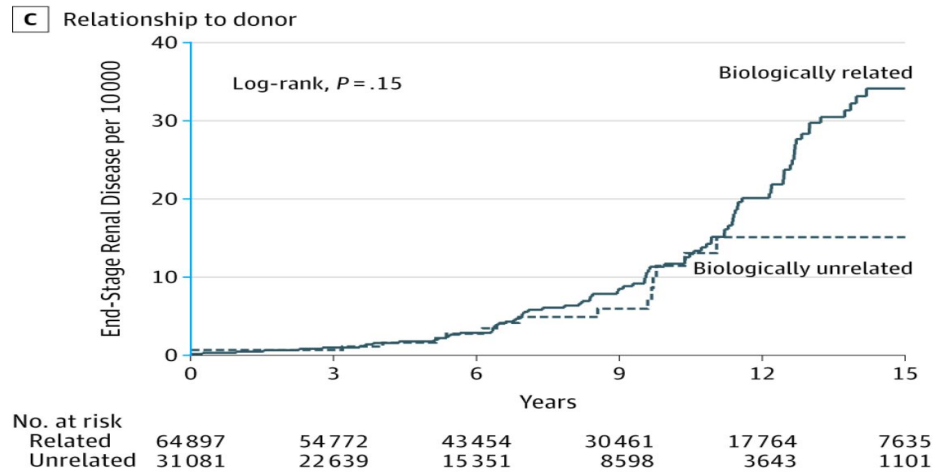
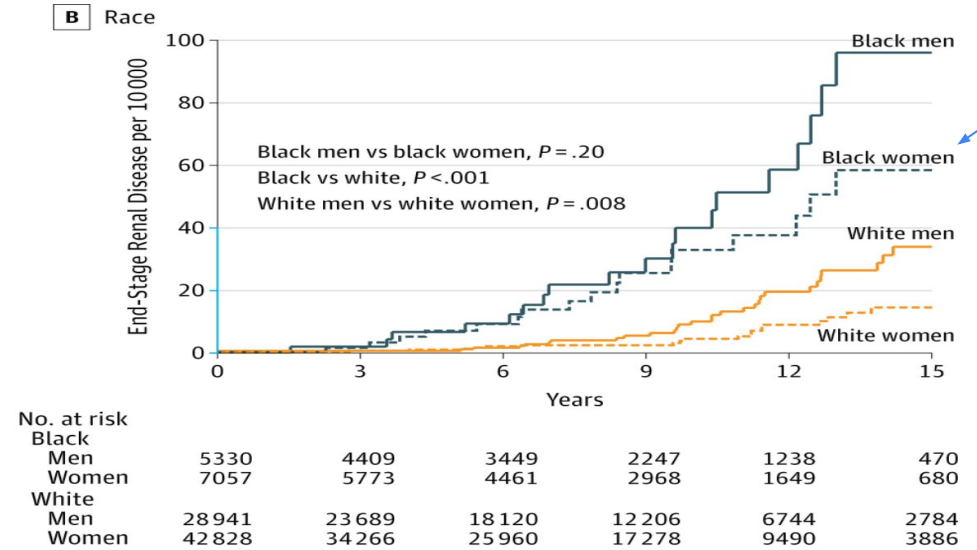
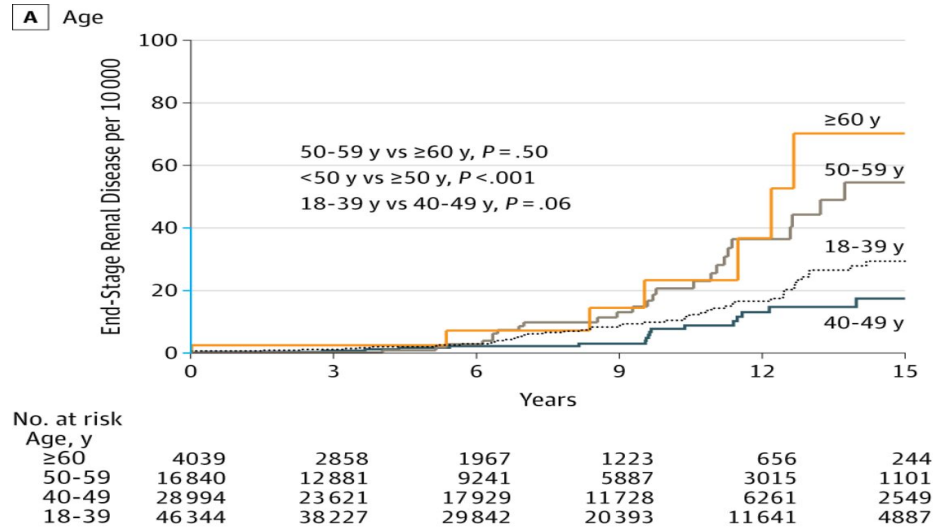


No. at risk	0	3	6	9	12	15
Live donors	12 061	6 989	2 452			
Nondonors	12 061	11 957	11 818			

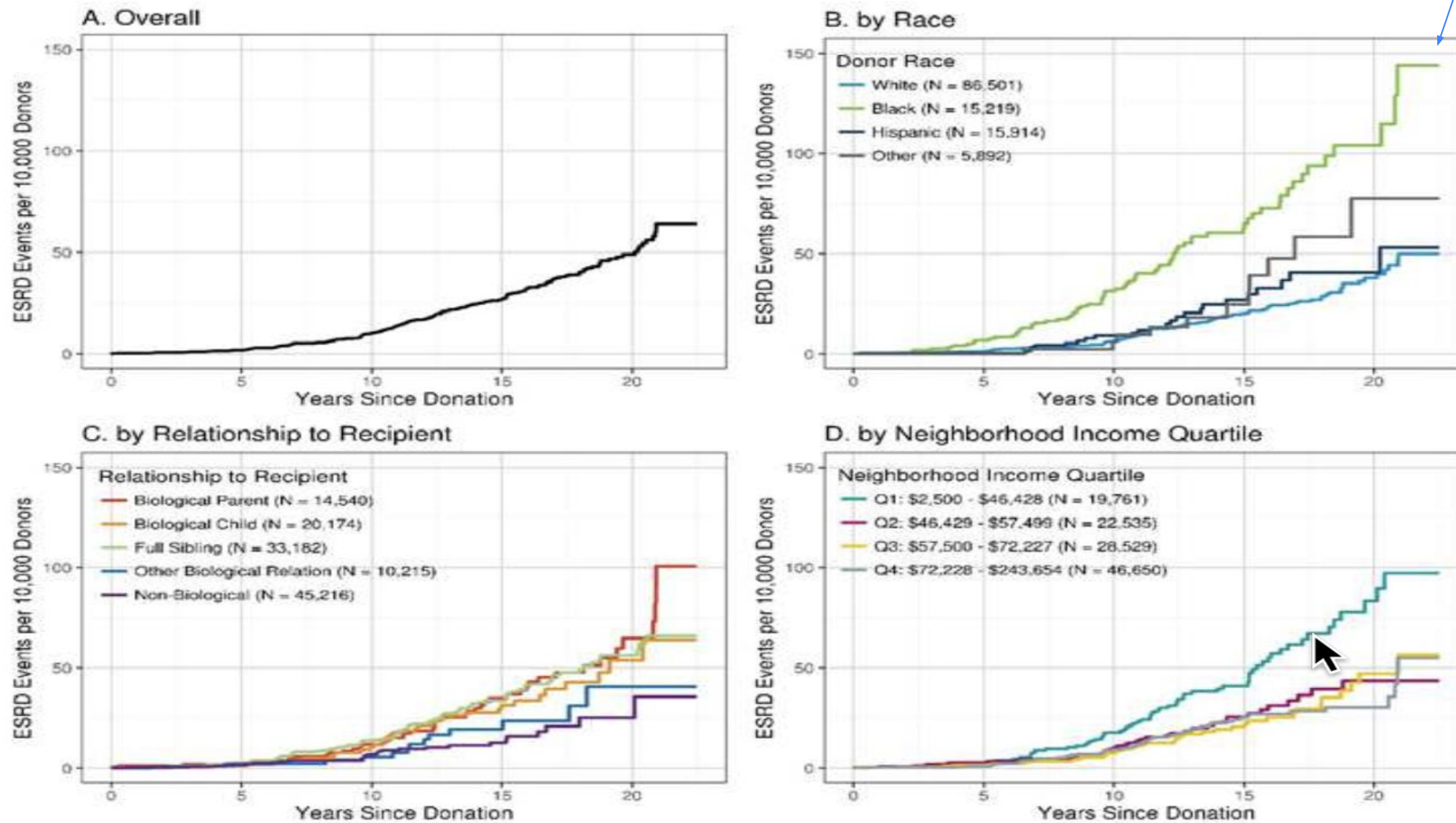


No. at risk	0	3	6	9	12	15
Live donors	71 769	44 080	16 234			
Nondonors	71 769	71 209	70 288			

# Risk of End-Stage Renal Disease Following Live Kidney Donation (97, 000 donors vs healthy nondonors)

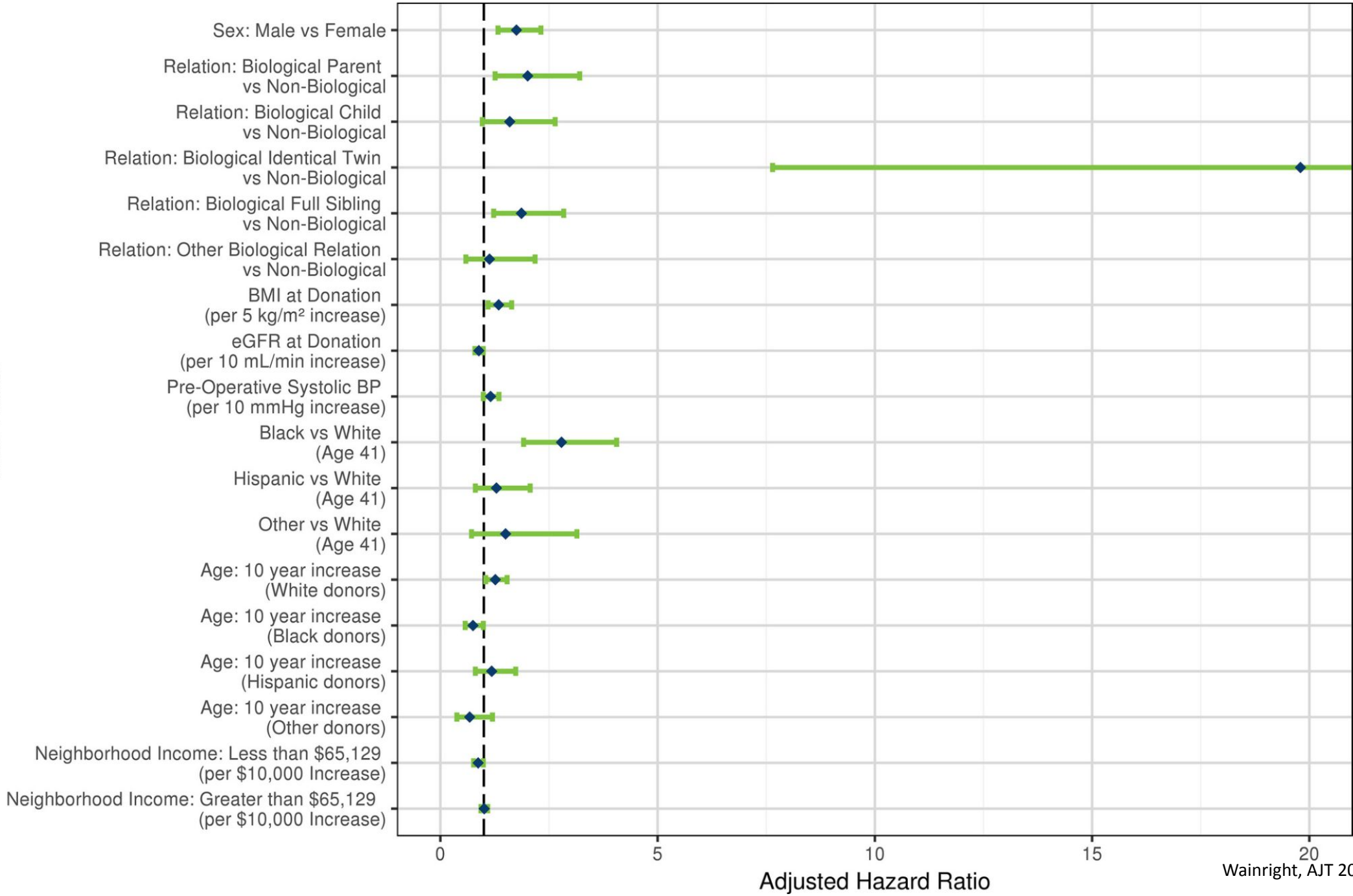


**Figure 1. Cumulative Incidence of ESRD among Living Kidney Donors, per Death-Censored Kaplan-Meier Analysis**



Wainright, AJT 2018. 123K US donors 1994-2016. 218 ESRD at 20 yrs. Donors were considered to have developed ESRD if we found a dialysis, waiting list, or transplant record for them in the OPTN database or CMS data

Risk Factor



		Time Since Donation				
		5-Year	10-Year	15-Year	20-Year	
Donor	Black Male	20-year-old	5 (1-8)	24 (7-40)	62 (20-103)	111 (35-186)
		40-year-old	3 (1-4)	13 (6-21)	35 (16-53)	63 (29-96)
		60-year-old	1 (0-3)	8 (1-14)	20 (3-36)	35 (5-65)
	Black Female	20-year-old	3 (1-5)	14 (4-23)	35 (11-59)	63 (19-107)
		40-year-old	2 (1-2)	8 (3-12)	20 (9-30)	36 (17-55)
		60-year-old	1 (0-2)	4 (1-8)	11 (2-21)	20 (3-37)
	White Male	20-year-old	1 (0-1)	3 (1-5)	7 (3-12)	13 (5-22)
		40-year-old	1 (0-1)	5 (2-7)	12 (6-17)	21 (11-31)
		60-year-old	1 (0-2)	7 (3-11)	19 (8-30)	34 (14-54)
	White Female	20-year-old	0 (0-1)	2 (1-3)	4 (2-7)	8 (3-13)
		40-year-old	1 (0-1)	3 (1-4)	7 (4-10)	12 (7-18)
		60-year-old	1 (0-1)	4 (2-6)	11 (5-17)	20 (9-30)



# Calculating Risk: Live donor risk calculator for ESRD

## Patient Characteristics:

Sex

Female

Race (African American or non-African American)

African American

Age (18-80yrs)

37

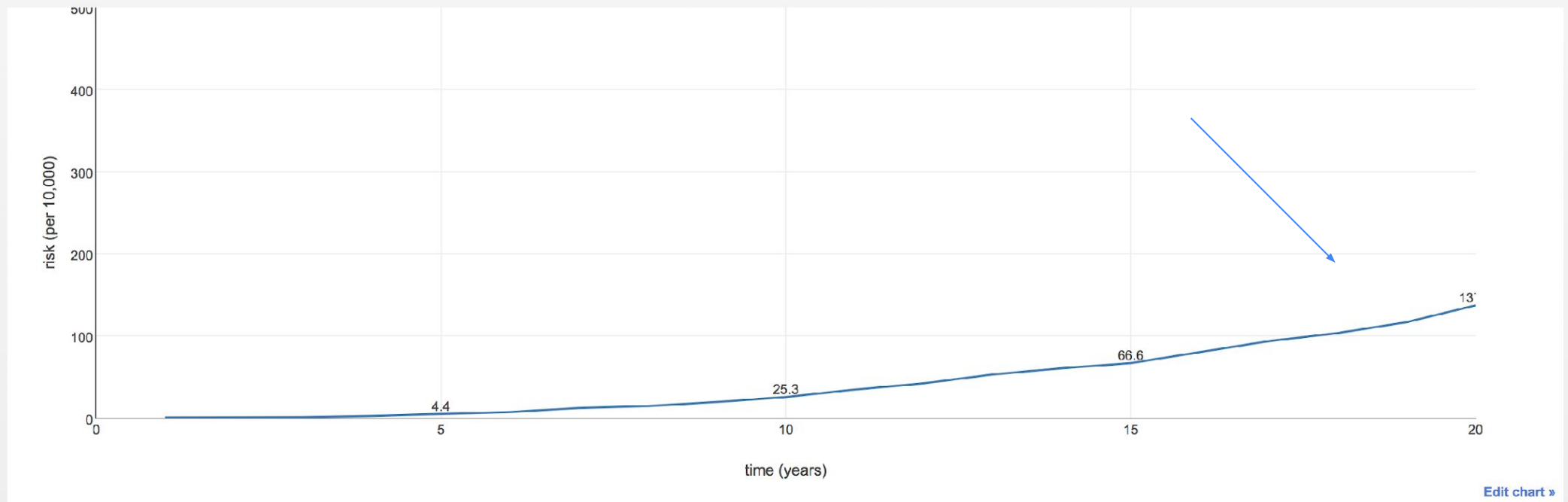
BMI (kg/m<sup>2</sup>)

32

Donor is 1st degree biological relative to recipient

Yes

## Risk of Developing ESRD for Adults Who Previously Donated a Kidney (per 10,000)

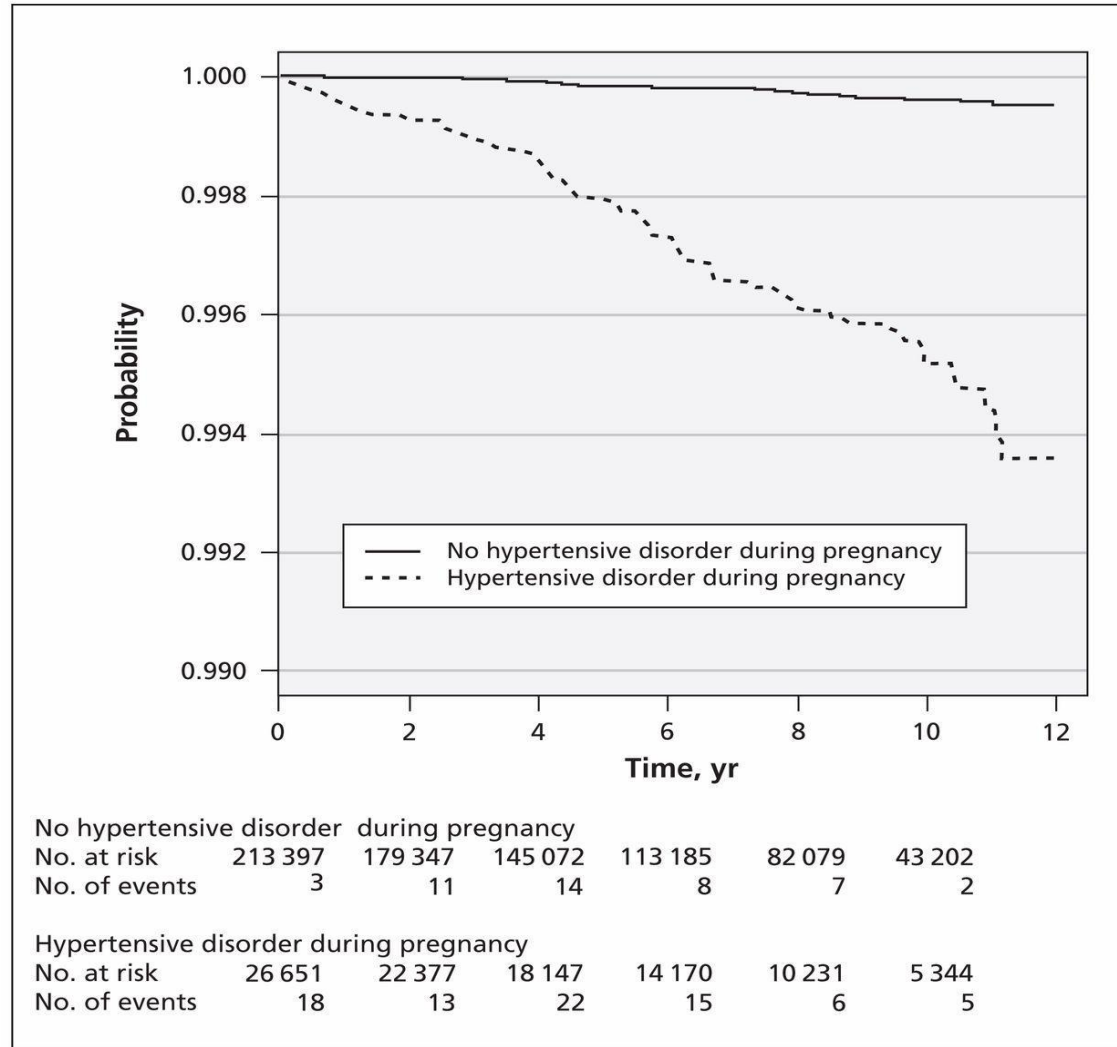


These numbers represent the number of living kidney donors (per 10,000) who will develop ESRD in 5, 10, 15 and 20 years since their donation.

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM).
- Had gestational HTN 10 years ago. BP now is 140/90.

# Estimated proportion of women without ESRD among those with and without hypertensive disorders during pregnancy 1996-2009.



P<.001

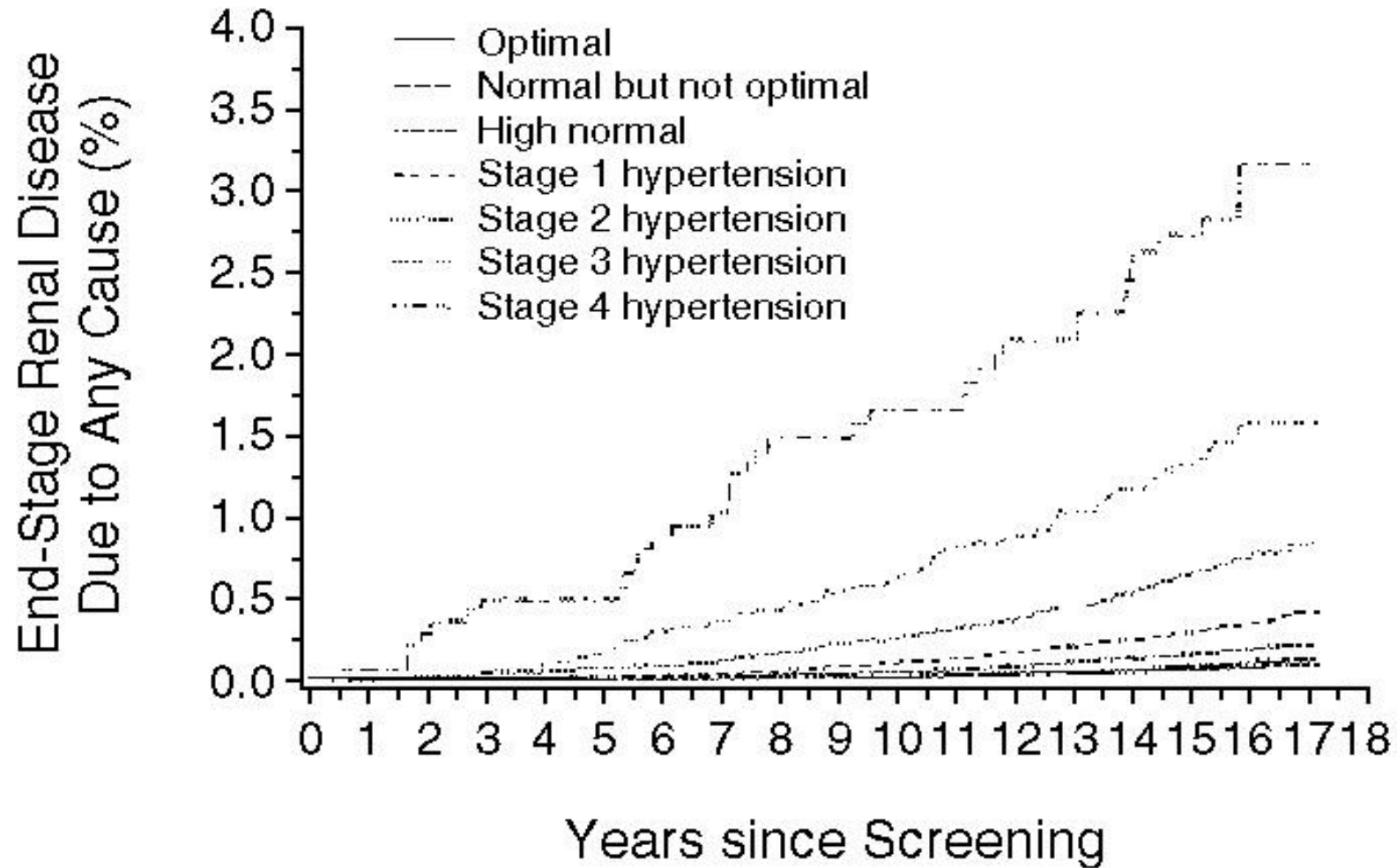
HR 14

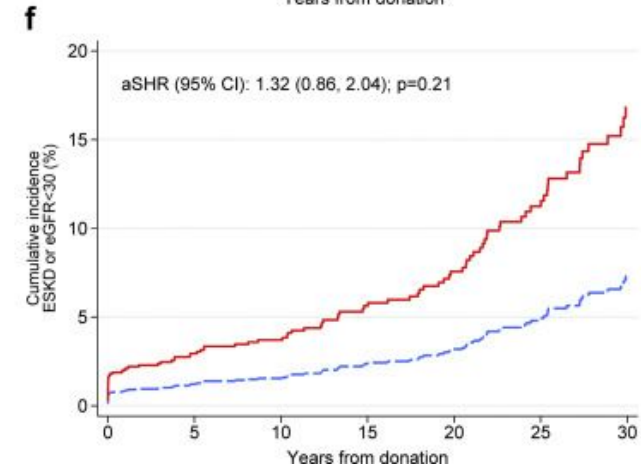
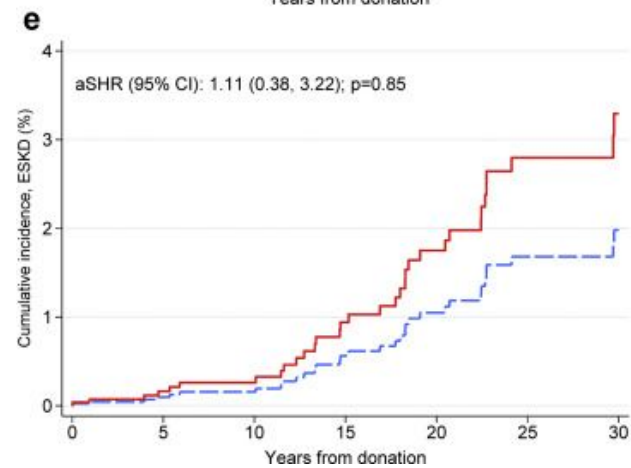
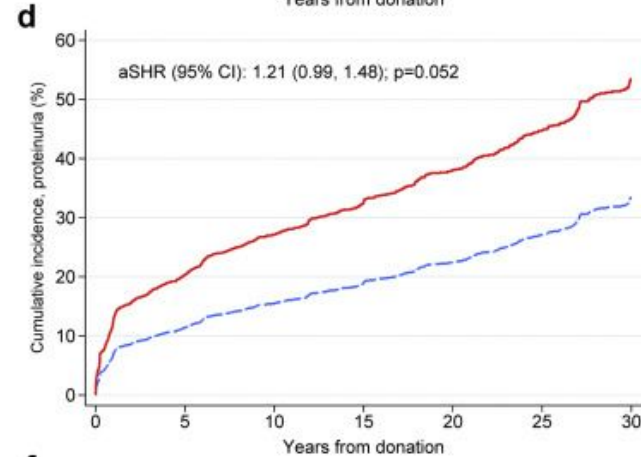
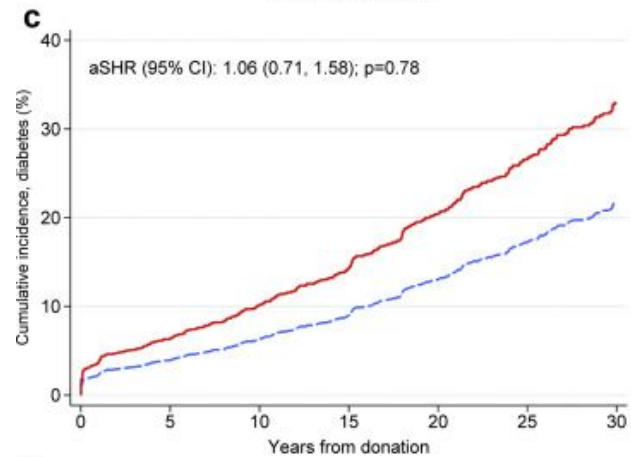
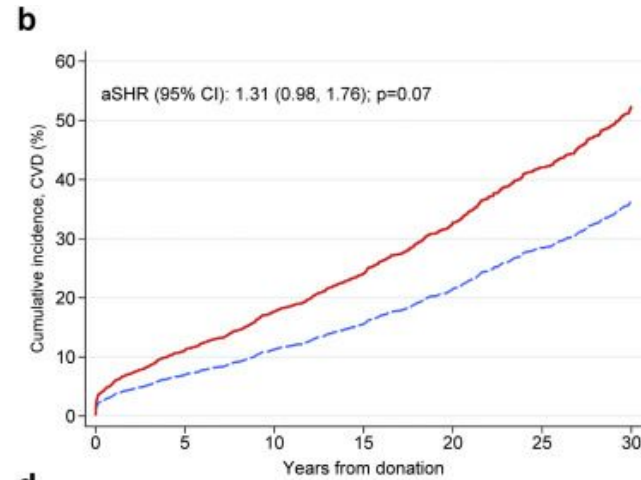
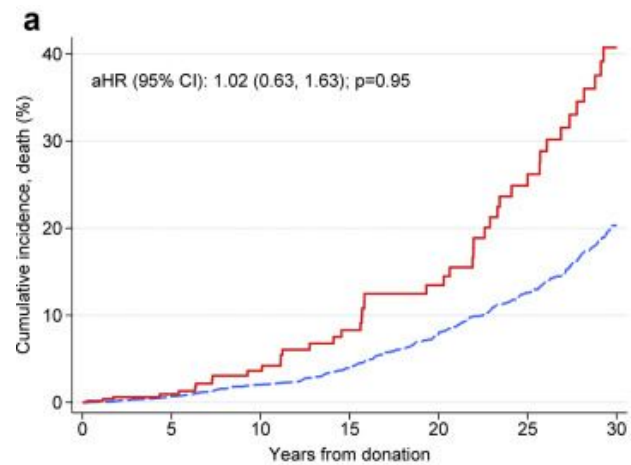
No hypertensive disorder during pregnancy	
No. at risk	213 397   179 347   145 072   113 185   82 079   43 202
No. of events	3   11   14   8   7   2
Hypertensive disorder during pregnancy	
No. at risk	26 651   22 377   18 147   14 170   10 231   5 344
No. of events	18   13   22   15   6   5

Wang I et al. CMAJ 2013;185:207-213



# Incidence of ESRD according to Blood-Pressure Category in 332,544 Men Screened for MRFIT

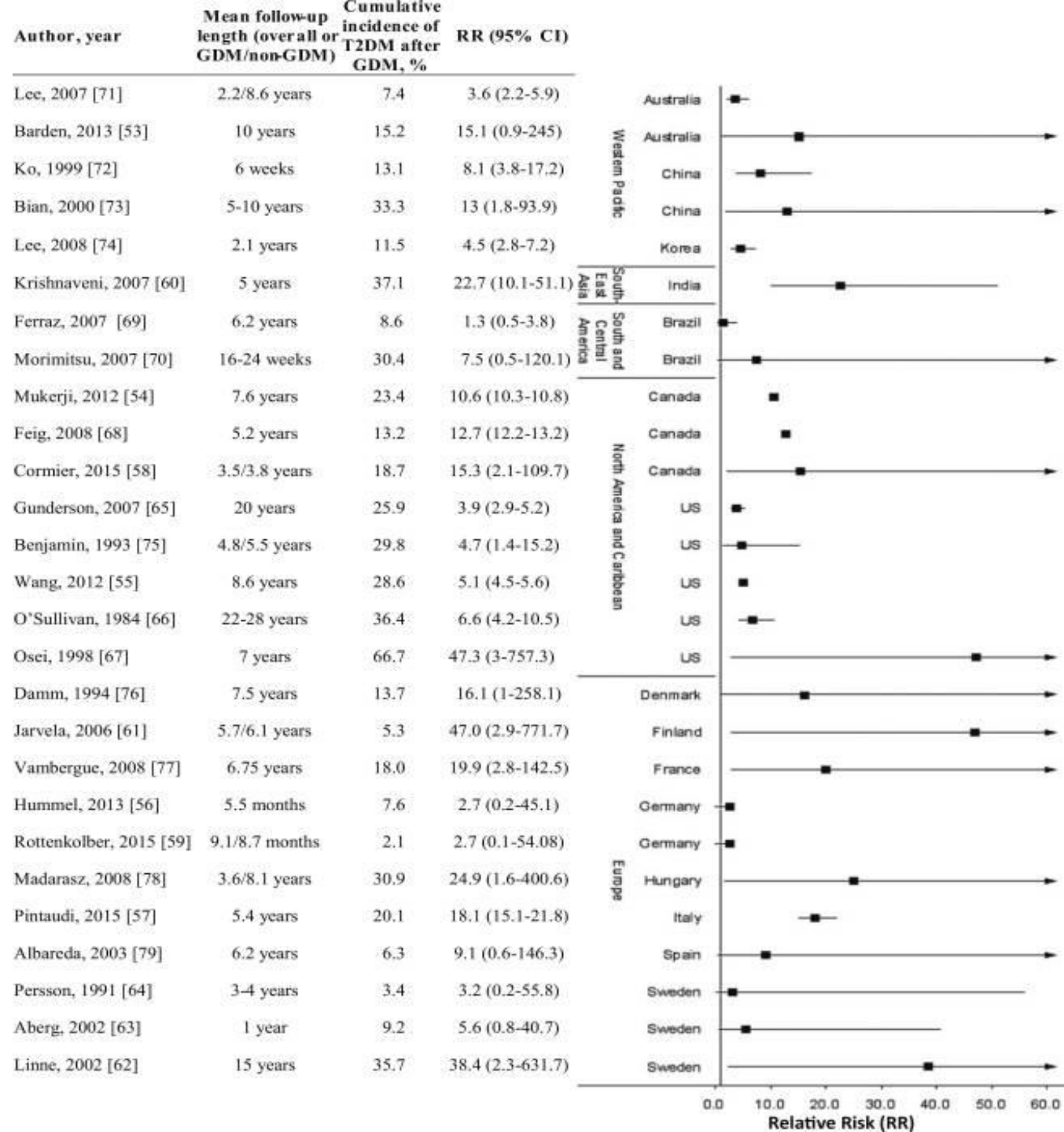




1963-2007: 8922 kidney donors from 3 U.S. transplant centers: the University of Minnesota, Mayo Clinic-Rochester, and the University of Alabama-Birmingham. 900 with HTN 140/90 or on meds. Avg F/U 14-17 years

Cumulative incidence of major outcomes. (a) Mortality. (b) Cardiovascular disease (CVD). (c) Diabetes. (d) Proteinuria. (e) End-stage kidney disease (ESKD). (f) Estimated glomerular filtration rate (eGFR) <30 ml/min/1.73m<sup>2</sup> or end-stage renal disease (ESRD). The red line indicates hypertensive donors and the dashed blue line indicates nonhypertensive donors

hypertensive donors, compared with nonhypertensive donors, are not at increased risk for reduced eGFR, proteinuria, or ESKD. (proteinuria:urine dipstick protein ≥2+, urine protein/osmolality ratio >0.42, urine random protein >15 mg/dl, or 24-hour protein >300 mg/day)



[Curr Diab Rep. 2016 Jan; 16\(1\): 7.](#)

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90.
- She wants to know if there is any genetic testing to predict ESRD in her?

Genes	Genetic kidney diseases	Inherited patterns	Clinical signs
<i>PKD1</i>	ADPKD	AD	Age-specific imaging criteria in a person with a family history of ADPKD
<i>PKD2</i>			
<i>GANAB</i>			
<i>ALG9</i>			
<i>DNAJB11</i>			
<i>APOL1</i>	<i>APOL1</i> risk alleles	AR	Sub-Saharan African ancestors with early-onset CKD and ESKD
<i>COL4A5</i>	X-linked Alport syndrome	XL	Progressive kidney failure Sensorineural hearing loss Ocular abnormalities
<i>COL4A3</i> and/or <i>COL4A4</i>	Autosomal recessive Alport syndrome	AR	Microscopic hematuria Proteinuria Ocular involvement Sensorineural hearing loss
<i>COL4A3</i> or <i>COL4A4</i>	Autosomal dominant Alport syndrome	AD	Microscopic hematuria, proteinuria without ocular or hearing abnormalities
<i>COL4A3</i> or <i>COL4A4</i>	Thin basement membrane disease	AD	Microscopic hematuria Gross hematuria Flank pain AKI Proteinuria
<i>CFH</i> , <i>MCP</i> , <i>CFI</i> , or <i>C3</i>	Pregnancy-associated aHUS		History of microangiopathic hemolytic anemia, thrombocytopenia, AKI

AD, autosomal dominant; ADPKD, autosomal dominant polycystic kidney disease; aHUS, atypical hemolytic uremic syndrome; AKI, acute kidney injury; *ALG9*, asparagine-linked glycosylation 9; *APOL1*, Apolipoprotein L1; AR, autosomal recessive; *CFH*, complement factor H; *CFI*, complement factor I; CKD, chronic kidney disease; *COL4A3*, collagen type IV alpha 3 chain; *COL4A4*, collagen type IV alpha 4 chain; *COL4A5*, collagen type IV alpha 5 chain; *C3*, complement component 3; *DNAJB11*, DnaJ homolog subfamily B member 11; ESKD, end-stage kidney disease; *GANAB*, glucosylase II alpha subunit; *MCP*, membrane cofactor protein; *PKD1*, polycystin 1, transient receptor potential channel interacting; *PKD2*, polycystin 2, transient receptor potential cation channel; XL, X-linked.

Kidneys from African American deceased-donors have shorter allograft survival and African American living-kidney donors more often develop ESRD. *Kidney International Reports*, Volume 5, Issue 3, March 2020

Nephron 2021 <https://doi.org/10.1159/000520150>

or do Renasight on selected donors



## Estimated 25-year Risk of CKD Among 18-year-old AA Male potential Living Kidney Donor

Score	Baseline Fasting Glucose	Family History of DM	Family History of HTN	Obese at Baseline (BMI ≥30)	Baseline eGFR 90–99	APOLI Risk Variants	Regular Smoking	25-year Risk (95% CI)
18	Normal	None	None	No	No	0	No	0.90% (0.43–1.36)
22	Normal	None	None	No	No	1	No	1.14% (0.60–1.69)
35	Normal	None	None	No	No	2	No	2.53% (1.59–3.45)
27	Normal	None	None	No	No	0	Yes	1.55% (0.89–2.22)
31	Normal	None	None	No	No	1	Yes	1.98% (1.20–2.76)
44	Normal	None	None	No	No	2	Yes	4.35% (2.89–5.79)
29	Normal	None	Yes	No	No	0	No	1.75% (1.03–2.47)
33	Normal	None	Yes	No	No	1	No	2.24% (1.38–3.09)
46	Normal	None	Yes	No	No	2	No	4.90% (3.27–6.51)
30	Normal	None	None	Yes	No	0	No	1.86% (1.11–2.61)
34	Normal	None	None	Yes	No	1	No	2.38% (1.48–3.26)
47	Normal	None	None	Yes	No	2	No	5.21% (3.47–6.91)
36	Impaired	None	None	No	No	0	No	2.68% (1.71–3.65)
40	Impaired	None	None	No	No	1	No	3.42% (2.24–4.58)
53	Impaired	None	None	No	No	2	No	7.44% (4.87–9.94)
36	Normal	None	None	No	Yes	0	No	2.68% (1.71–3.65)
40	Normal	None	None	No	Yes	1	No	3.42% (2.24–4.58)
53	Normal	None	None	No	Yes	2	No	7.44% (4.87–9.94)
42	Normal	Yes	Yes	No	No	0	No	3.86% (2.55–5.15)
46	Normal	Yes	Yes	No	No	1	No	4.90% (3.27–6.51)
59	Normal	Yes	Yes	No	No	2	No	10.58% (6.62–14.36)

Locke, et al **Apolipoprotein L1 and Chronic Kidney Disease Risk in Young Potential Living Kidney Donors**. *Ann Surg.* 2017 Feb 9. Healthy non donors, 25 yrs, CKD<sub>3</sub> or worse (rare ESRD). FH of DM alone is 3.8%, Caucasian male is 2.2%, female 1.2%

## **Integrating *APOL1* Gene Variants Into Renal Transplantation: Considerations Arising From the American Society of Transplantation Expert Conference, AJT 2017, cont'**

Inform potential donors of the risk of psychological stress and anxiety that may accompany knowledge of whether they, and potentially their children, express two *APOLI* risk alleles.

Offer *APOLI* genetic testing to those potential living donors who wish to know their status, with the cost of testing to be included as part of the evaluation.

For those found to have two *APOLI* risk alleles, use the information as one would other findings (e.g. prehypertension/hypertension, presence of the metabolic syndrome or impaired glucose tolerance, obesity, or smoking) as one consideration in the final recommendation as to their medical suitability for living kidney donation. Other factors that may affect this recommendation are the potential donor's age and a family history of ESRD with an early age of onset that was not related to diabetes mellitus.

# KDIGO 2017

“Apolipoprotein L1 (APO L1) genotyping may be offered to donor candidates with sub-Saharan African ancestors. Donor candidates should be informed that having 2 APO L1 risk alleles increases the lifetime risk of kidney failure but that the precise kidney failure risk for an affected individual after donation cannot currently be quantified“



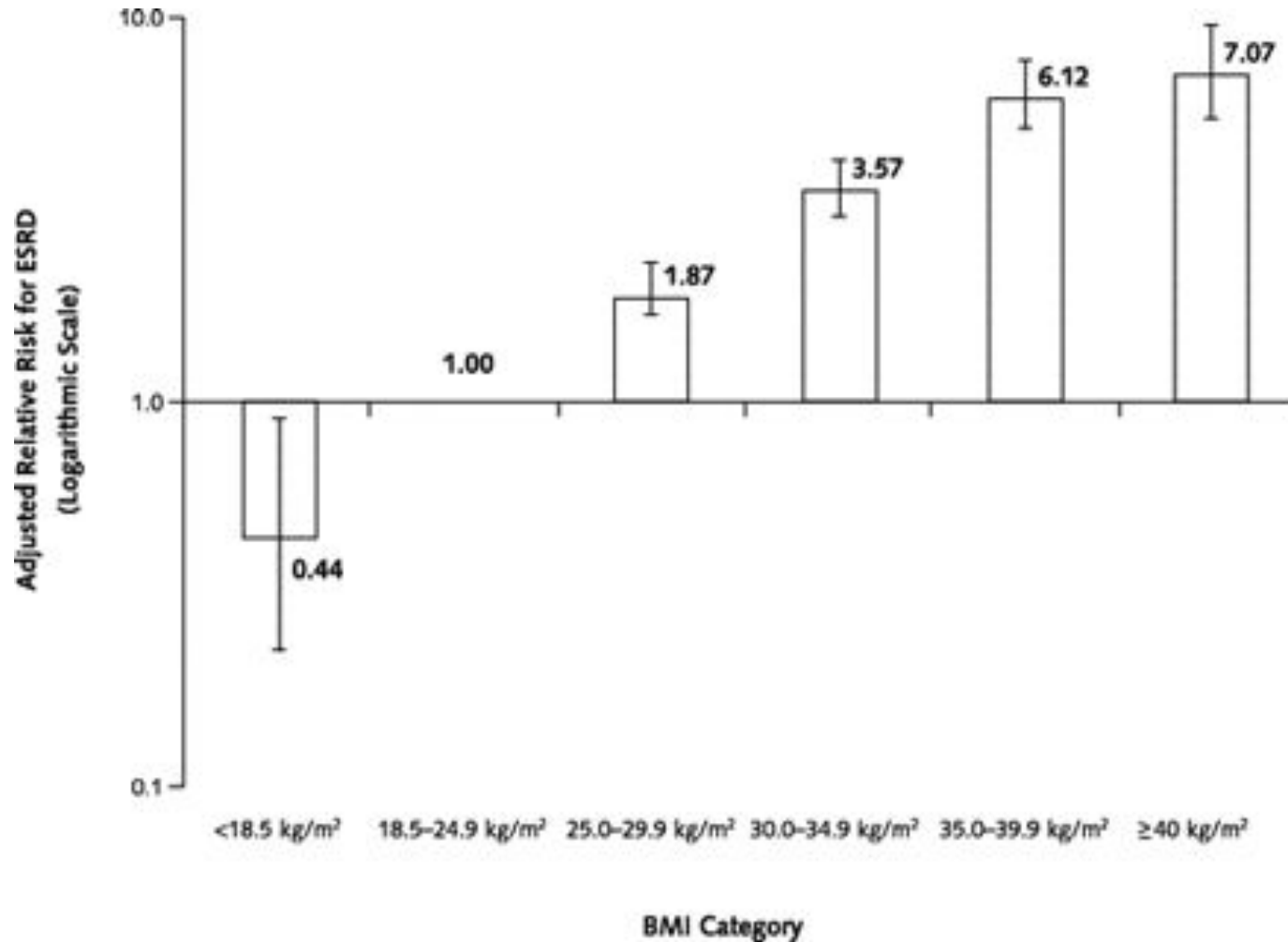


2019-2023. APOL1 assessed in all black live and deceased donors. Recipient and donor outcomes

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90.
- Her BMI is 32.

# BMI and Risk ESRD



320 252 Kaiser Permanente pts between 1964 and 1985. But RR lower when adjusted for DM: 4 and not 6.12. (ESRD rate here 0.4%)

# Obesity increases the risk of end-stage renal disease among living kidney donors (120 K donors)

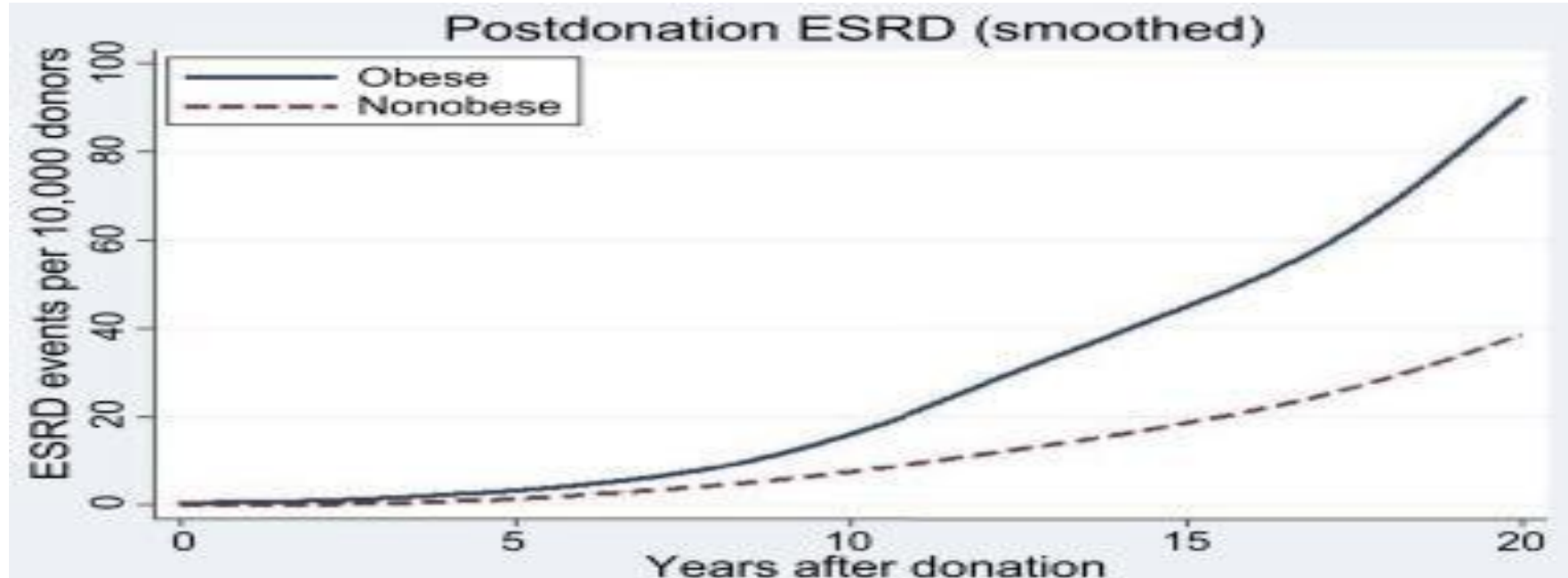
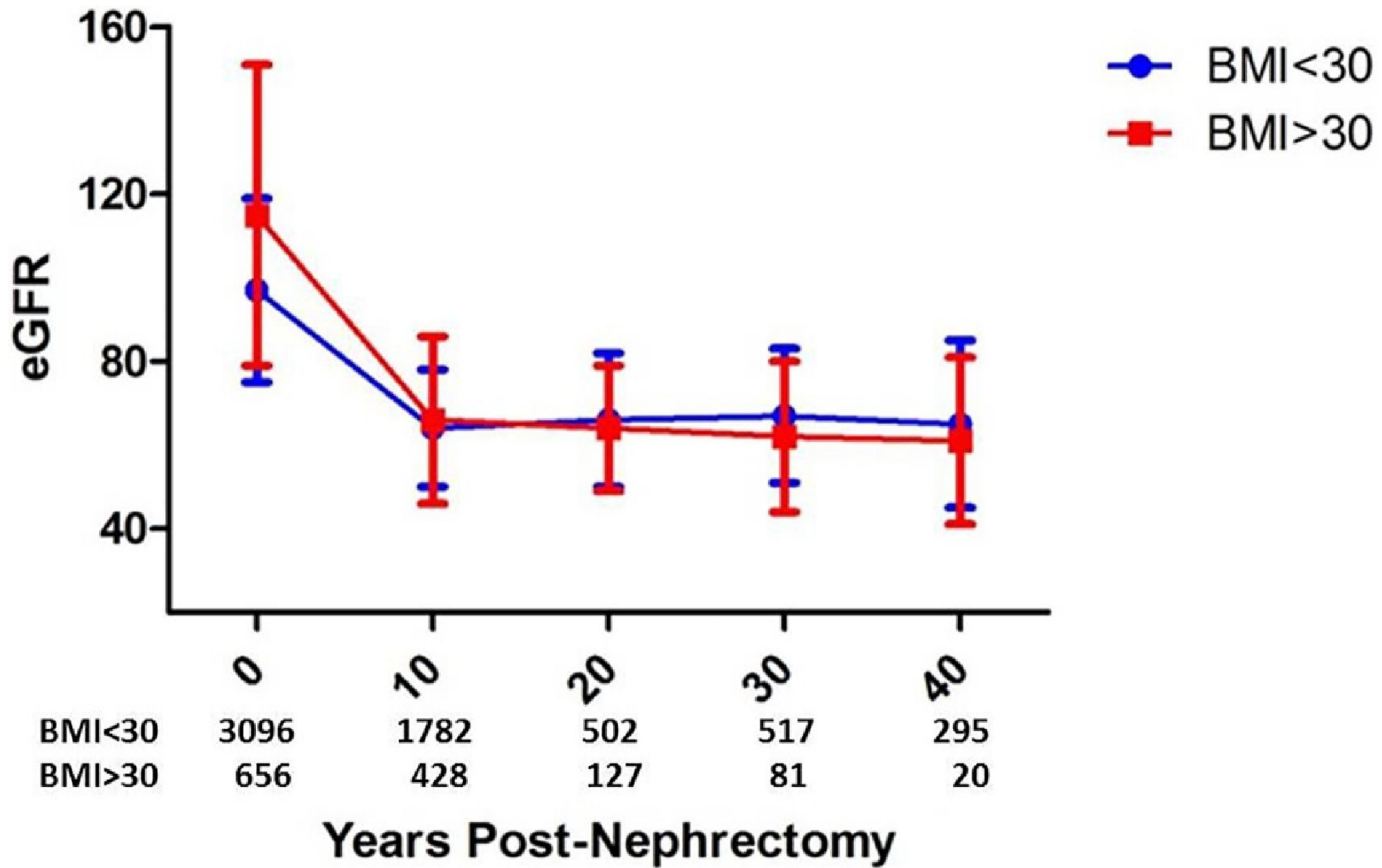
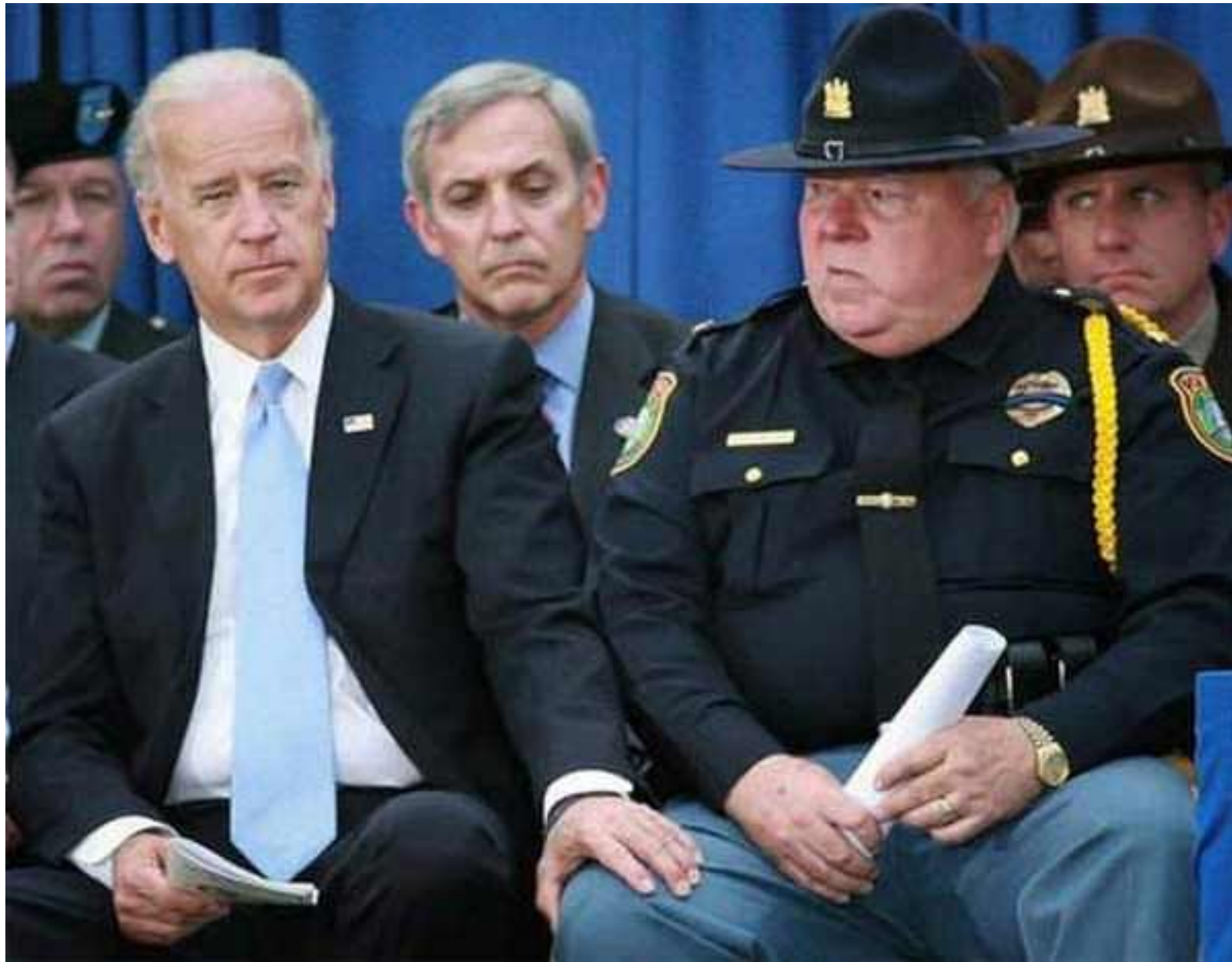


Figure 1. Cumulative incidence of postdonation end-stage renal disease (ESRD) events among living kidney donors by obesity status at time of donation.

**\*\*BMI 33 vs 25: 0.9% vs 0.4 % ESRD at 20 yrs**

Jayme E. Locke, Rhiannon D. Reed, Allan Massie, Paul A. MacLennan, Deirdre Sawinski, Vineeta Kumar, Shikha Mehta, Roslyn B. Mannon, Robert Gaston, Cora E. Lewis, Dorry L. Segev  
Kidney International, Volume 91, Issue 3, 2017, 699–703



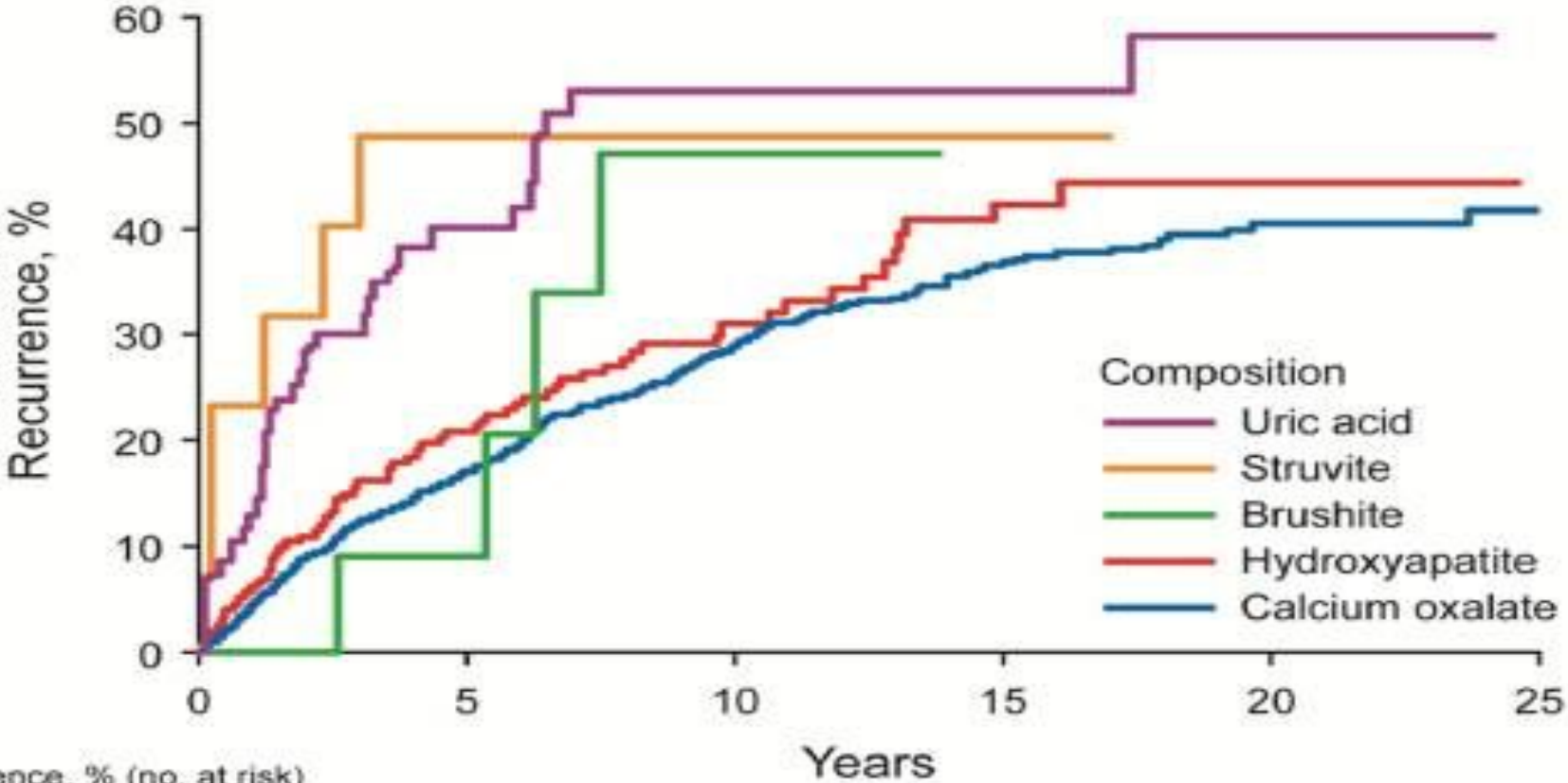


# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90. Her BMI is 32.
- CT angio reveals 4 mm stone in left kidney.



# Recurrence rate of stones



Composition	0	5	10	15	20	25
Uric acid	0 (71)	40 (33)	53 (18)	53 (13)	58 (4)	58 (1)
Struvite	0 (13)	49 (6)	49 (3)	49 (1)		
Brushite	0 (13)	9.1 (8)	47 (3)			
Hydroxyapatite	0 (264)	21 (152)	31 (74)	42 (38)	44 (14)	44 (3)
Calcium oxalate	0 (1127)	17 (694)	29 (418)	37 (236)	40 (115)	42 (24)

# Donors with Stones

Donor Study	# donors	Stone prevalence	Stone size (avg)	Stone events In donors
Lorenz, 2011	1957	9.7%	--	--
Chu, 2012	654	4.4%	--	--
Olsburgh, 2013	377	5% (20 donated)	3mm (range 2-12)	None at 2.1 yr follow up
Kim, 2012	325	7.4% (16 donated)	2mm (range 1-9)	None at 1 yr (1 recipient had obstruction)
Rizjkala, 2013	732	7.3% (54 donated)	2.4 mm (range 1-6)	1 donor event at 1.8 yrs
Serur, 2017		20 donated	2.4 mm	None, 6 yr

# Stones in the RELIVE study:

200 donors had kidney stones prior to donation. 142 were left with a stone

After  $16.5 \pm 10.9$  years (range 0-44 years) from donation to study close, no ESKD occurred in donors with stones. The multivariable risks of hypertension, proteinuria, and reduced GFR were similar in donors with and without kidney stones.

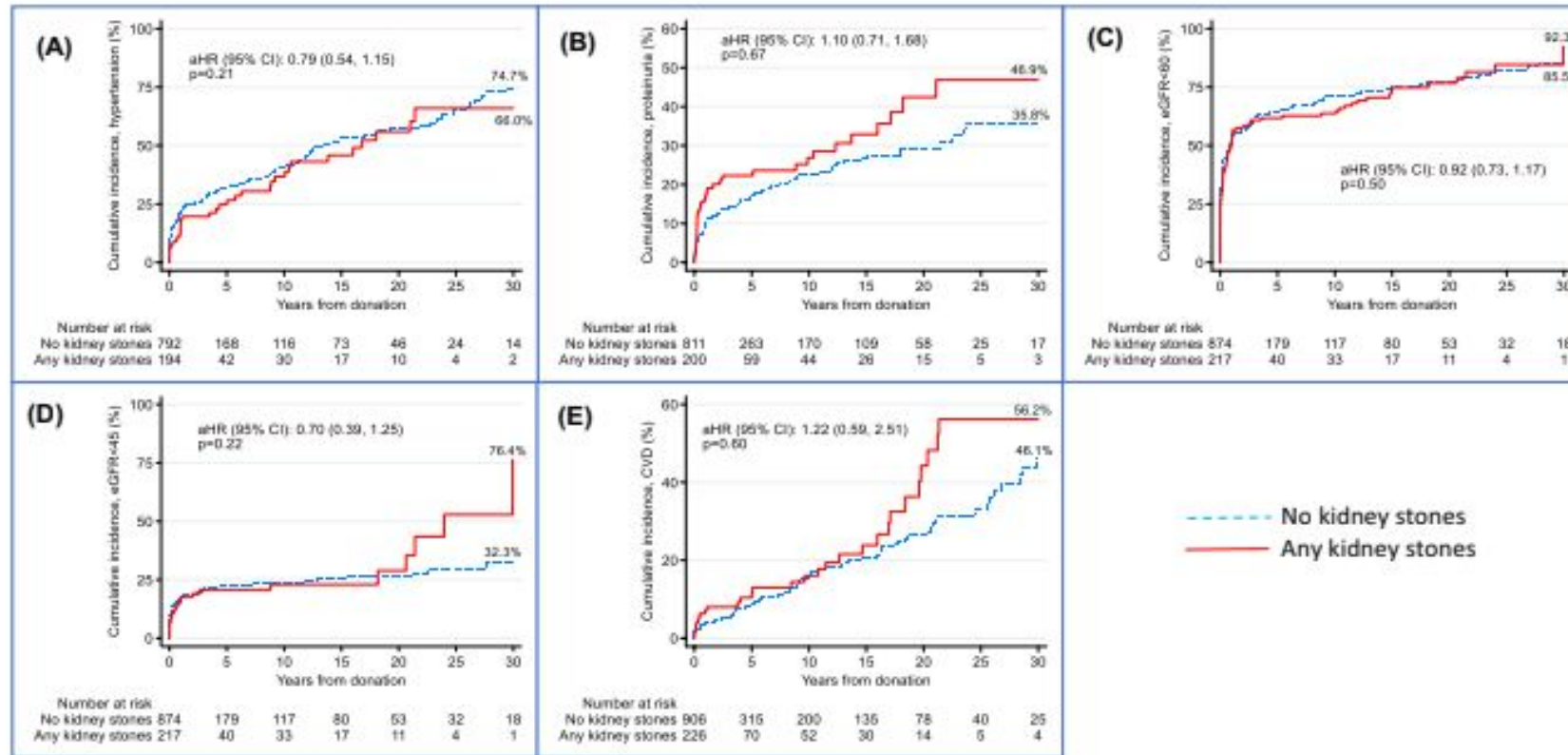
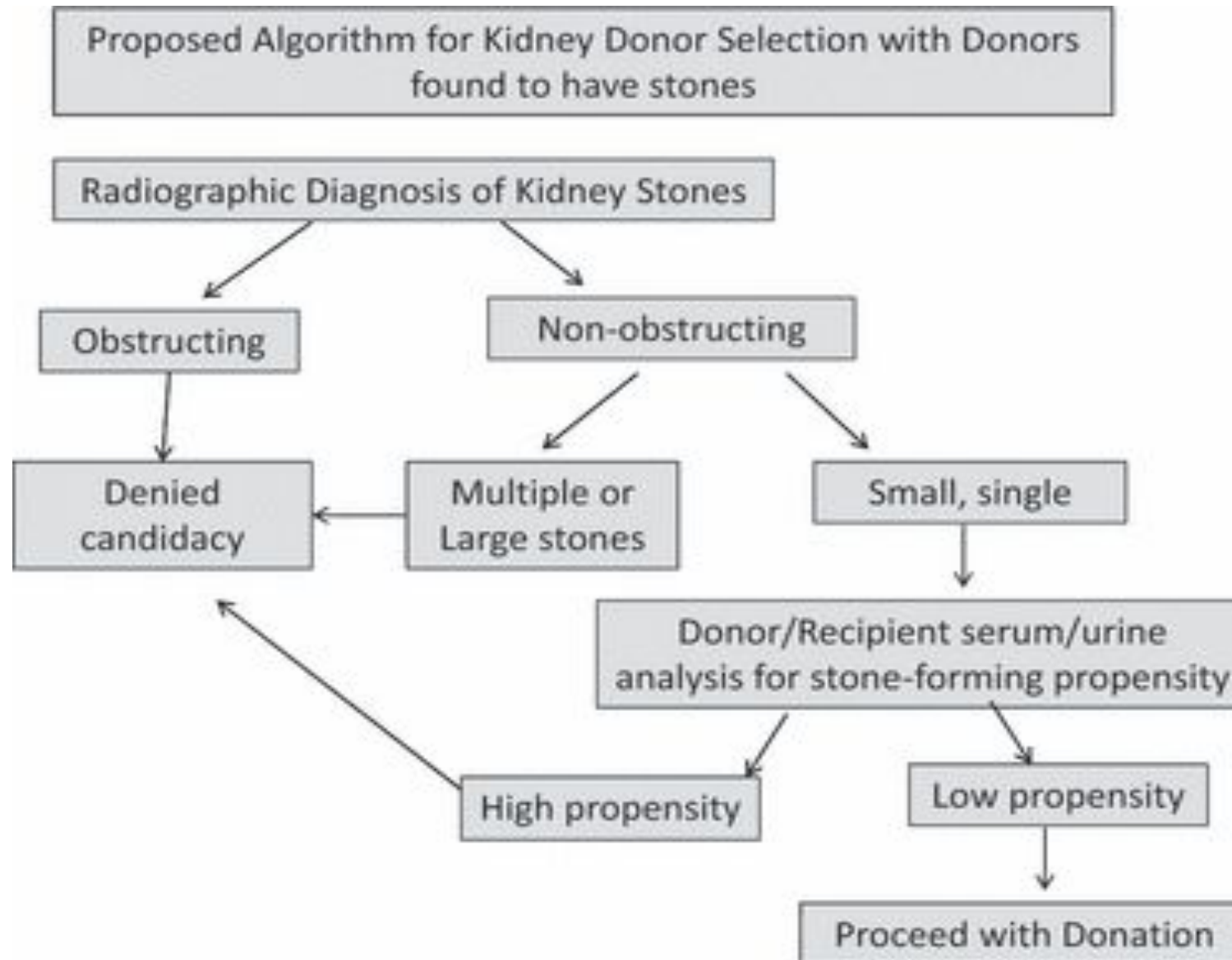


FIGURE 2 Cumulative incidence of individual outcomes. (A) Hypertension. (B) Proteinuria. (C) eGFR < 60 ml/min/1.73m<sup>2</sup>. (D) eGFR < 45 ml/min/1.73 m<sup>2</sup>. (E) Cardiovascular disease

**Use this calculator to predict the risk of a second symptomatic kidney stone after the first symptomatic stone.**

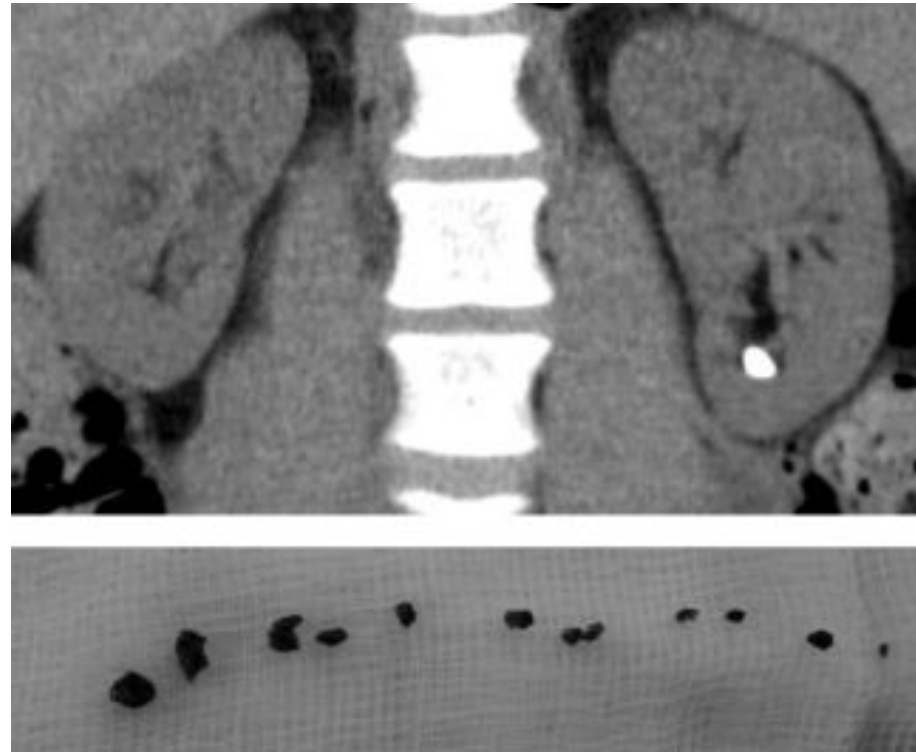
First symptomatic stone?	<input type="button" value="Yes"/>
Age (yrs)	<input type="text"/>
Gender	<input type="button" value="Female"/>
Race	<input type="button" value="Not Caucasian"/>
Family history of kidney stones?	<input type="button" value="No"/>
Gross hematuria?	<input type="button" value="No"/>
Uric acid composition?	<input type="button" value="No"/>
Imaging performed?	<input type="button" value="No"/>
Symptomatic ureterovesical junction stone (on imaging)	<input type="button" value="No"/>
Symptomatic renal pelvic or lower pole stone? (on imaging)	<input type="button" value="No"/>
Concurrent asymptomatic stone? (on imaging)	<input type="button" value="No"/>
Prior incidental (asymptomatic) stone?	<input type="button" value="No"/>
Prior suspect kidney stone event (no stone seen)	<input type="button" value="No"/>
	<input type="button" value="Submit"/>

# Incidental kidney stones



# Incidental renal stones in potential live kidney donors:

(Laser fragmentation of large stone predonation)





# Incidental renal stones in potential live kidney donors- role of *ex vivo* ureteroscopy





# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90. Her BMI is 32. CT angio reveals 4 mm stone in left kidney.
- U/A shows >5 RBCs repeatedly.

# Microscopic Hematuria

- 10 potential donors with micro hematuria were biopsied
- 1 IGAN, 4 Thin BM disease, 2 NI, 1 HTN changes, 2 other.
- 4/10 ended donating (2 NIs, 2 TBMD)

Koushik R, et al, Transplantation , 2005

# Microscopic Hematuria

## **45 biopsies:**

62 % normal

29% TBM

9% IgAN

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90. Her BMI is 32. CT angio reveals 4 mm stone in left kidney. U/A shows 5 RBCs repeatedly.
- Fasting glucose 108.

# Spectrum of DM

Type of Diabetes	Normal glucose tolerance	Hyperglycemia	
		Pre-diabetes	Diabetes Mellitus
		Impaired fasting glucose or impaired glucose tolerance	Not insulin requiring Insulin required for control Insulin required for survival
Type 1			
Type 2			
Other specific types			
Gestational Diabetes			
Time (years)			
FPG	<5.6 mmol/L (100 mg/dL)	5.6–6.9 mmol/L (100–125 mg/dL)	≥7.0 mmol/L (126 mg/dL)
2-h PG	<7.8 mmol/L (140 mg/dL)	7.8–11.1 mmol/L (140–199 mg/dL)	≥11.1 mmol/L (200 mg/dL)

Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: <http://www.accessmedicine.com>

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# Familial risk of DM

1 in 7 if one of your parents was diagnosed before the age of 50

1 in 13 if one of your parents was diagnosed after the age of 50

1 in 2, if both your parents have diabetes

Source: ADA

2017

# Pre-Diabetes: Donors with IFG

- 143 donors with Impaired fasting glucose 1994-2007
- 58% of IFG donors had reverted to normal fasting glucose at a mean follow-up of 10.4 years. Higher proportion of IFG donors had developed DM (15.56% vs. 2.2%, P=0.06). GFR and Ualb same

**Prediabetic living kidney donors have preserved kidney function at 10 years after donation. Chandran S1, Masharani U, Webber AB, Wojciechowski DM. 2014**



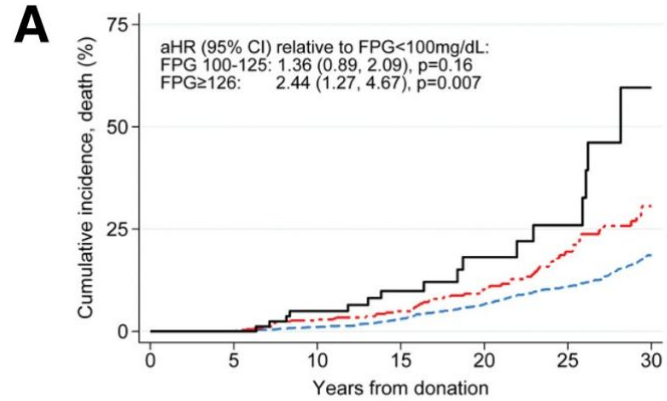
TABLE 2. - Outcomes of RELIVE study donors at study end in 2010–2012

Outcome, n (%)	Donors with data available	Events, n (%)	FPG <100 mg/dL (n = 6204)	FPG 100–125 mg/dL (n = 1826)	FPG ≥126 mg/dL (n = 250)	Overall P
Mortality	8280	362 (4.4)	272 (4.4) <sup>a</sup>	72 (3.9) <sup>a</sup>	18 (7.2) <sup>b</sup>	0.06
CVD	8266	1002 (12.1)	734 (11.9) <sup>a</sup>	232 (12.7) <sup>a</sup>	36 (14.5) <sup>a</sup>	0.32
Diabetes	7624	545 (7.1)	202 (3.5) <sup>a</sup>	93 (5.5) <sup>b</sup>	250 (100.0) <sup>c</sup>	<0.001
Hypertension	7469	2196 (29.4)	1566 (27.6) <sup>a</sup>	554 (35.3) <sup>b</sup>	76 (34.7) <sup>b</sup>	<0.001
Proteinuria	7446	1024 (13.8)	756 (13.6) <sup>a</sup>	247 (15.0) <sup>a</sup>	21 (9.5) <sup>b</sup>	0.06
eGFR <60 mL/min/1.73 m <sup>2</sup>	8038	4498 (56.0)	3256 (53.9) <sup>a</sup>	1103 (62.6) <sup>b</sup>	139 (58.6) <sup>a, b</sup>	<0.001
eGFR <45 mL/min/1.73 m <sup>2</sup>	8038	965 (12.0)	661 (10.9) <sup>a</sup>	270 (15.3) <sup>b</sup>	34 (14.3) <sup>a, b</sup>	<0.001
eGFR <30 mL/min/1.73 m <sup>2</sup>	8038	55 (0.7)	39 (0.6) <sup>a</sup>	12 (0.7) <sup>a</sup>	4 (1.7) <sup>a</sup>	0.16
ESKD	7739	41 (0.5)	29 (0.5) <sup>a</sup>	9 (0.5) <sup>a</sup>	3 (1.2) <sup>a</sup>	0.26
eGFR <30 mL/min/1.73 m <sup>2</sup> or ESKD	8229	79 (1.0)	57 (0.9) <sup>a</sup>	17 (0.9) <sup>a</sup>	5 (2.0) <sup>a</sup>	0.22

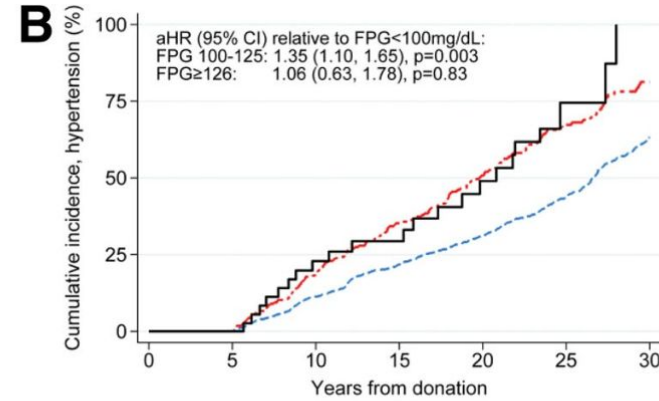
**IFG in donors** Minnesota, Mayo, University of Alabama- 8922 live kidney donations at the 3 centers from 1963 to 2007. F/U 17 years

# IFG in donors

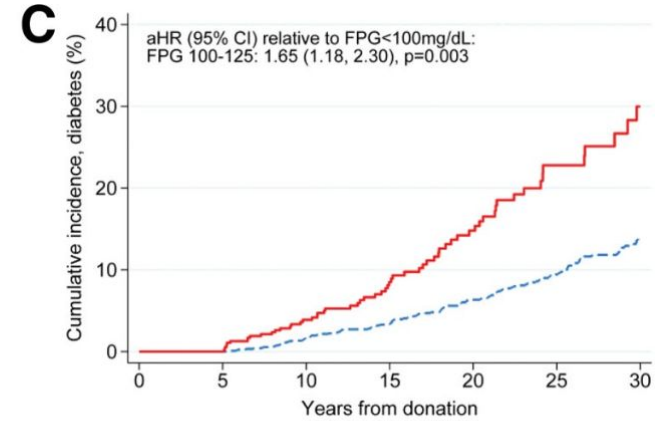
Minnesota, Mayo, University of Alabama- 8922 live kidney donations at the 3 centers from 1963 to 2007



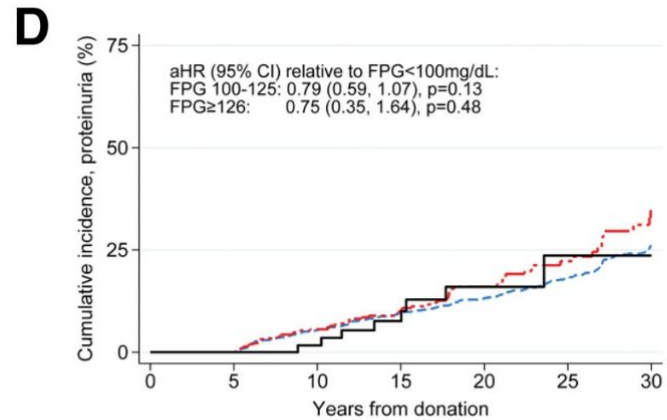
Number at risk	<100	100-125	≥126
2528	2528	1783	1341
629	629	411	283
92	92	68	49
	1034	189	27
	713	98	11
	376	48	3



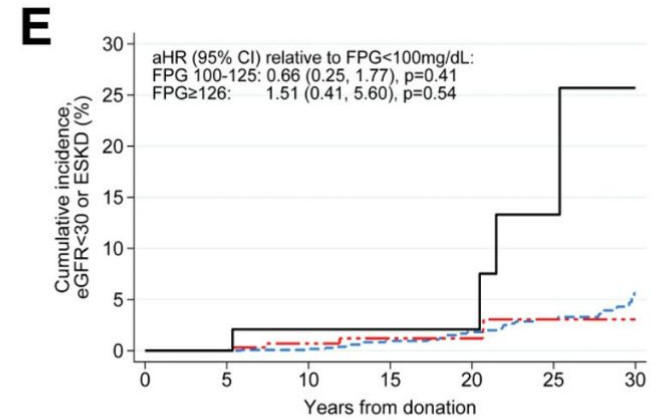
Number at risk	<100	100-125	≥126
1375	1375	986	739
285	285	189	126
38	38	25	19
	576	83	12
	356	41	3
	147	16	0



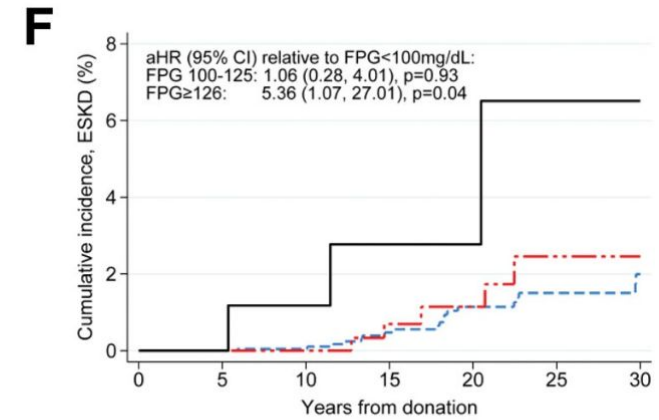
Number at risk	<100	100-125	≥126
2258	2258	1563	1140
561	561	356	234
	871	149	72
	602	72	37
	319	37	0



Number at risk	<100	100-125	≥126
2117	2117	1472	1071
518	518	344	231
73	73	54	38
	805	148	17
	550	73	6
	284	36	3



Number at risk	<100	100-125	≥126
1428	1428	1044	797
322	322	218	159
50	50	37	29
	643	118	18
	436	67	7
	192	31	2



Number at risk	<100	100-125	≥126
2341	2341	1647	1224
579	579	378	259
87	87	64	47
	946	172	26
	655	89	11
	347	45	3

Cumulative incidence of individual outcomes. Analysis performed on donors having follow-up time  $\geq 5$  y. (A) Mortality, (B) hypertension, (C) diabetes, (D) proteinuria, (E) eGFR <30 or ESKD, and (F) ESKD. Blue dashed lines indicate <100 mg/dL; red dashed lines indicate 100–125 mg/dL (22%); and black dashed lines indicate  $\geq 126$  mg/dL (3%).

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90. Her BMI is 32. CT angio reveals 4 mm stone in left kidney. U/A shows 5 RBCs repeatedly. A1C is 5.9%.
- She wants another baby 1 year after donation.

# Pregnancy

Fetal and maternal outcomes in 98 donors with both pre- and post-donation pregnancies

	Pre-donation pregnancies (n=204)	Post-donation pregnancies (n=173)
<b>Fetal outcomes</b>		
Full-term birth	146(71.6%)	116(67.1%)
Prematurity	15(7.4%)	15(8.7%)
Fetal loss	43(21.1%)	42(24.3%)
Death	2(4.7%)	1(2.4%)
Miscarriage	33(76.7%)	36(85.7%)
Abortion	8(18.6%)	5(11.9%)
<b>Maternal outcomes</b>		
Gestational diabetes	1(0.5%)	1(0.6%)
Gestational hypertension	1(0.5%)	6(3.5%)
Preeclampsia or toxemia	1(0.5%)	6(3.5%)
Proteinuria	4(1.5%)	8(4.6%)

Within the same woman, there was no difference in the odds of premature delivery or fetal loss. However, the odds of adverse maternal outcomes in post-donation pregnancies significantly increased.

# Maternal and Fetal Outcomes in Living Kidney Donors and Matched Non-donors.

**Table 3. Maternal and Fetal Outcomes of Pregnancies after Cohort Entry in Living Kidney Donors and Matched Nondonors.**

Outcome	Pregnancies in Donors (N=131)	Pregnancies in Nondonors (N=788)	Odds Ratio (95% CI)	P Value*
	<i>no. of events (%)</i>			
Primary outcome: gestational hypertension or preeclampsia	15 (11)	38 (5)	2.4 (1.2–5.0)	0.01
Secondary outcomes				
Gestational hypertension†	7 (5)	17 (2)	2.5 (0.9–6.5)	0.06
Preeclampsia	8 (6)	21 (3)	2.4 (1.0–5.6)	0.05
Cesarean section	41 (31)	224 (28)	1.2 (0.7–2.1)	0.44
Postpartum hemorrhage	≤5 (≤4)‡	24 (3)	0.9 (0.3–2.9)	0.91
Preterm birth with gestation of <37 wk	10 (8)	52 (7)	1.2 (0.5–2.5)	0.70
Low birth weight of <2500 g	8 (6)	31 (4)	1.7 (0.7–4.0)	0.21

\* P values were derived from random-effects logistic-regression models for binary outcome data, accounting for the correlation structure within matched sets and in women with multiple pregnancies.

† When diagnostic codes for both gestational hypertension and preeclampsia were present in a given pregnancy, the outcome was counted as a diagnosis of preeclampsia.

‡ To comply with privacy regulations for minimizing the chance of identification of a study participant, numbers of participants are suppressed in the case of 5 or fewer participants (reported as ≤5).

# Case

- 37 yr old AA female, mother of 2, wishing to donate to her father (DM). Her BP was high during her last pregnancy 10 years ago. BP now is 140/90. Her BMI is 32. CT angio reveals 4 mm stone in left kidney. U/A shows 5 RBCs repeatedly. A1C is 5.9%. She wants another baby 1 year after donation.
- It is found that her father actually has PKD (in addition to DM).



# Donors at risk for PKD

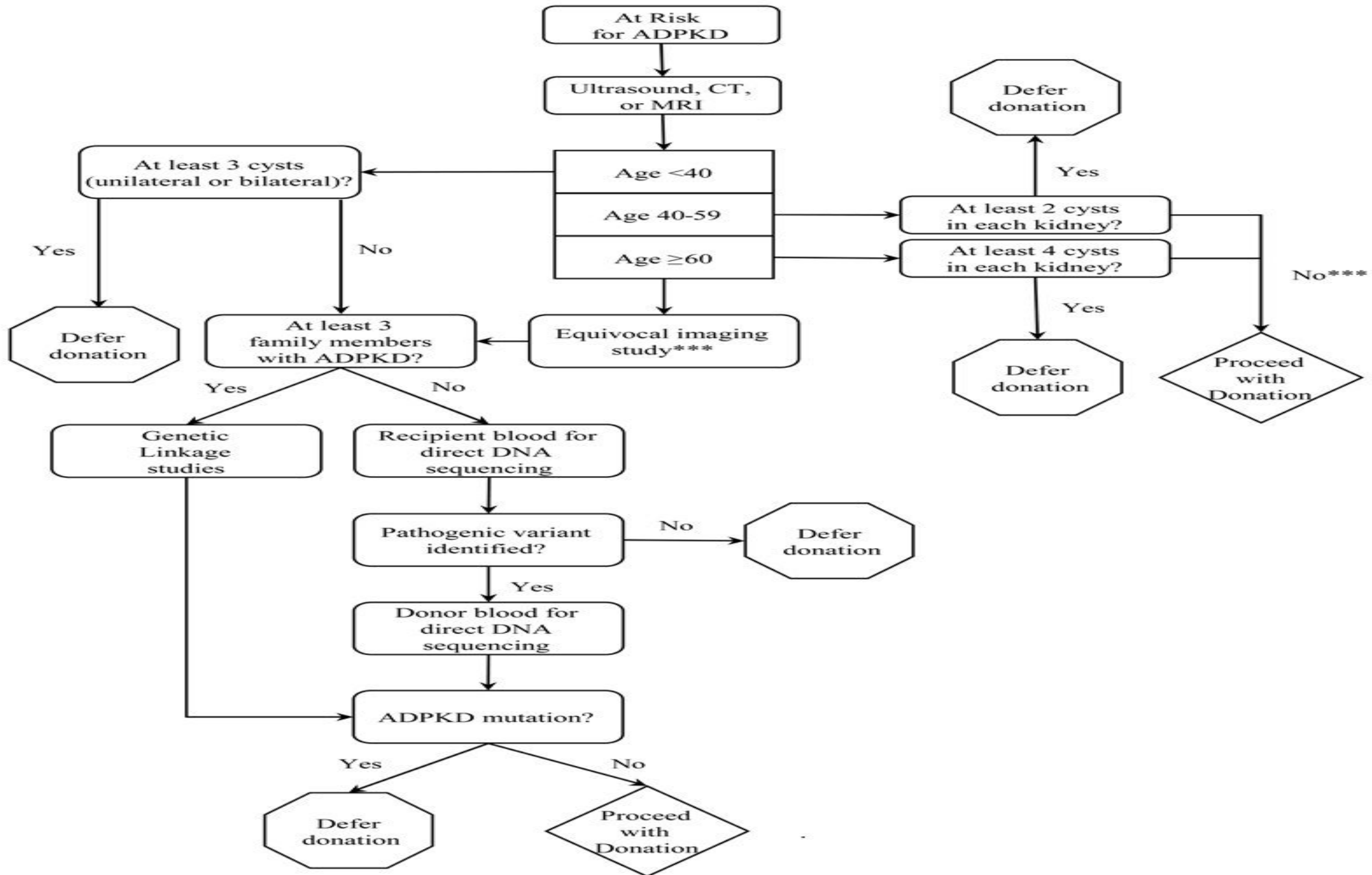
Table 1

Ultrasound Criteria for Diagnosis of ADPKD in Patients at 50% Risk of *PKD1* Inheritance (Adapted from Pei, et al. (9))

<b>Age</b>	<b>Diagnostic Criteria by Ultrasound</b>
<40	At least 3 renal cysts (unilateral or bilateral)
40–59	At least 2 renal cysts in each kidney
≥60	At least 4 renal cysts in each kidney

Huang E, et al. DNA Testing For Live Kidney Donors At Risk For Autosomal Dominant Polycystic Kidney Disease. *Transplantation*, 2009.



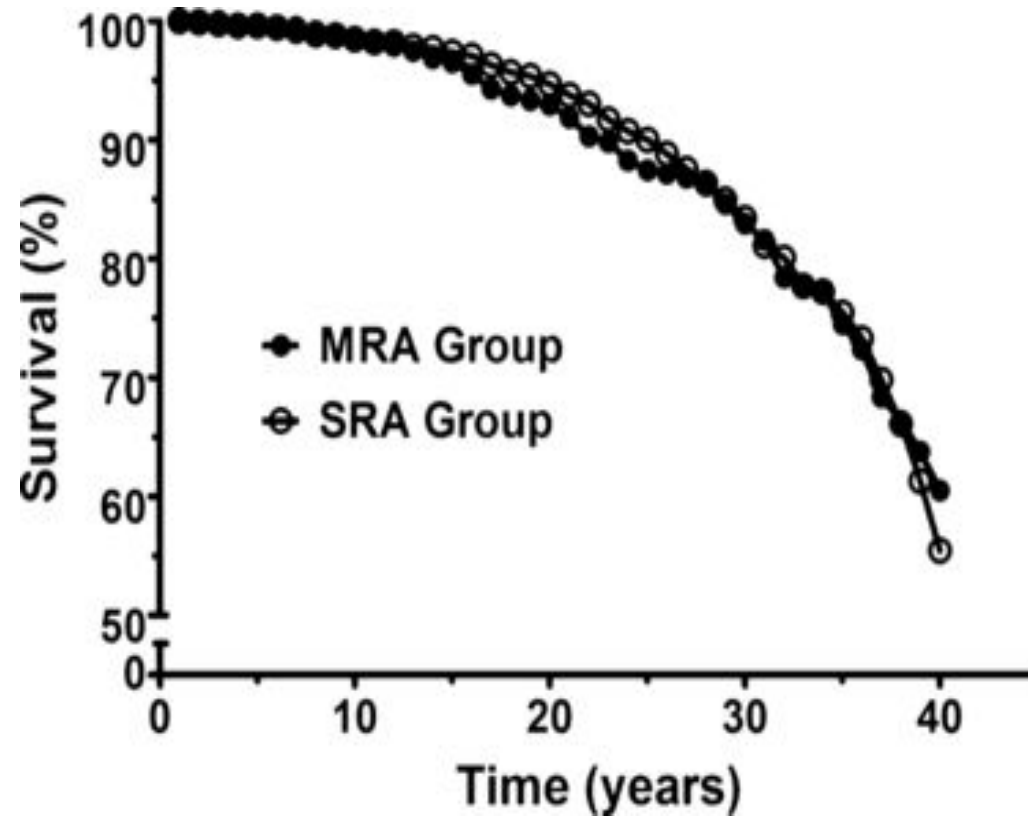


# Case

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- Her CT shows 3 renal arteries on right and 1 renal artery on left and on 2 cm simple cyst on right.

# Outcome of living kidney donors left with multiple renal arteries

(1200 donors with MRA, 15 yr f/u, no change in HTN, proteinuria, or GFR)

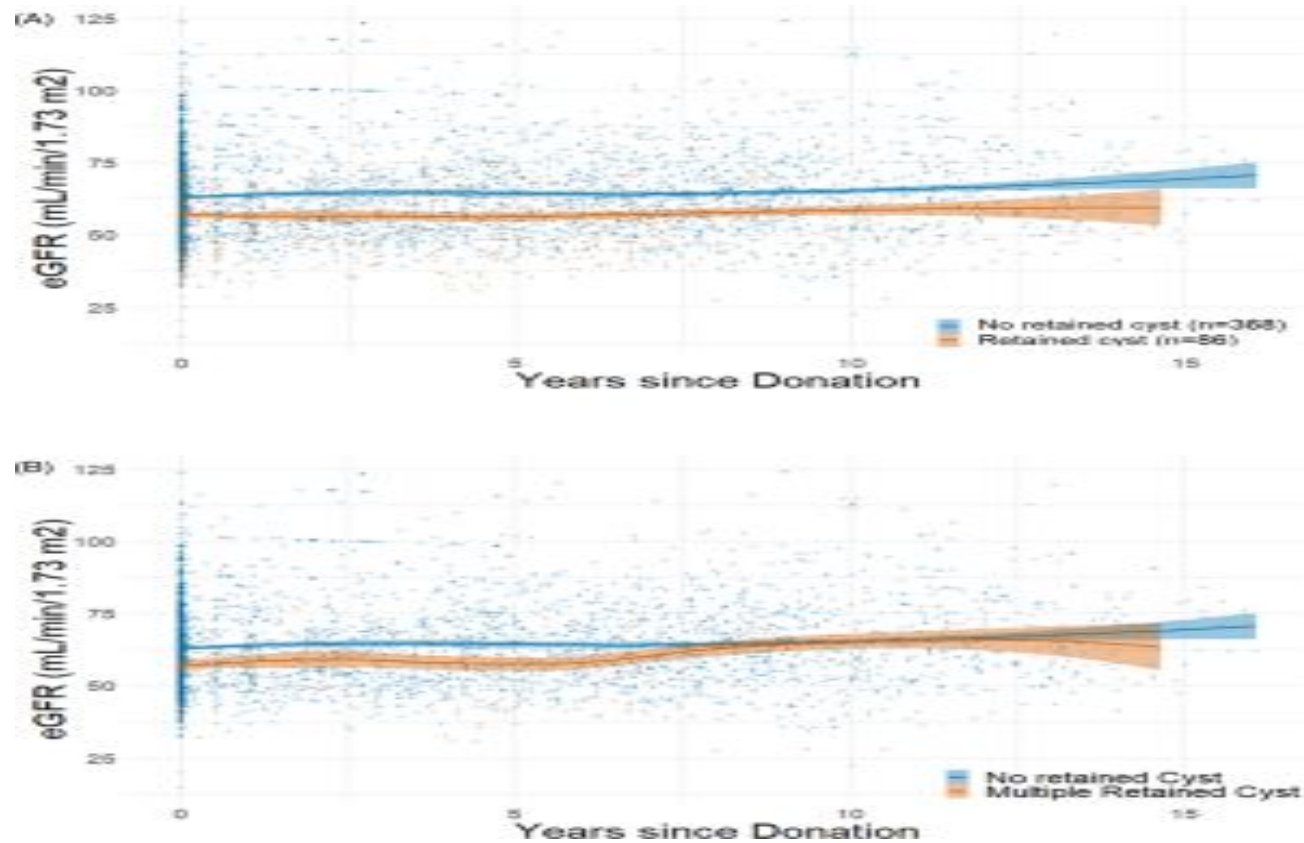


## Clinical Transplantation

[Volume 26, Issue 1](#), pages E7-E11, 23 OCT 2011 DOI: 10.1111/j.1399-0012.2011.01548.x

[http://onlinelibrary.wiley.com/doi/10.1111/j.1399-0012.2011.01548.x/full#f2\(Uminn\)](http://onlinelibrary.wiley.com/doi/10.1111/j.1399-0012.2011.01548.x/full#f2(Uminn))

## Cysts in the remaining kidney



*A, Postdonation estimated glomerular filtration rate (eGFR) trajectory among donors with vs without retained renal cysts. B, Postdonation estimated glomerular filtration rate (eGFR) trajectory among donors with vs without multiple retained renal cysts*

## Summary of the risks of living kidney donation

Perioperative risk	Perioperative risk relatively low: major complications around 2.5%; overall risk between 7 and 17%, mainly bleeding and infection. Increased risk conferred by black ethnicity, obesity, haematological disorders, psychiatric conditions and robotic nephrectomy.
Mortality	Short-term (90 day) mortality risk: 3.1 in 10,000. Long-term mortality equivalent to control populations; one study reports higher mortality after very long-term (25-year) follow-up.
End-stage kidney disease	Overall prevalence low, but 3–5 times higher than in well-matched controls. Increased risk conferred by younger age, black ethnicity, male gender, lower GFR, smoking history and the presence of hypertension, albuminuria, obesity or diabetes.
Hypertension and cardiovascular risk	Some studies report a 2–4-fold increased risk of hypertension. Increased risk conferred by black ethnicity. No significantly increased risk of cardiovascular events.
Gout	Slightly increased risk of gout post-donation but similar to the general population. Increased risk conferred by male gender and black ethnicity.
Metabolic bone disease	Observed differences in PTH, vitamin D3 and FGF-23 but no difference in pathological events.
Psychological outcomes	Reduced HRQoL in the first 3 months, which improves by 12 months after donation. Reduced HRQoL associated with obesity, history of psychiatric difficulty and non-white race. Education, older age and first-degree relation to the recipient are protective factors.
Kidney stone	Donors with no metabolic abnormality and small kidney stones may safely donate.
Obesity	Slightly increased risk of infection and operative time. Increased incidence of hypertension and diabetes. Possible longer-term increased risk of ESKD and mortality.
Black race	Higher relative risk of hypertension, CKD and ESKD. Increased risk of gout. Increased perioperative risk.
Pregnancy	2.4-fold higher risk of gestational hypertension and pre-eclampsia. No adverse effect on foetal or maternal outcomes.





Thank you for your attention.....



# Risk of End-Stage Renal Disease Following Live Kidney Donation (97,000 donors vs healthy nondonors). USA Study

General population lifetime risk for  
ESRD: 3.2%

Donor ESRD: 0.9%

Nondonor ESRD: 0.14%

JAMA. 2014;311(6):579-586



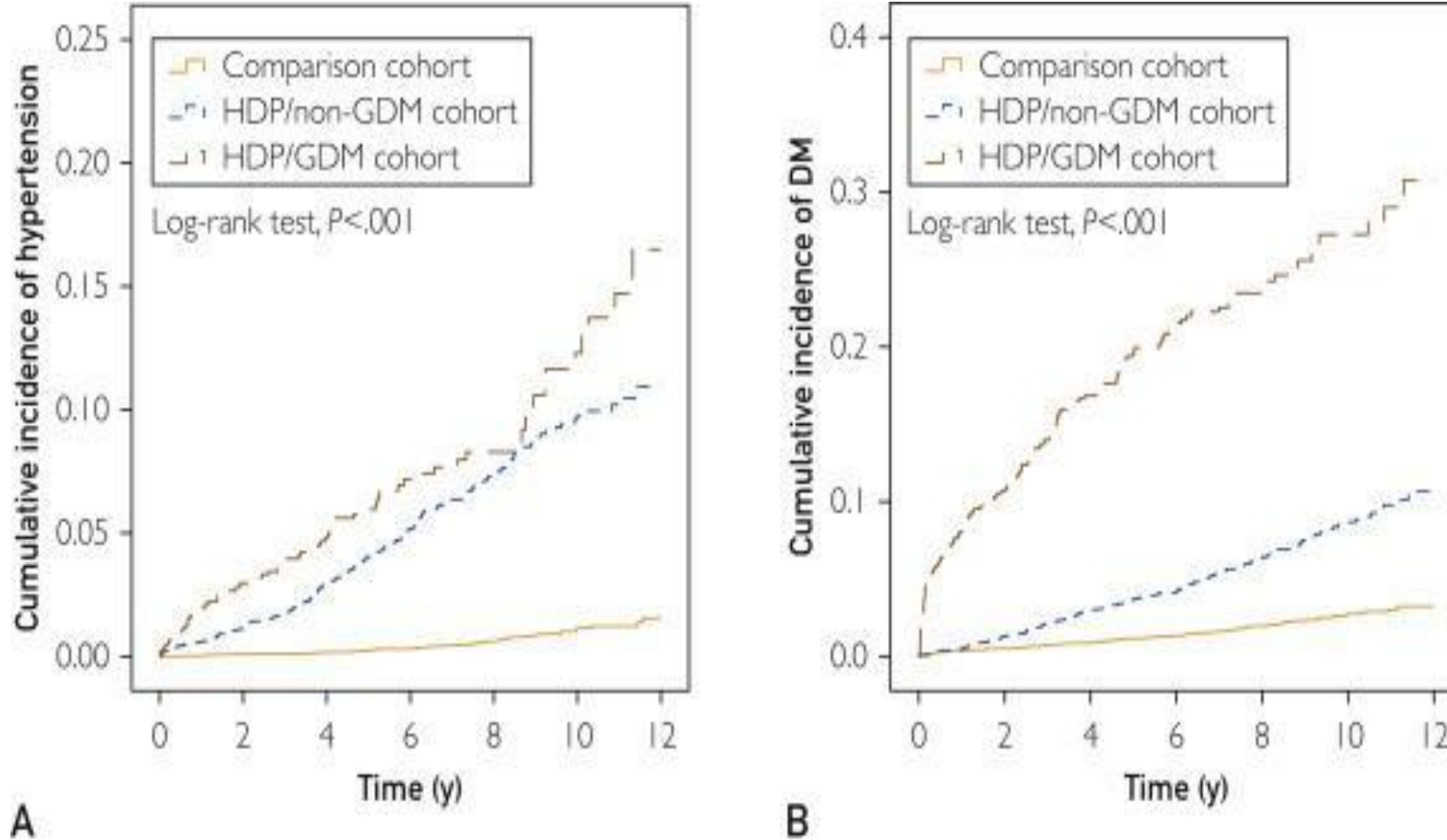
# Diabetic Nephropathy in African Americans

Type 2 diabetes mellitus is 1.4 to 2.2 times more prevalent in African Americans than whites.

Plus higher rates of micro-vascular complications.

2-3 X rate of ESRD than whites

# Risk of Subsequent Hypertension and Diabetes in Women With Hypertension During Pregnancy and Gestational Diabetes

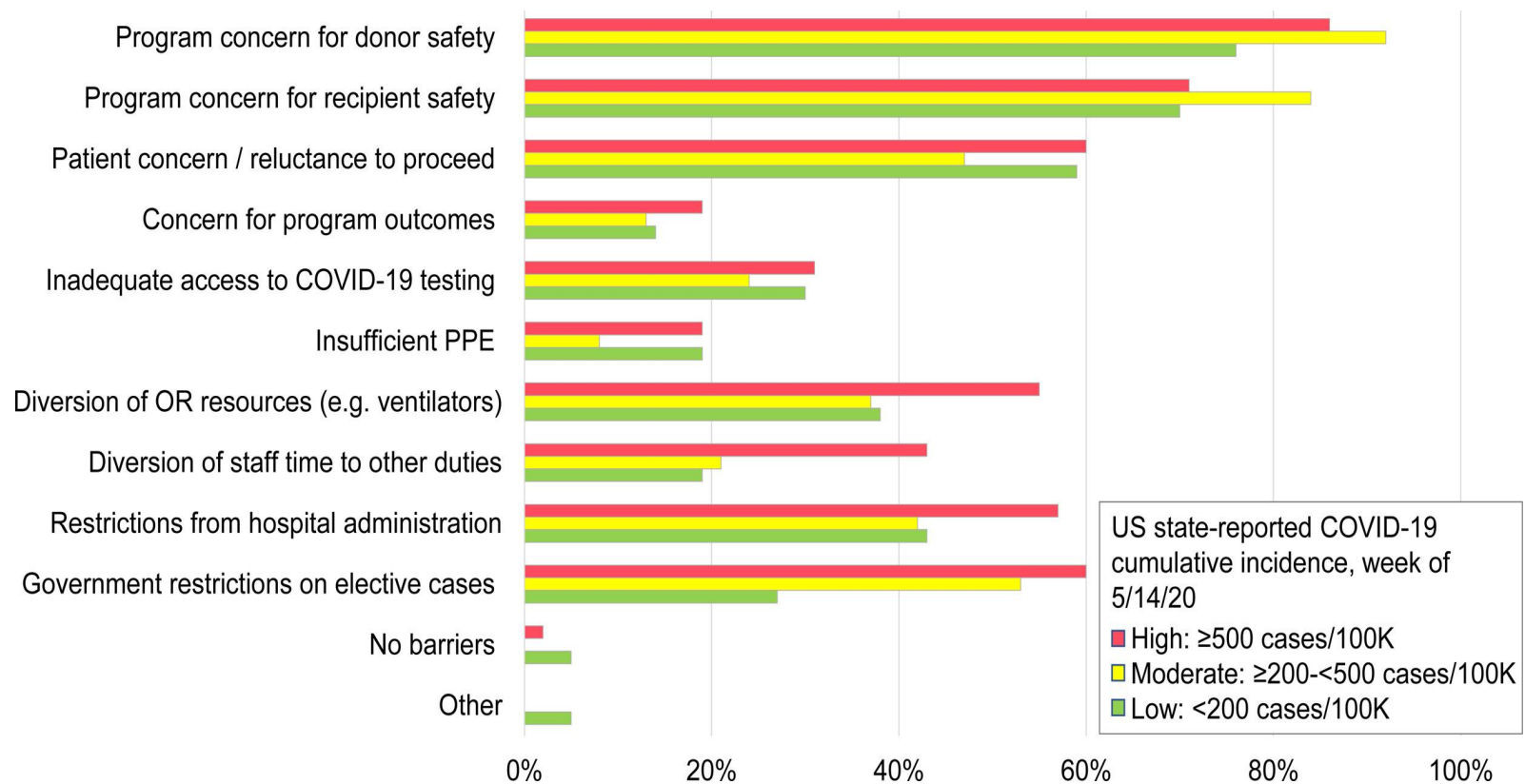


Lien-Jen, et al. Mayo Clinic Proceedings, 2016 1200 both, 5000 1, 12000 none.

# Micosroscopic hematuria

- Of 242 Japanese donors, 20 had persistant dysmorphic hematuria (>5 RBCs) pre-donation.
- 2 year follow up looking at proteinuria, GFR: 5-6 X risk of proteinuria; decr in GFR

## Kidney Transplantation During the COVID-19 Pandemic



# Summary of medically complex donor

- HTN
- Obesity
- Stone
- Hematuria
- Pre-diabetes
- Pregnancy
- PKD risk
- Multiple arteries
- AA race (Apol1)