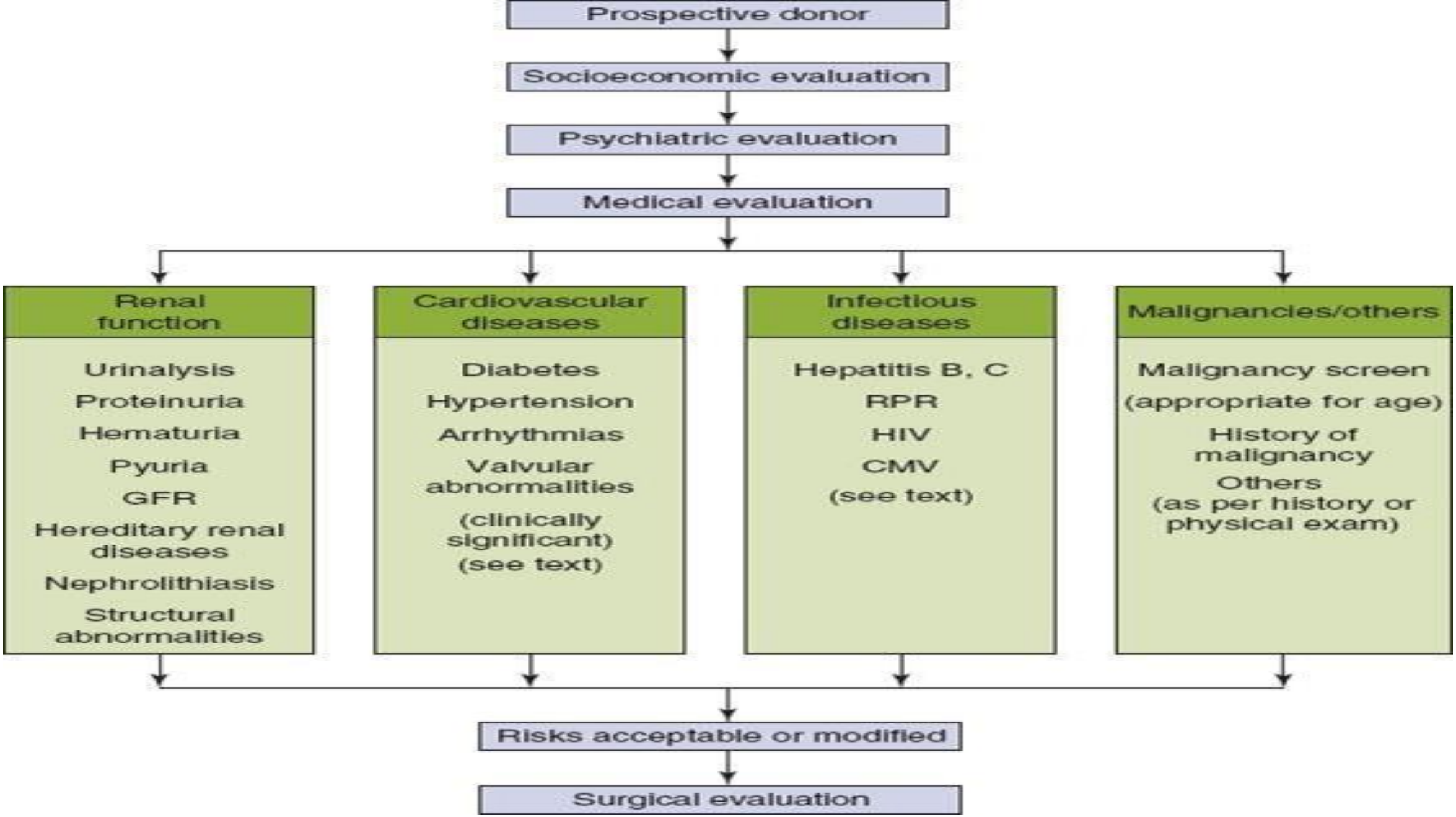

IN
GOD'S NAME

Living Donor Kidney Transplantation

Dr Sahar Vahdat
assistant Professor of Nephrology
Khorshid Kidney Center
IUMS

Evaluation of Living Kidney Donors

Table of Contents


Prospective donor
Socioeconomic evaluation
Psychiatric evaluation
Medical evaluation
Renal function
Urinalysis
Proteinuria
Hematuria
Pyuria
GFR
Hereditary renal diseases
Nephrolithiasis
Structural abnormalities
Cardiovascular diseases
Diabetes
Hypertension
Arrhythmias
Valvular abnormalities
(clinically significant)
(see text)
Infectious diseases
Hepatitis B, C
RPR
HIV
CMV
(see text)
Malignancies/others
Malignancy screen
(appropriate for age)
History of malignancy
Others
(as per history or physical exam)
Risks acceptable or modified
Surgical evaluation

Which Donor to Choose?

- selection of the most appropriate donor depends on a variety of factors including the **degree of HLA matching & donor age & size**

- Biologically related donors are generally preferred over unrelated donors

- If the **donors** (family member) have similar match grade(one haplotype-matched parent or sibling) , it may be advisable to choose **the older donor** with the thought that the younger donor would still be available for donation if the first kidney eventually fails

- There is some evidence that recipients of maternal kidneys may have a somewhat greater incidence of rejection and graft loss

Donor Age

- Advanced age can increase the risk for perioperative complications, but there is **no mandated upper age limit for living kidney donation**

- Some programs in the United States exclude donors **> 70 ys**

- There is a trend toward using older donors, and the outcome of these donations, particularly to older recipients, is reported to be excellent

- With respect to younger donor age, most programs regard **18 ys** to be a firm lower age limit

- Approximately 10% of all living donations are to recipients who are> 65 ys

PREDONATION KIDNEY FUNCTION

1. Evaluation
2. Selection
3. Counseling

Question 1

- Which of the following methods is recommended for the initial evaluation of kidney function in a living donor?

a. eGFRcr CKD-EPI
b. eGFRcr-cys
c. mGFR
d. mCrCl

Answer

a. eGFRcr CKD-EPI
b. eGFRcr-cys
c. mGFR
d. mCrCl

Evaluation

- Donor kidney function should be expressed as **GFR** & **not as serum creatinine** concentration

Donor GFR should be expressed in **mL/min per 1.73 m2 rather than mL/min**

Donor GFR should be estimated from **serum creatinine** (**eGFRcr**) for **initial** assessment

Evaluation (cont…)

Donor GFR should be confirmed using one or more of the following:

- **Measured GFR** (mGFR) using an exogenous filtration marker: preferably **urinary or plasma clearance**of inulin, iothalamate, 51Cr-EDTA, iohexol or **urinary** clearance of 99mTc-DTPA

- **Measured Cr clearance** (**mCrCl**)

- **Estimated GFR** from the combination of serum Cr & cystatin C (eGFRcr-cys)

- **Repeat eGFRcr**
- Both eGFRcr and eGFRcys are imprecise at high levels of GFR, so confirmatory testing is recommended for all donor candidates

Evaluation (cont…)

If there are **parenchymal, vascular or urological abnormalities or asymmetry of kidney size** on renal imaging**:**

Single kidney GFR should be assessed using radionuclides or contrast agents that are excreted by glomerular filtration (eg, 99mTc-DTPA)

Confirmatory test

mGFR using an exogenous filtration marker is the most accurate confirmatory test

- mGFR is not available in all centers, so alternatives are acceptable mClcr is not as accurate as mGFR
- It overestimates mGFR because of Cr secretion, with the magnitude of overestimation exceeding 15% at normal GFR, & is prone to error because of inaccurate urine collections
- **eGFRcr–cys** is generally recommended over eGFR**cr or** eGFR**cys**
- **Repeat eGFRcr** can be used if no other confirmatory tests are available

NDT 29: 1195–1203, 2014

NEJM 367: 20–29, 2012

Selection

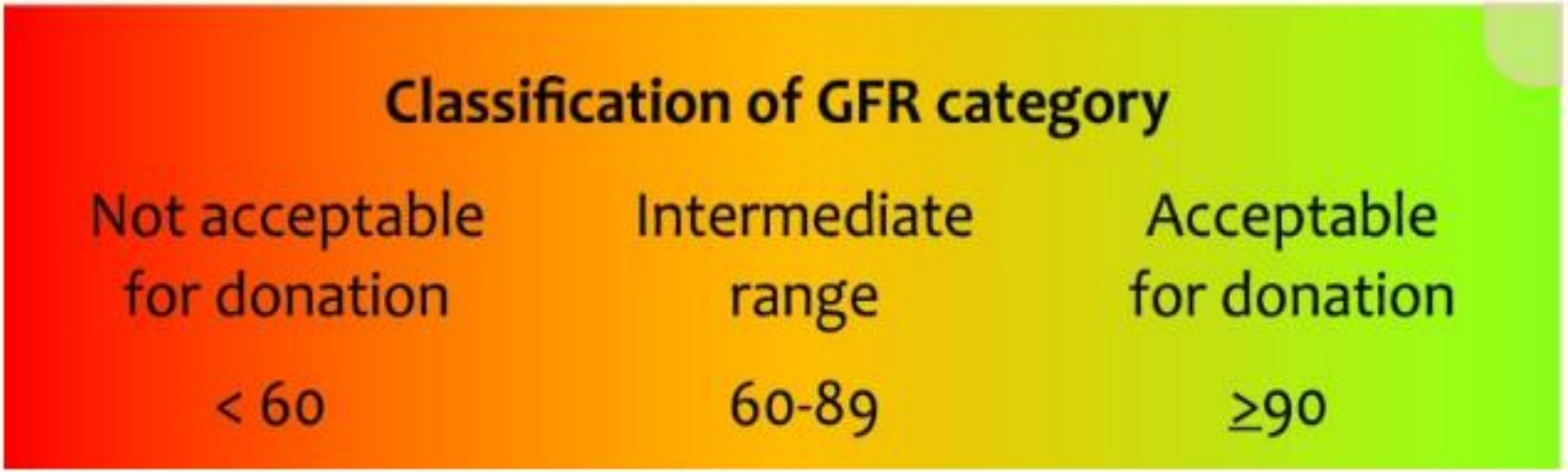


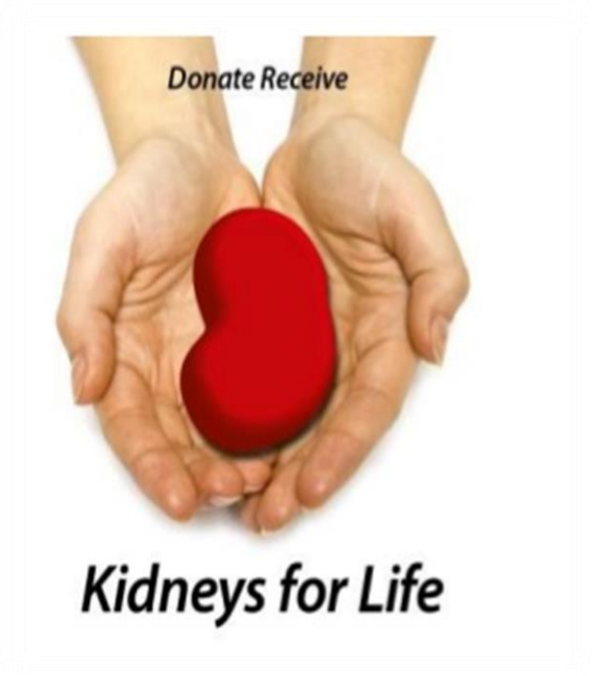
Figure 3.

KDIGO classification of GFR categories and use in decision-making for donor candidates. Colors are blended together to signify that the threshold for decision-making is imprecise.

Counseling

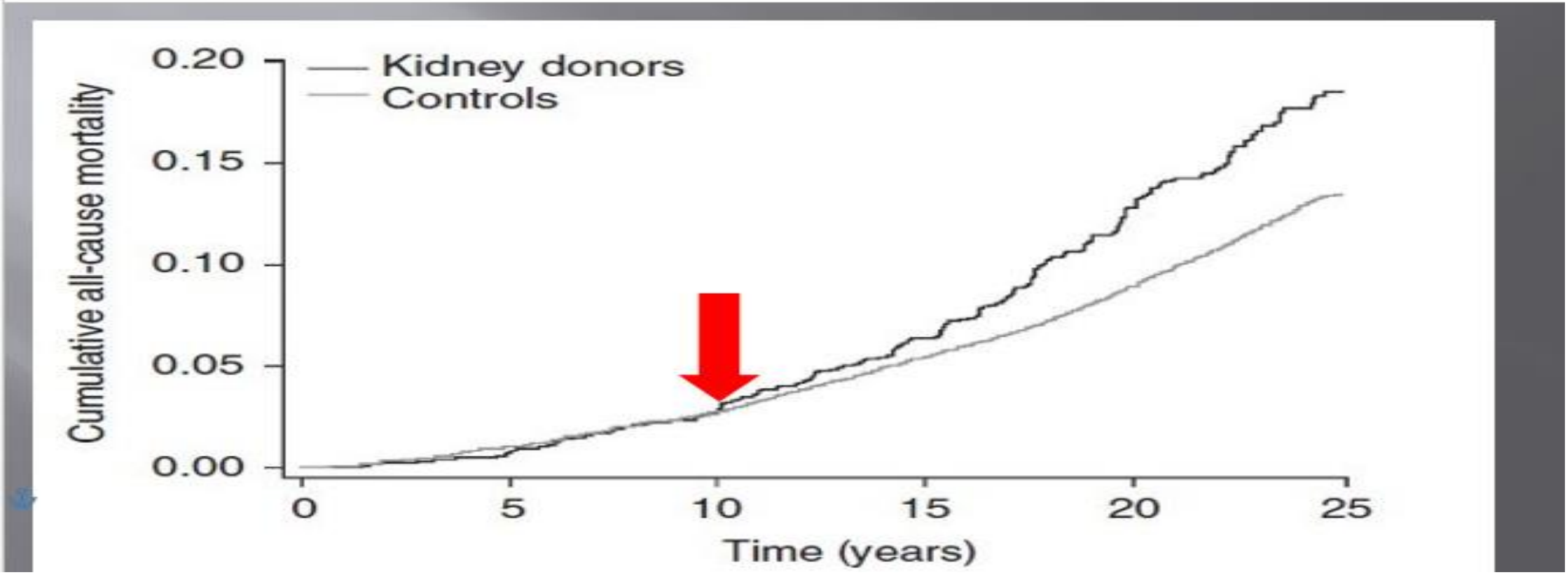
- We suggest that donor candidates be informed that the future risk of developing kidney failure necessitating treatment with dialysis or transplantation is **slightly higher** because of donation

- **average absolute risk in the 15 years following donation remains low**



Long-term risks for kidney donors

Geir Mjøen[1], Stein Hallan[2,3], Anders Hartmann[1], Aksel Foss[1], Karsten Midtvedt[1], Ole Øyen[1], Anna Reisæter[1], Per Pfeffer[1], Trond Jenssen[1], Torbjørn Leivestad[4], Pål- Dag Line[1], Magnus Øvrehus[2], Dag Olav Dale[1], Hege Pihlstrøm[1], Ingar Holme[5], Friedo W. Dekker[6] and Hallvard Holdaas[1]



Nephrology Dialysis Transplantation, Volume 32, Issue 2, 1 February 2017, Pages 216–223

Question 2

- Do more complicated GFR approval procedures beyond eGFR for all candidates?

a. Yes

b. No

Answer

- Do more complicated GFR approval procedures beyond eGFR for all candidates?

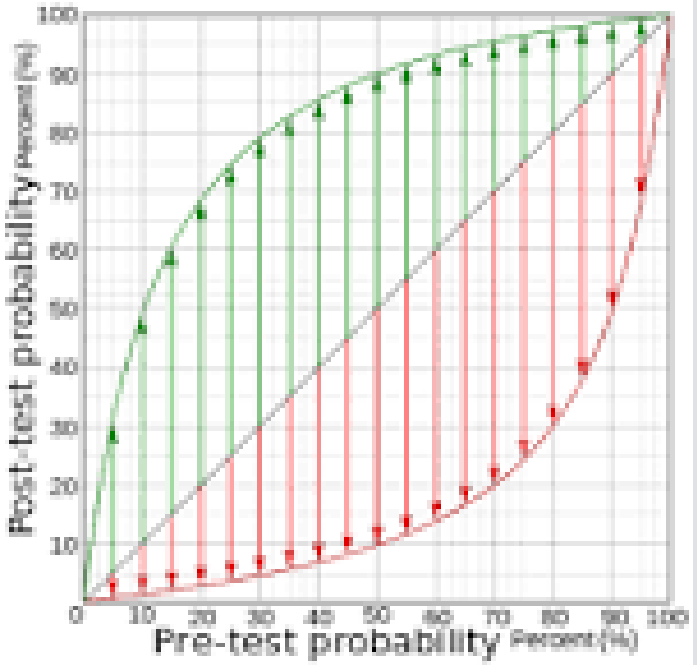
a. Yes

b. No

Assessment of GFR Range

A web-based calculator has been developed to **compute post-test probabilities for mGFR above or below various threshold probabilities** (http://ckdepi.org/equations/donor-candidate-gfr-calculator/)
Accessed March 1, 2017

Pre- and post-test probability



Pre-test probability and post-test probability are the probabilities of the presence of a condition before and after a diagnostic test, respectively. Post-test probability, in turn, can be positive or negative, depending on whether the test falls out as a positive test or a negative test, respectively.

Cont…

web-based tool to compute the **probability of mGFR** in living donor candidates based on demographic characteristics obtained from the National Health and Nutrition Examination Survey (NHANES) and the test performance of **eGFR** from **CKD-EPI**

This tool was subsequently validated in a French cohort of 311 living donor candidates, with demonstration of good diagnostic performance

if the post test probability that mGFR is greater than the GFR threshold for decision-making based on this tool (eg, .80 or 90 ml/min per 1.73 m^2) is extremely high and if urine ACR is very low, then these tests(eGFR) could simply be repeated for confirmation **without mGFR, mCrCl, or timed AER**

Assessment of GFR Range (cont..)

Donor candidates with eGFR in **intermediate** ranges would **require confirmatory** tests with **mGFR, mCrCl**

Diagnostic Post Test Probability of Disease Calculation

Enter the value of pretest probability

%

Enter the value of likelihood ratio

+ −

Calculate Clear

For a positive diagnostic test, the post test probability is

%

For a negative diagnostic test, the post test probability is

%

Donor Candidate GFR Calculator: Determining Probability of GFR Above or Below Certain Threshold

The data below are derived from Huang N, Foster M, Lentine K et al. Estimated GFR for living kidney donor evaluation. *American Journal of Transplantation* [epub ahead of print Nov 23 2015].

Step 1: Describe your patient

Age	50	years
Sex	○ Male ◉ Female	
Race	◉ Non Black ○ Black	
Creatinine	1	◉ mg/dL ○ µmol/L
Cystatin C	1.1	mg/L
eGFRcr		
eGFRcr-cys		

Step 2: Determine pre-test probability

Calculate pre-test probability

Result (Pre-test probability based on age, sex and race from US population data)

Measured GFR Thresholds			
<60	<70	≥80	≥90
6	12	77	64

Percentage of NHANES participants who had eGFRcr-cys less or above the specified thresholds. If you are interested in the opposite of the threshold (eg < 80), then subtract the value given from 100.

You can use the numbers above or a different number based on knowledge of your patient's medical history. For example, if your patient has a strong family history of CKD, you may wish to alter the pretest probability. If so, write the number to be used as pre-test probability in table below.

Step 3: Calculate the post-test probability

The calculator will look up the likelihood ratio based on the eGFR calculated from the creatinine and cysatin provided above and will compute post-test probability.

Calculate post-test probability

	Measured GFR Thresholds			
	<60	<70	≥80	≥90
Post-test probability from eGFRcr†	4	15	52	18
Post-test probability from eGFRcr-cys‡	2	19	20	2

Summary report

Based on the information supplied:

Age	50
Sex	Female
Race	Non Black
Creatinine	1 mg/dL
Cystatin C	1.1 mg/L
Estimated GFR from creatinine	66 ml/min per 1.73 m^2
Estimated GFR from creatinine-cystatin C	66 ml/min per 1.73 m^2

	Measured GFR Thresholds			
	<60	<70	≥80	≥90
Pre-test probability	6	12	77	64
Post-test probability from eGFRcr†	4	15	52	18
Post-test probability from eGFRcr-cys‡	2	19	20	2

Step 3: Calculate the post-test probability

The calculator will look up the likelihood ratio based on the eGFR calculated from the creatinine and cysatin provided above and will compute post-test probability.

Calculate post-test probability

	Measured GFR Threshold			
	<60	<70	≥80	≥90
Post-test probability from eGFRcr†	0	0	100	98
Post-test probability fr				

†Post test probability of mGFR

the threshold (eg < 80), then su

No need for confirmatory test if post test probability is ≥95%

Donor Candidate GFR Calculator: Determining Probability of GFR Above or Below Certain Threshold

The data below are derived from Huang N, Foster M, Lentine K et al. Est
American Journal of Transplantation [epub ahead of print Nov 23 2015

Step 1: Describe your patient

Age	50	years
Sex	○ Male ◉ Female	
Race	◉ Non Black ○ Black	
Creatinine	0.7	◉ mg/dL ○ µmol/L
Cystatin C		mg/L
eGFRcr		
eGFRcr-cys		

Calculate post-test probability

	Measured GFR Thresholds			
	<60	<70	≥80	≥90
Post-test probability from eGFRcr[1]	0	1	96	89
Post-test probability from eGFRcr-cys[2]	N/A	N/A	N/A	N/A

[1] **Post test probability of mGFR above or below the threshold based on eGFRcr.** If you are interested in the opposite of the threshold (eg = 60), then subtract the value given from 100.

[2] **If you also indicated the eGFRcr-cys, the calculator will use the post-test probability from the eGFRcr as the pre-**

Assessment of GFR Range

- **In some patients, it may be difficult to perform a clearance measurement**

- A recent study suggested that **eGFR may be sufficiently accurate for decision-making without the need for mGFR or mClcr in many donor candidates**

In that study, 53% of recent donors in the United States had eGFR sufficiently high to provide a ≥95% post-test probability that mGFR was ≥90 ml/min per 1.73 m^2

American Journal of Transplantation 2016; 16: 171–180

American Journal of Transplantation 2016; 16: 3024–3032
Wiley Periodicals Inc.

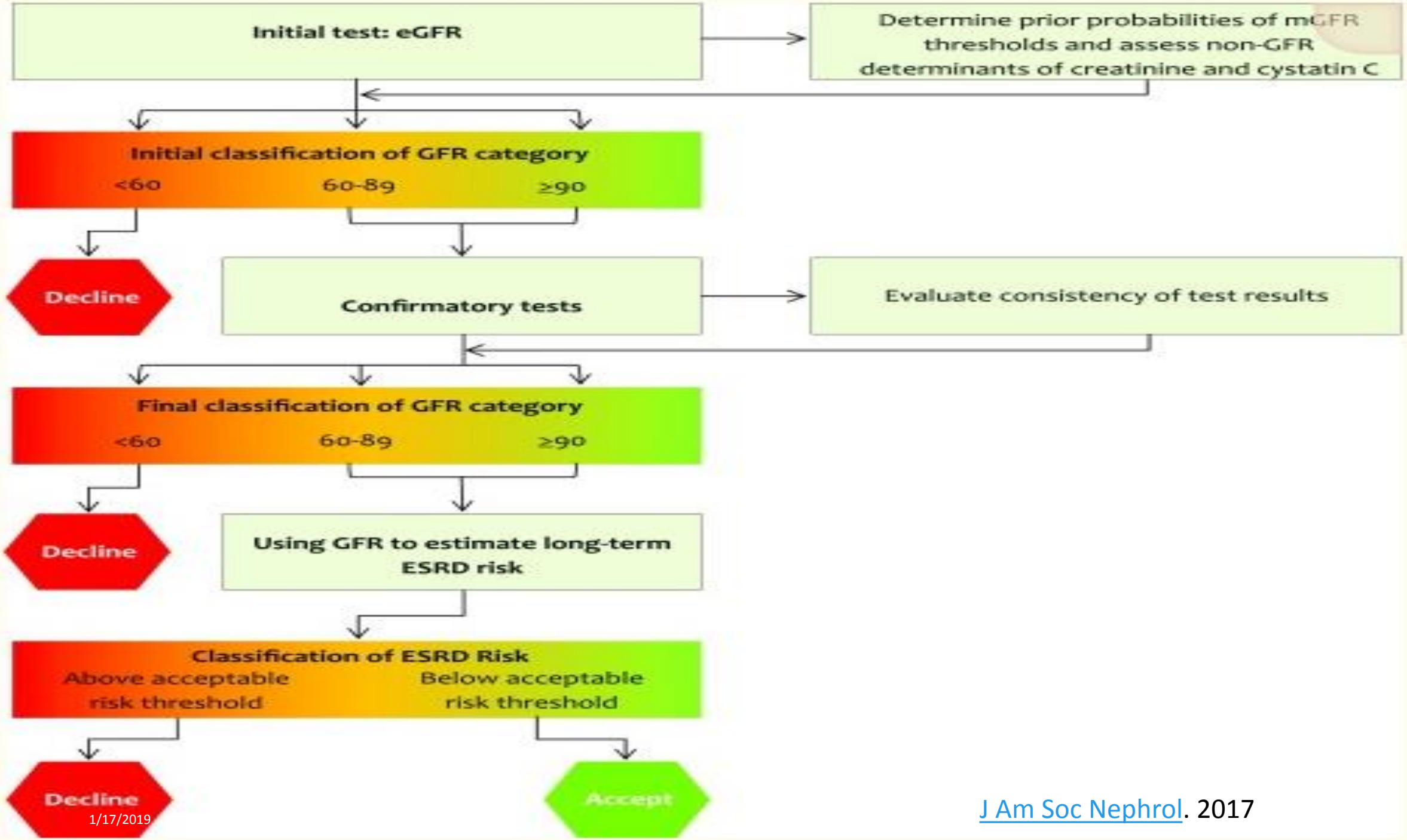
doi: 10.1111/ajt.13905

Brief Communication

Estimated or Measured GFR in Living Kidney Donors Work-up?

Physiology Department, Paris Descartes University, and INSERM, Unit 1151, Paris, France [12]AP-HP, Hopital Europ^een Georges Pompidou, !

In conclusion, we recommend calculating posttest 90 for each potential kidney donor



J Am Soc Nephrol. 2017

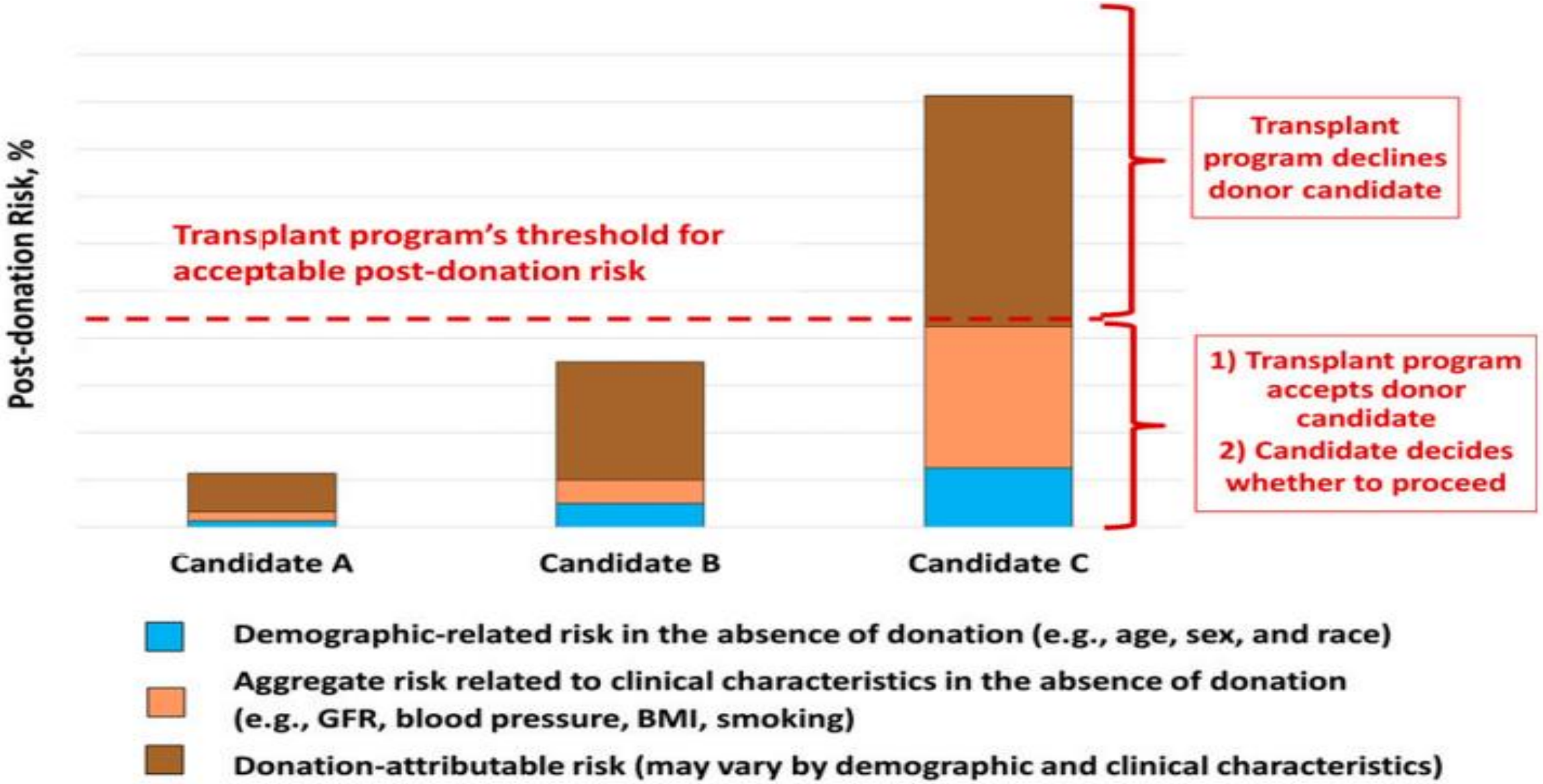
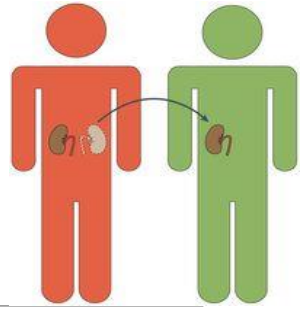


Figure 1. KDIGO proposed framework for a transplant center to accept or decline a donor

Long-term ESRD risk



A. Long-term risk in the **absence of donation** can be computed from **demographic and clinical** characteristics, including GFR (**http://www.transplantmodels.com/esrdrisk/**)

B. **Additional risk attributable to donation** is likely to be **3.5–5.2 times higher** than risk in the absence of donation **depending on sex and race**, but there is substantial uncertainty, especially in younger donor candidates, and we suggest caution in decision-making

J Am Soc Nephrol. 2017 Apr; 28(4): 1062–1071

Prediction Models

This model projects 15 year and lifetime predonation ESRD risks (ie, without donation-attributable risk) in donor candidates based on age, sex, race, GFR, ACR, diabetes, smoking, blood pressure, antihypertensive drug use, and BMI

- The tool was developed from a meta-analysis of data from nearly 5 million healthy persons from 7 cohorts, with calibration to annual ESRD incidence in the US healthy population, and is now available online: http:// www.transplantmodels.com/esrdrisk

Grams ME, Sang Y, Levey AS, et al. N Engl J Med 2016;374(5):411-421

Use of prediction tool to estimate ESRD risk in donor candidates

1. Use the online tool (http://www.transplantmodels. com/esrdrisk) to estimate the projected lifetime risk of kidney failure **in the absence of donation** according to baseline demographic and health characteristics included in the online tool
2. Multiply the projected predonation risk **by** the best available estimate for donation-attributable risk to obtain the projected postdonation risk. For example, Grams et al report a relative risk of 3.5-5.3 for 15-year ESRD risk, according to sex and race
3. Compare the projected risk estimate to the program's postdonation threshold of acceptable risk

4. **Exercise caution** when there is concern that the individual has risk factors not captured in the online tool (eg, **familial or genetic risk**) and for **younger** candidates

KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. Transplantation. 2017;101(8S Suppl 1):S1-S109

ESRD Risk Tool for Kidney Donor Candidates

Projected Incidence of End-Stage Renal Disease:	
0.04% Pre-Donation 15-Year*	**0.30%** Pre-Donation Lifetime*
? Post-Donation 15-Year**	? Post-Donation Lifetime**

blue: < 1%, **green:** 1-2%, **yellow:** 2-3%, **orange:** 3-5%, **red:** >5%

The pre-donation risks represent projections if a person does not donate

Patient Characteristics:

Age (18-80yrs)	40
Gender	Female
Race (White or Black)	White
eGFR (mL/min/1.73m²)	90
Systolic Blood Pressure (mmHg)	120
Hypertension Medication	No Medication
BMI (kg/m²)	25
Non-Insulin Dependent Diabetes	No Diabetes
Urine Albumin to Creatinine (mg/g) click on units to change between mg/g and mg/mmol	4
Smoking History	Non-Smoker

Postdonation Risk of ESRD in Living Kidney Donors

Kidney Donor Risk of ESRD

Select your donor characteristics below. This prediction model is intended for adults who have already donated a kidney in the United States. It provides an estimated risk of developing ESRD.

Patient Characteristics:

Sex	**Female**
Race (African American or non-African American)	**Non-African American**
Age (18-80yrs)	**40**
BMI (kg/m²)	**25**
Donor is 1st degree biological relative to recipient	**No**

Table 2.

Risk factors for ESRD in living kidney donors

Characteristic	aHR[a]	*P* Value
Men (at age 40)	1.88 (95% CI, 1.50 to 2.35)	<0.001
black race (at age 40)	2.96 (95% CI, 2.25 to 3.89)	<0.001
Age per 10 yr: nonblack	1.40 (95% CI, 1.23 to 1.59)	<0.001
Age per 10 yr: black	0.88 (95% CI, 0.72 to 1.09)	0.3
BMI per 5 kg/m^2	1.61 (95% CI, 1.29 to 2.00)	<0.001
First-degree biologically related to recipient	1.70 (95% CI, 1.24 to 2.34)	<0.01

[a]Male sex and greater BMI were associated with higher risk of ESRD (both $P<0.001$). Older age was associated with higher risk of ESRD in nonblack male donors ($P<0.001$), but the association between age and risk was not statistically significant in black donors ($P=0.1$). Donors who were closely related to their recipient had higher risk of ESRD ($P<0.01$).

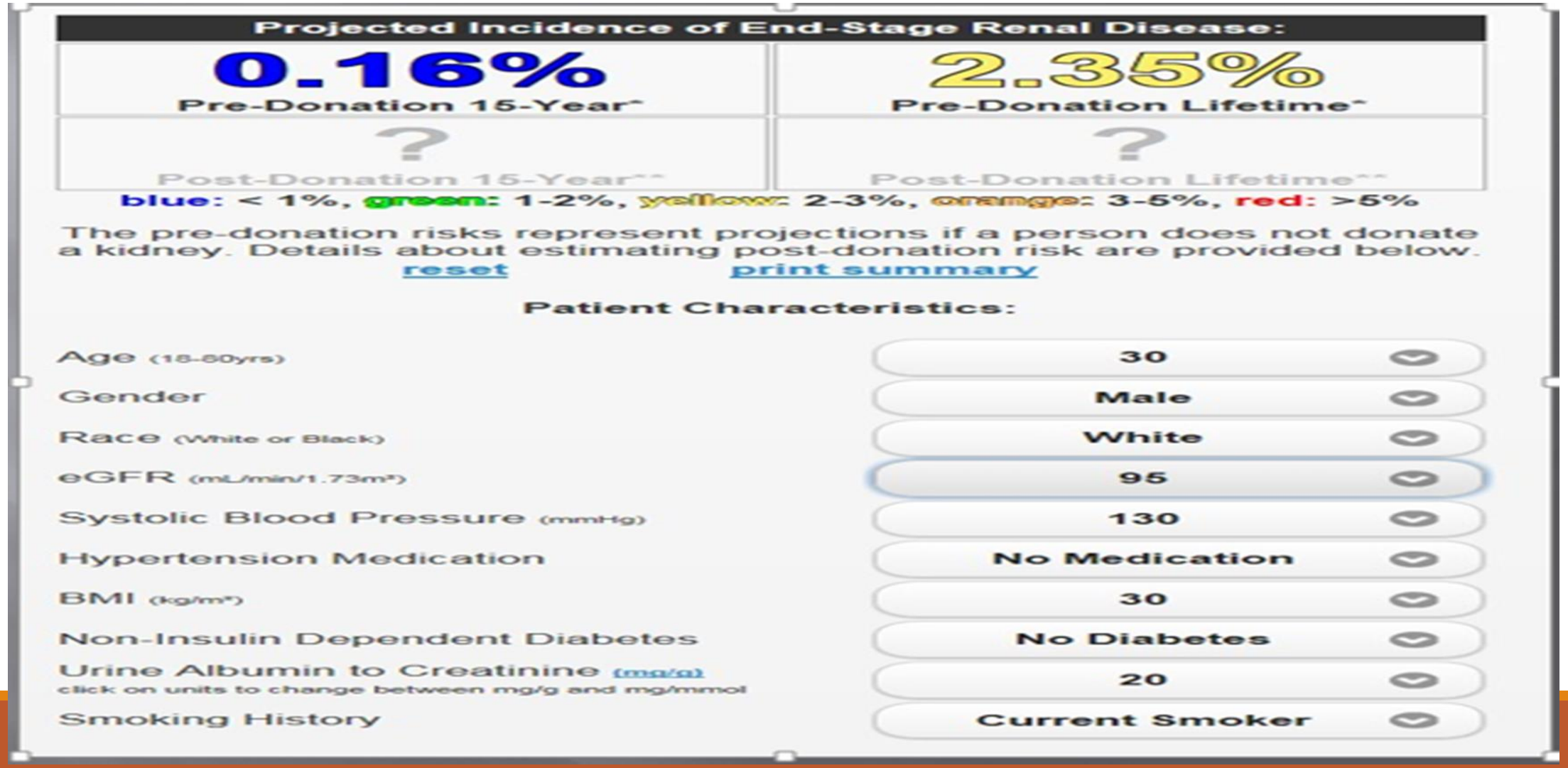
J Am Soc Nephrol. 2017 Sep; 28(9): 2749–2755

Question3

Do you accept the following candidate for donation?

a. yes

b. No

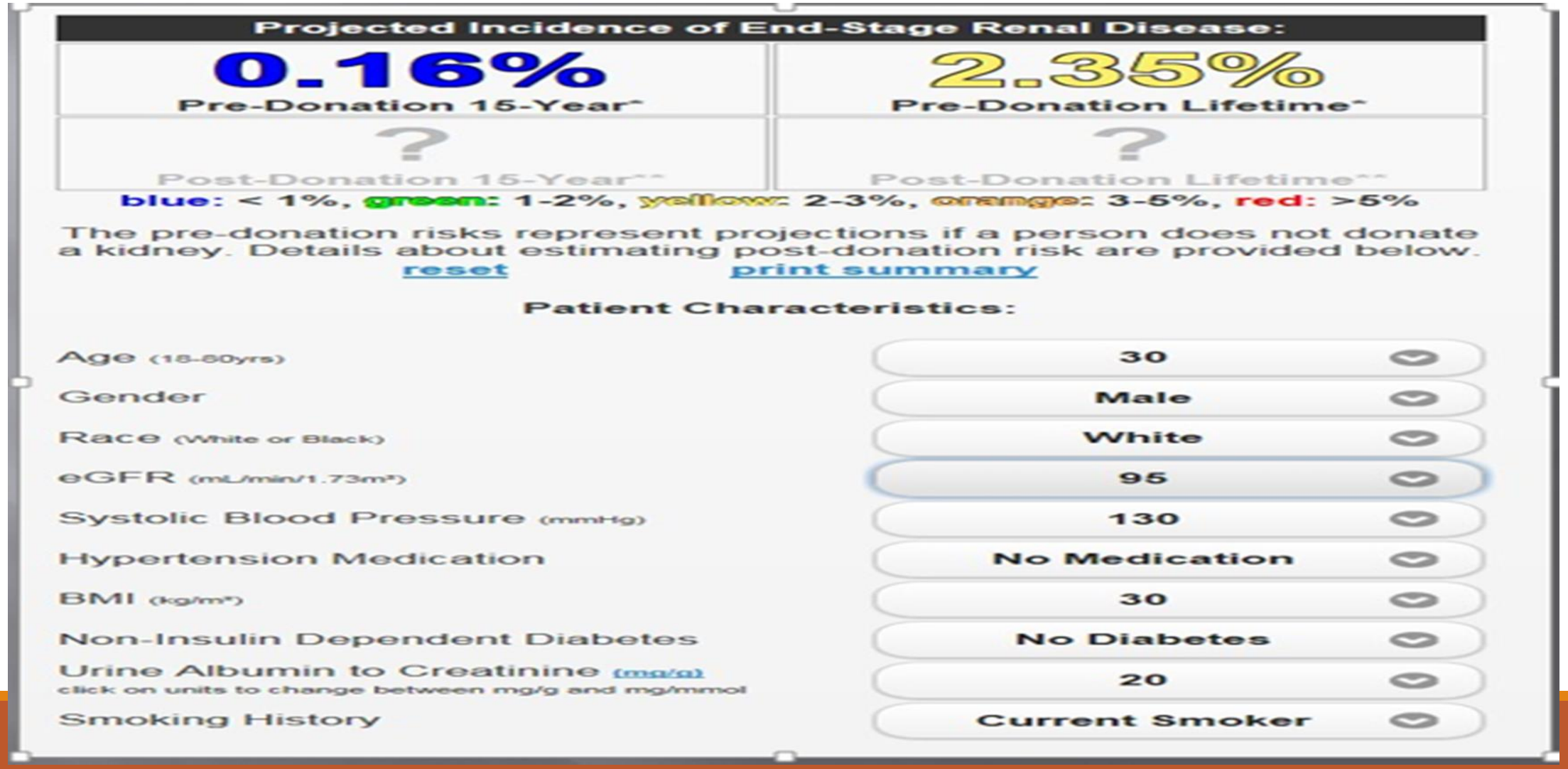


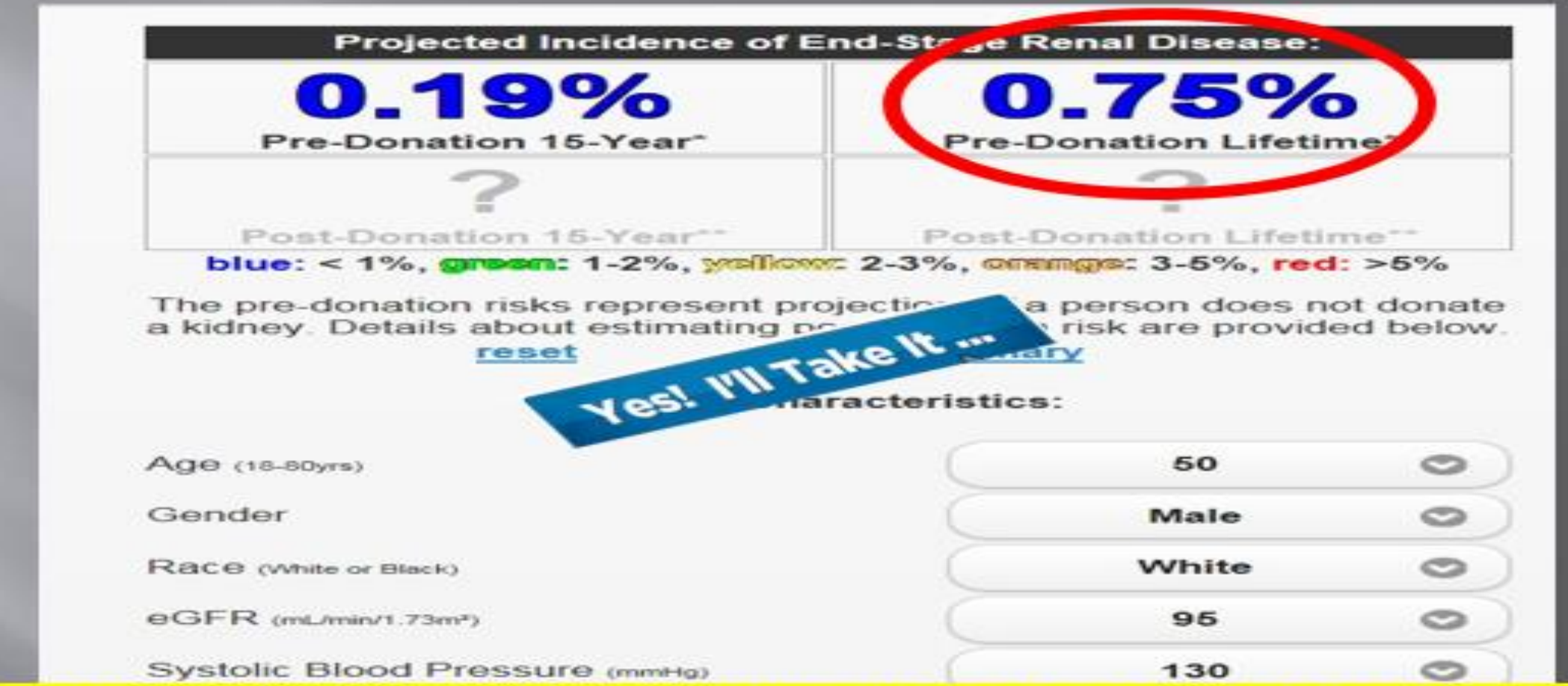
answer

Do you accept the following candidate for donation?

a. yes

b. No





(http://www.transplantmodels.com/esrdrisk/).

For example, if a transplant program sets the acceptable lifetime postdonation ESKD risk threshold at 5%, and assumes a donation attributable RR of 3.5 to 5.3 according to sex and race, then the acceptable predonation lifetime ESKD risk threshold would be approximately 1.0-1.5.

Projected Incidence of End-Stage Renal Disease:

0.16%	2.35%
Pre-Donation 15-Year*	Pre-Donation Lifetime*
?	?
Post-Donation 15-Year**	Post-Donation Lifetime**

blue: < 1%, green: 1-2%, yellow: 2-3%, orange: 3-5%, red: >5%

The pre-donation risks represent projections if a person does not donate a kidney. Details about estimating post-donation risk are provided below.

reset print summary

Patient Characteristics:

Age (18-60yrs)	30
Gender	Male
Race (White or Black)	White
eGFR (mL/min/1.73m²)	95
Systolic Blood Pressure (mmHg)	130
Hypertension Medication	
BMI (kg/m²)	
Non-Insulin Dependent Diabetes	No Diabetes
Urine Albumin to Creatinine (mg/g)	20
click on units to change between mg/g and mg/mmol	
Smoking History	Current Smoker

OLDER AGE AT DONATION; LOWER RISK OF ESRD

Higher risk particularly among young black persons

Projected Incidence of End-Stage Renal Disease:

0.38%	0.76%
Pre-Donation 15-Year*	Pre-Donation Lifetime*
?	?
Post-Donation 15-Year**	Post-Donation Lifetime**

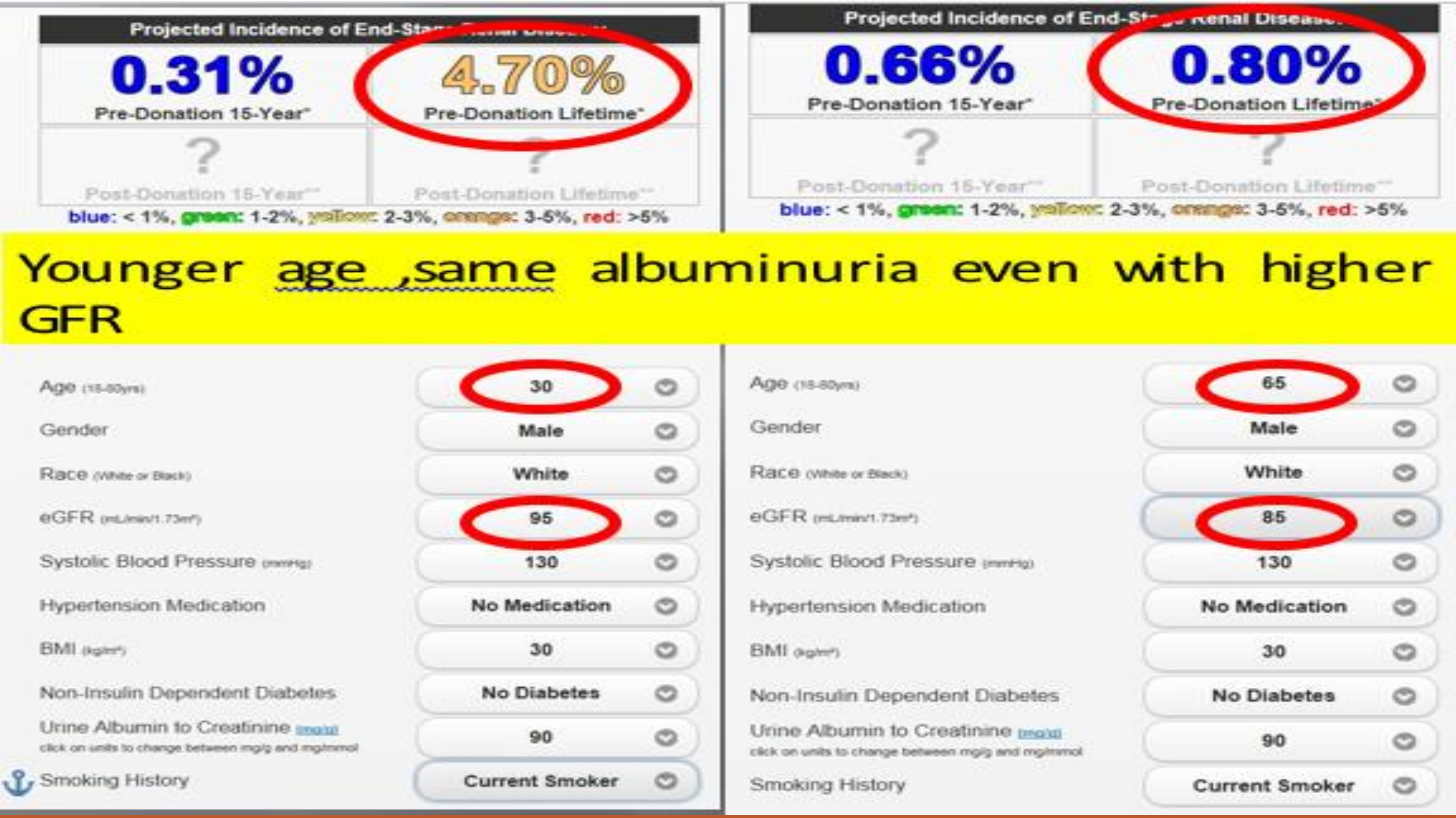
blue: < 1%, green: 1-2%, yellow: 2-3%, orange: 3-5%, red: >5%

The pre-donation risks represent projections if a person does not donate a kidney. Details about estimating post-donation risk are provided below.

reset print summary

Patient Characteristics:

Age (18-60yrs)	55
Gender	Male
Race (White or Black)	White
eGFR (mL/min/1.73m²)	95
Systolic Blood Pressure (mmHg)	130
Hypertension Medication	edication
BMI (kg/m²)	30
Non-Insulin Dependent Diabetes	No Diabetes
Urine Albumin to Creatinine (mg/g)	20
click on units to change between mg/g and mg/mmol	
Smoking History	Current Smoker


Projected Incidence of End-Stage Renal Disease
0.31%
Pre-Donation 15-Year*
4.70%
Pre-Donation Lifetime*
?
Post-Donation 15-Year**
?
Post-Donation Lifetime**
blue: < 1%, green: 1-2%, yellow: 2-3%, orange: 3-5%, red: >5%
Projected Incidence of End-Stage Renal Disease
0.66%
Pre-Donation 15-Year*
0.80%
Pre-Donation Lifetime*
?
Post-Donation 15-Year**
?
Post-Donation Lifetime**
blue: < 1%, green: 1-2%, yellow: 2-3%, orange: 3-5%, red: >5%
Younger age ,same albuminuria even with higher GFR
Age (18-80yrs)
30
Gender
Male
Race (White or Black)
White
eGFR (mL/min/1.73m²)
95
Systolic Blood Pressure (mmHg)
130
Hypertension Medication
No Medication
BMI (kg/m²)
30
Non-Insulin Dependent Diabetes
No Diabetes
Urine Albumin to Creatinine mg/g
click on units to change between mg/g and mg/mmol
90
Smoking History
Current Smoker
Age (18-80yrs)
65
Gender
Male
Race (White or Black)
White
eGFR (mL/min/1.73m²)
85
Systolic Blood Pressure (mmHg)
130
Hypertension Medication
No Medication
BMI (kg/m²)
30
Non-Insulin Dependent Diabetes
No Diabetes
Urine Albumin to Creatinine mg/g
click on units to change between mg/g and mg/mmol
90
Smoking History
Current Smoker

limitations

- lack of inclusion of biologic and household relatedness with ESRD as possible prediction variables
- there is substantial uncertainty in long-term risk estimates, especially for younger candidates in whom it is difficult to predict whether they will develop the conditions that confer higher risk for ESRD
- KDIGO recommended that quantifying donation-attributable relative risk for a given clinical profile and incorporating updated estimates into the online tool should be a leading priority for future research

PREDONATION ALBUMINURIA
Evaluation

- Donor proteinuria should be measured **as albuminuria**, not total urine protein

- **Initial** evaluation of donor albuminuria screening should be performed using urine albumin-to-creatinine ratio (**ACR**) in a random urine specimen(<0.2mg alb/mg creatinine)

Donor albuminuria should be confirmed using:

- Albumin excretion rate (AER, mg/day [mg/d]) in a timed urine specimen
  - Repeat ACR if AER cannot be obtained

PREDONATION ALBUMINURIA
Selection

- Urine **AER less than 30 mg/d** should be considered an acceptable level for donation

- The decision to approve donor candidates with **AER 30 to 100 mg/d** should be individualized based on demographic and health profile in relation to the transplant program's acceptable risk threshold

- Donor candidates with urine **AER greater than 100 mg/d** should not donate

Transplantation Proceedings
Volume 38, Issue 9, November 2006, Pages 2796-2797

Transplant Proc. 2006 Nov;38(9):2796-7.

Evaluation of proteinuria in healthy living kidney donor candidates.

Leischner MP[1], Naratadam GO, Hou SH, Singh AK, Leehey DJ.

Author information

Abstract

BACKGROUND: Evaluation of living kidney donor candidates includes careful assessment for the presence or absence of kidney disease. Kidney donation has been considered to be at least relatively contraindicated if urinary total protein excretion is above the normal range. However, at the present time, there is no uniformly accepted level of urine total protein excretion that would exclude donation. Albumin excretion instead of total protein excretion as a criterion has not previously been evaluated.

MATERIALS AND METHODS: This was a prospective observational study over a 3-year period in a single tertiary care center designed to assess current selection criteria for kidney donation with respect to urine total protein and albumin excretion.

RESULTS: Twenty four percent (25 of 105) of healthy adult kidney donor candidates had elevated urinary total protein excretion rates (150 to 292 mg/24 h). Of these 105 candidates, 39 had simultaneous measurements of both urinary total protein and albumin. Although one-third (13/39) had elevated 24-hour urine total protein values, none had elevated urine albumin excretion.

CONCLUSION: Measurement of albumin, the most common single protein found in urine, appears to be helpful in the evaluation of proteinuria in donor candidates. Many healthy adult kidney donor candidates have mildly elevated total protein excretion but normal albumin excretion. We believe that such patients should not be excluded from donation.

PMID: 17112832 DOI: 10.1016/j.transproceed.2006.08.126

PREDONATION HEMATURIA

Evaluation

Donor candidates with persistent microscopic hematuria should undergo testing to identify possible causes

which may include:

- Urinalysis and urine culture to assess for infection
- Cystoscopy and imaging to assess for urinary tract malignancy
- 24-hour urine stone panel to assess for nephrolithiasis and/or microlithiasis
- Kidney biopsy to assess for glomerular disease (eg, thin basement membrane nephropathy, IgA nephropathy, Alport syndrome)

Selection

- Donor candidates with hematuria from a reversible cause that resolves (eg, a treated infection) **may be** acceptable for donation
- Donor candidates with IgA nephropathy should not donate

Alport Syndrome

- kidney donors with a family history of Alport syndrome need to be carefully screened for hematuria, hypertension, sensorineural hearing loss, and ocular abnormalities
- The absence of hematuria in an **adult male 20 years of age** or older essentially **excludes** the presence of the genetic defect
- Adult female siblings with **normal urinalysis** have a low risk for being carriers and are acceptable as donors
- female relatives with **persistent hematuria** are most likely carriers of the mutation and have a 10% to 15% risk for developing chronic kidney disease. Donation is not advisable
- Although genetic testing is possible, it is not readily available and generally not performed
- **Proteinuria** is also associated with increased risk of renal failure in Alport families and should be considered **exclusion criteria**

Thin Basement Membrane Disease

- TBMD generally has a benign prognosis, the impact of hyperfiltration after uninephrectomy may increase the risk for renal dysfunction
- Donation from individuals with TBMD remains **controversial**
- The presence of hypertension, proteinuria, or both precludes donation
- Potential donors should also be advised that long-term donor risk remains unknown and that any effect of TBMD on **allograft function** remains unclear
- Development of glomerular diseases (most commonly **IgA nephropathy**) in the allograft organ **may** occur following transplantation from patients with **TBMD**

Systemic Lupus Erythematosus

- Systemic lupus erythematosus (SLE) occurs in approximately 12% or more of first-degree relatives
- Prospective living-related donors should be screened for ANA, complement levels, and abnormal urinary findings
- A family member of a patient with SLE who has a **positive ANA** has an about **40-fold** increased risk for developing **lupus** and generally should be excluded from donation
- In unrelated potential donors, an isolated elevated ANA level is not considered a contra indication for donation

Sickle Cell Trait

- Many programs do not routinely screen donors for sickle cell trait

- unexplained hematuria, women with recurrent bacteriuria or pyelonephritis, and those with a family history of sickle cell disease or sickle cell trait should be screened for sickle cell trait

- It is probably prudent to **exclude** prospective donors with documented **recurrent bacteriuria or pyelonephritis** and those with evidence of **papillary necrosis** on imaging studies

- Young prospective donors should be forewarned of the increased risk for **medullary carcinoma**, and regular postdonation follow-up is advised

Pyuria and/or bacteruria

- Common causes of pyuria should be ruled out
- UTI and asymptomatic bacteruria are more common in women, with about one-third having a UTI at some time
- In males it is uncommon, other than in the first year of life and over the age of 60 years owing to prostatic hypertrophy
- In the face of **persistent sterile pyuria**, **renal tuberculosis** should be ruled out with three morning urine acid-fast bacilli cultures
- If no obvious infectious or inflammatory source can be found, a **renal biopsy** should be considered to rule out **interstitial nephritis** or **chronic pyelonephritis**
- **Evidence for renal tuberculosis, interstitial nephritis, or pyelonephritis is a contraindication to donation**

KIDNEY STONES

Evaluation

- Donor candidates with prior or current kidney stones should be assessed for an underlying cause

- A stone initially detected in a person> **50 ys** is unlikely to recur. In contrast, the risk for stone recurrence is higher in individuals < **35ys** and **must be** considered during the donor evaluation process

Selection

should be based on :

assessment of stone recurrence risk and possible consequences of kidney stones after donation

KIDNEY STONES
Cont…

- prospective donors with a distant history of stones **(>10 years)** but **without metabolic abnormalities** (e.g., hypercalcemia, hyperuricemia, hyperoxaluria, hypocitraturia, or metabolic acidosis) are at **low risk** for stone recurrence and ***may be acceptable*** as living donors

- An **asymptomatic** potential donor with **a current single stone may be** suitable for donation if the current stone **size is <1.5 cm** or potentially removable during transplantation

- A history of a **single stone episode** associated with treated **primary hyperparathyroidism and normocalcemia** does **not necessarily preclude donation**

Kidney stone
Contraindication of donation

- Prospective donors with a history of a kidney stone **must be** advised of increased risk for recurrence (**50% in 5 to 7 years**)

- a high risk for **recurrent** stones such as **cystinuria**, **primary or enteric hyperoxaluria, inflammatory bowel disease, and sarcoidosis**

- A history of **struvite stones**

- The presence of **nephrocalcinosis**, **bilateral stones**, **history of stone recurrence despite preventive therapy**

HYPERURICEMIA, GOUT

Evaluation

Donor candidates should be asked about prior episodes of gout

Counseling

- ✓ Donor candidates and donors with **prior episodes of gout** should be informed of recommended **methods to reduce** their risk of future episodes of gout
- ✓ An elevated blood level of uric acid is a predictor of decline in kidney function
- ✓ Potential donors should be screened for their blood uric acid levels
- ✓ Uric acid levels can rise postdonation

PREDONATION BLOOD PRESSURE

Evaluation

- Blood pressure should be measured before donation on **at least 2 occasions** by clinical staff trained in accurate measurement technique, using equipment calibrated for accuracy

- When the presence or absence of hypertension is indeterminate (eg, blood pressure is high normal or variable), blood pressure should be further evaluated using **ambulatory blood pressure monitoring (ABPM)** or **repeated** using standardized blood pressure measurements

PREDONATION BLOOD PRESSURE(cont..)

- The donor should have a mean **awake** blood pressure **less than 135/85 mm Hg** and **sleep** blood pressure **less than 120/75 mm Hg**

- Most transplant program **exclude** prospective donors with blood pressures **greater than 140/90** from donation

PREDONATION BLOOD PRESSURE

Selection

- Donor candidates with hypertension that can be controlled to **SBP<140 mm Hg and DBP<90 mm Hg** using **1 or 2 antihypertensive** agents, who **do not have** evidence of target organ damage,**maybe** acceptable for donation
- A history of mild hypertension **may be** acceptable for donation if the prospective donor is **not African American and is >50 ys without** evidence of **microalbuminuria or end-organ damage**
- Any secondary cause of hypertension should be ruled out and treated if identified before proceeding with the evaluation

PREDONATION METABOLIC & LIFESTYLE RISK FACTORS

Obesity

- The relative risk for developing ESRD is **three fold** for a BMI between **30 and 35** and nearly **five fold** for a BMI of **35 to 40**

- The decision to approve donor candidates with obesity and BMI >30 kg/m^2 should be individualized based on demographic and health profile

- Donor candidates who have had bariatric surgery should be assessed for risk of nephrolithiasis

Cont..

- Obese potential donors should be encouraged to lose weight before kidney donation

- Donation is not advisable in the presence of other comorbid

- conditions Approximately half of programs in the United States regard a BMI greater than 35 as a contraindication to donation, and some report excluding donors with a BMI over 30

- BMI may be unreliable as a risk predictor and **waist to hip ratio might be a better** predictor, especially of cardiovascular outcomes(The WHO states that abdominal obesity is defined as a **waist-hip ratio** above 0.90 for males and above 0.85 for females)

Metabolic Syndrome and Fatty Liver

large waist size (40 inches or above in male and 35 inches or above in female) plus two of the following:

1. Hyperlidipemia, TG ≥ 150 mg/dL or treatment with a lipid-lowering agent
2. HDL ≤ 40 mg/dL
3. Systolic blood pressure ≥ 135 mm Hg
4. Diastolic blood pressure ≥ 85 mm Hg
5. Fasting blood glucose ≥ 100 mg/dL

Metabolic syndrome has been associated with decreased glomerular density, hyperfiltration, glomerulosclerosis, and a decline in GFR following uninephrectomy

Cont…

- metabolic syndrome is not, in itself, a contraindication for kidney donation in older donors, it is a **contraindication in young** donors, particularly if they are **from at-risk ethnicities**
- Liver function should be assessed in all potential donors, especially if they tend to obesity or metabolic syndrome
- Hepatitis in the setting of fatty liver should be considered a contraindication to donation unless it resolves or can be successfully treated
- Alcohol consumption must be curtailed

Smoking and Recreational Drugs

- Current cigarette smokers in general are not considered as suitable donors
- Smoking is a risk factor for declining renal function in donors and studies have shown that there is significant risk of rejection
- Policies on marijuana use vary among programs but occasional recreational use should not necessarily exclude donation
- Drug abuse including **alcohol, cocaine, and meth are contraindications to donation** and these patients should undergo a successful detoxification process before they are considered for donation
- Potential donors requiring chronic narcotic use for pain relief must undergo psychiatric evaluation and **are generally not suitabl** living organ donors

Cont..

Donor candidates who smoke **should be** advised to **quit at least 4 weeks before donation to** reduce their risk of **perioperative** complications, and commit to life long abstinence to prevent long-term complications

Glucose Intolerance

- Glycemia should be assessed by **fasting blood glucose and/or HbA_{1c}** before donation

- 2-hour glucose tolerance or HbA_{1c} testing should be performed in donor candidates with **elevated fasting bloodglucose,history of gestational diabetes,or family history of diabetes in a first-degree relative**

- Donors < 40 ys with a second-degree relative with type 2 DM should also undergo OGTT and HbA1c

- Donor candidates with type 1 diabetes mellitus should not donate

- Donor candidates with prediabetes or type 2 diabetes should be counseled that their condition may progress over time and may lead to end-organ complications

Cont…

Glucose Intolerance

- Donation **is not recommended** in individuals with **mild or borderline IGT and additional risk factors**
- Individuals with blood glucose in the **high range of IFG probably should not donate** because of the greater tendency for deterioration
- Women with a history of **gestational diabetes** have a high lifetime risk for developing type 2 diabetes—as high as 50% to 70% in some series
- An **OGTT in conjunction with stimulated insulin levels may be more helpful** in determining risk than an OGTT alone because some women with a history of gestational diabetes may have evidence of insulin resistance that may portend a higher risk for future development of overt diabetes

EVALUATION OF GENETIC KIDNEY DISEASE

Autosomal Dominant Polycystic Kidney Disease (ADPKD)

- Donor candidates with ADPKD should not donate

- Donor candidates with a family history of ADPKD in a first-degree relative may be acceptable for donation if they meet age-specific imaging **or** genetic testing criteria that reliably exclude ADPKD

- For potential donors >30 ys, it is safe to proceed with donor nephrectomy if ultrasound or computed tomography (CT) reveals no evidence of cysts

- For potential donors between the ages of 20 and 30 ys, a negative ultrasound alone does not rule out ADPKD
- Genetic studies, such as linkage analysis and direct DNA sequencing, are gold-standard diagnostic tests

PREGNANCY

- Female donor candidates should be asked about future childbearing plans

- Female donor candidates should be asked about prior hypertensive disorders of pregnancy (eg, gestational hypertension, preeclampsia, or eclampsia)

- Women should not be excluded from donation solely because they desire to conceive children after donation

PREGNANCY

Cont…

- unilateral donor nephrectomy should not have an effect on fertility, outcome of future pregnancies, incidence of preterm delivery, or low birth-weight

- A greater incidence of preeclampsia, however, has been reported (11% in donors compared to 5% in matched non-donors)

- It is advisable to delay pregnancy for **at least 6 months** to allow for maximal compensatory hypertrophy of the single kidney and prudent to obtain early prenatal care with screening for hypertension, urinary abnormalities, and renal function

Outcome of the living kidney donor

consequences of kidney donation on the living donor health, considering:

- ✓ very short term (linked to the surgery)
- ✓ short term (effect of nephrectomy on glomerular filtration rate)
- ✓ long term (risk of mortality, chronic kidney disease, proteinuria and hypertension)

POSTDONATION FOLLOW-UP CARE

The following should be performed **at least annually** postdonation:

- Blood pressure measurement
- BMI measurement
- Serum creatinine measurement with GFR estimation
- Albuminuria measurement
- Review and promotion of ahealthy lifestyle including regular exercise, healthy diet and abstinence from tobacco
- Review and support of psychosocial health and well-being

Nephrol Dial Transplant (2012) 27: 41–50

LONG-TERM POST NEPHRECTOMY ISSUES

- Within days to weeks after uninephrectomy, hyperfiltration in the remaining kidney **increases the GFR to about 75% to 80%** of predonation value
- Similar to the nondonating population, an additional 5 mL per minute loss in GFR per decade occurred after donating
- This acute compensation is, however, **less efficient in elderly** as it is related to the use of the renal functional reserve
- This ability to functional renal adaptation actually decrease by half after donation or even more in old or obese patients

Am J Transplant 2005; 5: 2417–2424

Nephrol Dial Transplant (2012) 27: 41–50

LONG-TERM POST NEPHRECTOMY ISSUES

proteinuria

- Urine albumin excretion, attributable to single nephron hyperfiltration may be elevated but **is usually low grade** and not associated with a higher risk for renal dysfunction

- this complication occurs only in a minority of donors

- The proteinuria will be <1 g/24 h in the **vast majority** of donors
  More severe and nephrotic proteinuria are exceptional

LONG-TERM POST NEPHRECTOMY ISSUES

hypertension

- The incidence of **hypertension requiring treatment** increases with time following kidney donation, but most studies suggest a similar frequency compared with an age-matched population

- it would appear reasonable to **target a SBP≤ 130 mm Hg** for long-term follow-up of donors

Nephrol Dial Transplant (2012) 27: 41–50

Long-Term Medical Care

- In the United States, transplant centers are required to report follow-up donors **at discharge** (**or 6 weeks postdonation**, which ever comes first) **6 months, 1 year, and 2 years after donation**

- Routine checkups, cancer screening appropriate for age, regular aerobic exercise, weight reduction, tobacco avoidance, and excessive alcohol abstinence should be emphasized

Long-Term Medical Care(cont..)

- Kidney donors with established medical issues before donation, such as **mild hypertension**, **history of nephrolithiasis**, or **obesity**, should have **more frequent** follow-up
- Donors should be **discouraged** from using **high-protein diets** for weight loss or **protein supplements** for body building because they may contribute to hyperfiltration injury

- They should be advised to avoid **longterm regular use** of nonsteroidal anti-inflammatory drugs

Summary

- selection of the most appropriate donor depends the degree of HLA matching & donor age & size
- Donor kidney function should be expressed as GFR(mL/min per 1.73 m2) & not as serum creatinine concentration
- mGFR using an exogenous filtration marker is the most accurate confirmatory test
- future risk of developing kidney failure necessitating treatment with dialysis or transplantation is **slightly higher**
- A web-based calculator has been developed to compute post-test probabilities http://ckdepi.org/equations/donor-candidate-gfr-calculator for mGFR above or below various threshold probabilities
- Long-term risk in the absence of donation can be computed from http://www.transplantmodels.com/esrdrisk
- Advanced age can increase the risk for perioperative complications, but there is **no** mandated upper age limit for living kidney donation


THANK YOU
HAVE A NICE TIME