

Χρονία νεφρική νόσος (ХНΝ) στην καθημερινή παιδιατρική πράξη

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Νοσοκομείο Παιδων ΜΗΤΕΡΑ



Χρονία νεφρική
νόσος

ΧΝΝ στην παιδιατρική πράξη

Η ΧΝΝ είναι πολύ σπάνια στα παιδιά;

Είναι ένα πρόβλημα που απασχολεί μόνο τους
εξειδικευμένους παιδονεφρολόγους;

Γιατί και πώς πρέπει να αποτελεί μέρος της
καθημερινής παιδιατρικής πράξης;

**1 στους 7 - 9 ενήλικες σε όλο το
κόσμο έχει ΧΝΝ**

CKD electronic health records-based registry: CURE-CKD



Original Investigation | Nephrology

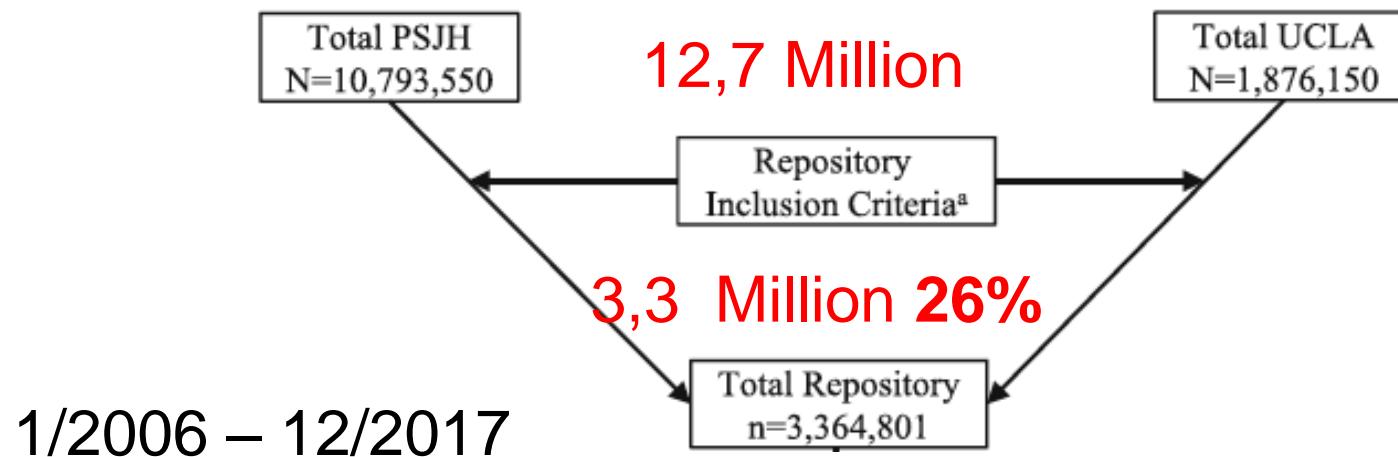
Clinical Characteristics of and Risk Factors for Chronic Kidney Disease Among Adults and Children An Analysis of the CURE-CKD Registry

Katherine R. Tuttle, MD; Radica Z. Alicic, MD; O. Kenrik Duru, MD; Cami R. Jones, PhD; Kenn B. Daratha, PhD; Susanne B. Nicholas, MD, MPH, PhD; Sterling M. McPherson, PhD; Joshua J. Neumiller, PharmD; Douglas S. Bell, MD; Carol M. Mangione, MD; Keith C. Norris, MD, PhD

Tuttle KR JAMA Network Open. 2019;2(12):e1918169

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2757881>

CKD electronic health records-based registry: CURE-CKD



Patients with at least a single qualifying measure for CKD and/or at-risk for CKD

Patients with at least a single for CKD and/or at-risk for CKD

Diagnostic code for CKD, HTN, DM and prediabetes

Qualifying measure for CKD: eGFR <60 mL/min/1.73m²
UACR ≥30 mg/g UPCR ≥150 mg/g

HbA1c ≥5.7%;

any random blood glucose ≥140 mg/dL

or fasting blood glucose ≥100 mg/dL

Individuals prescribed anti-hyperglycemic agents

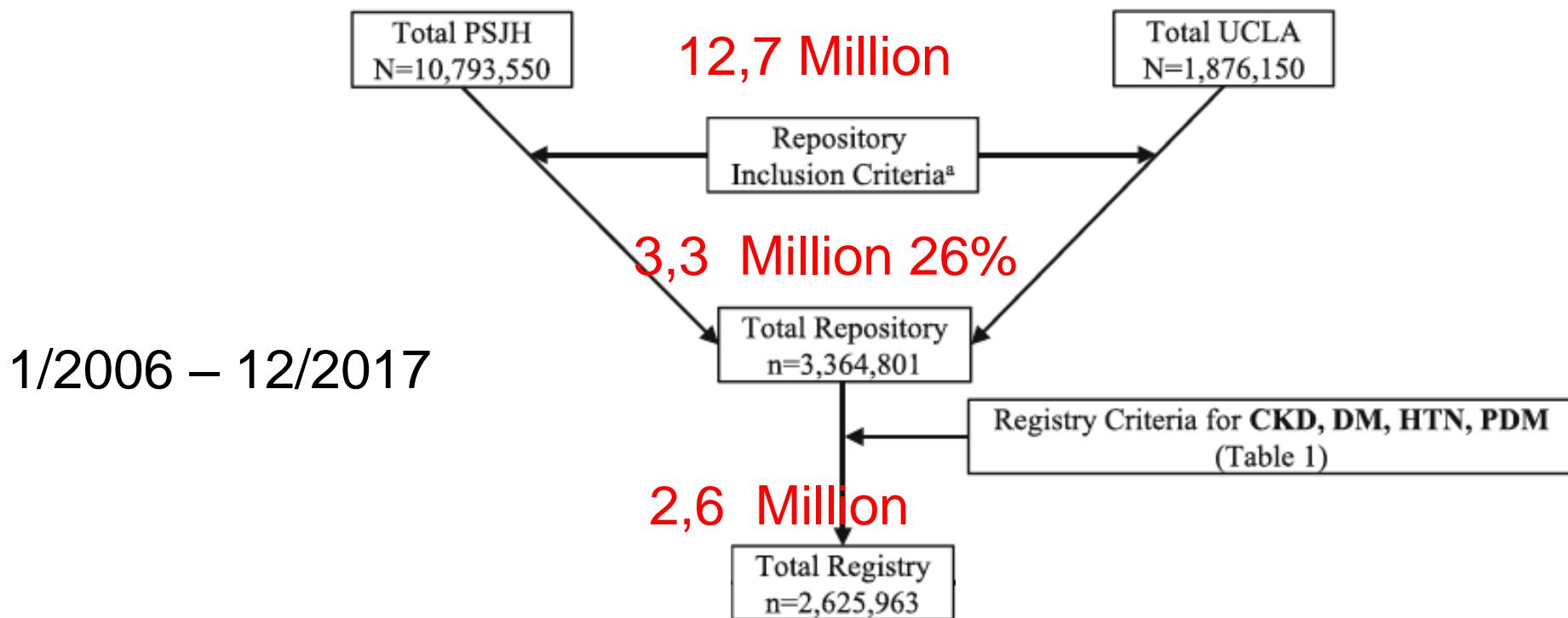
Blood pressure ≥140mm Hg or ≥90mm

Individuals prescribed anti-hypertensive agents

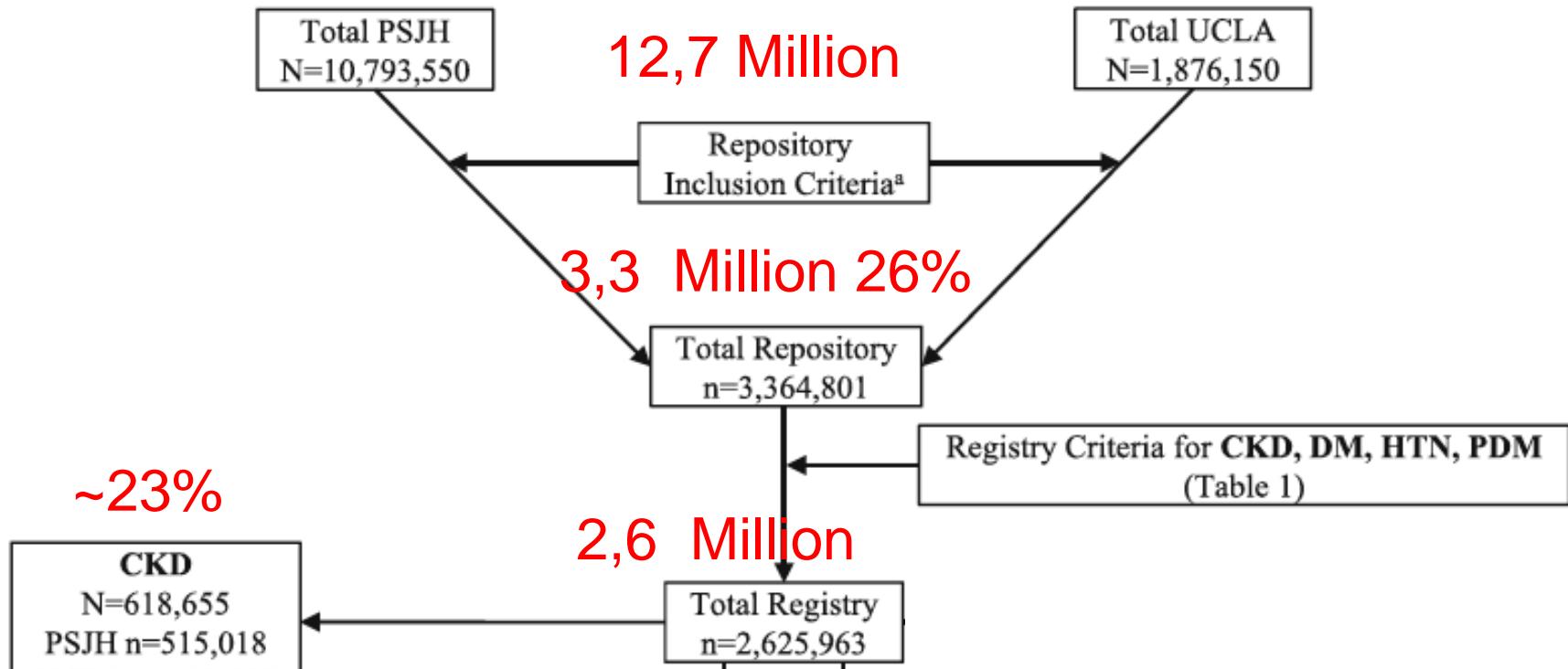
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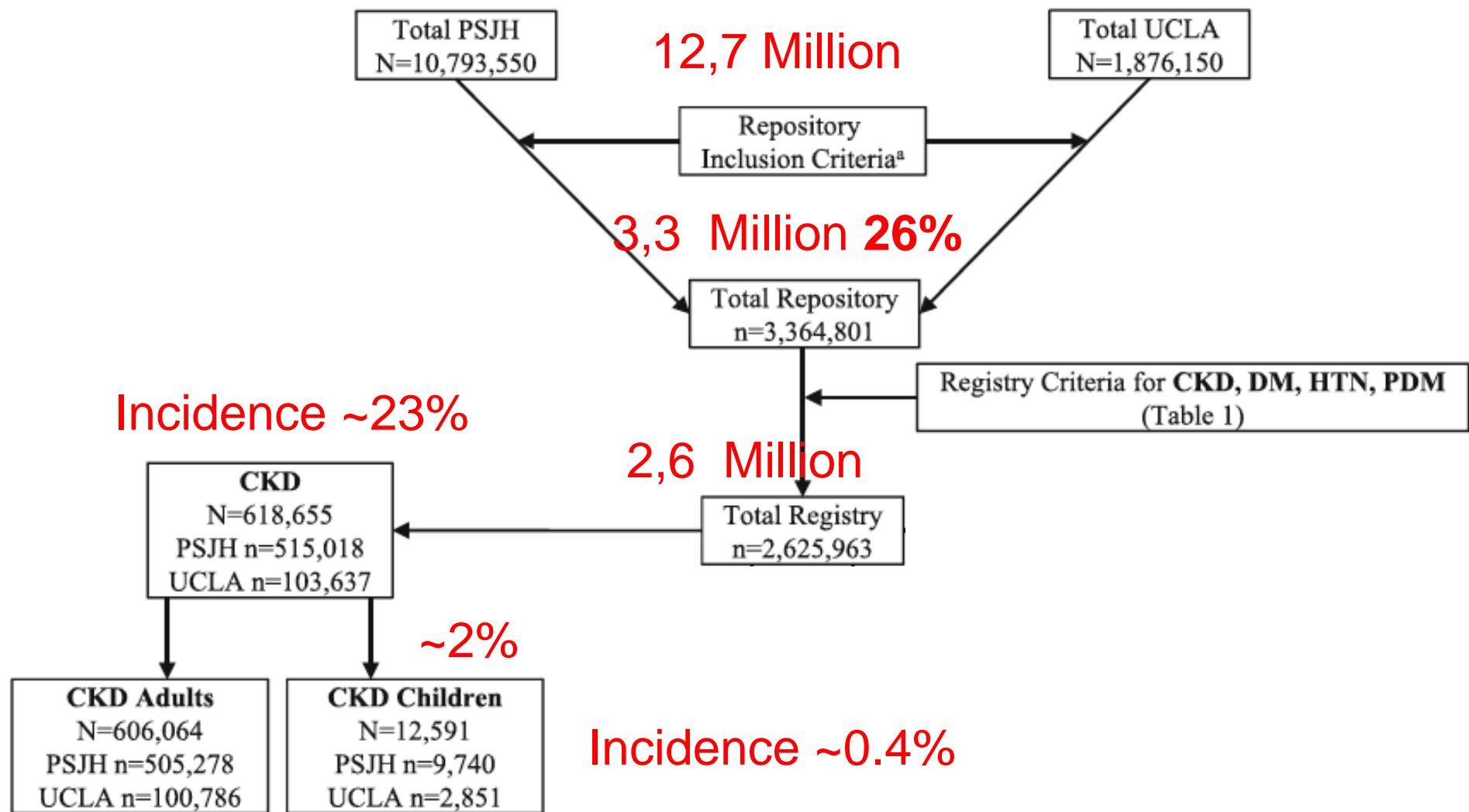
CKD electronic health records-based registry: CURE-CKD



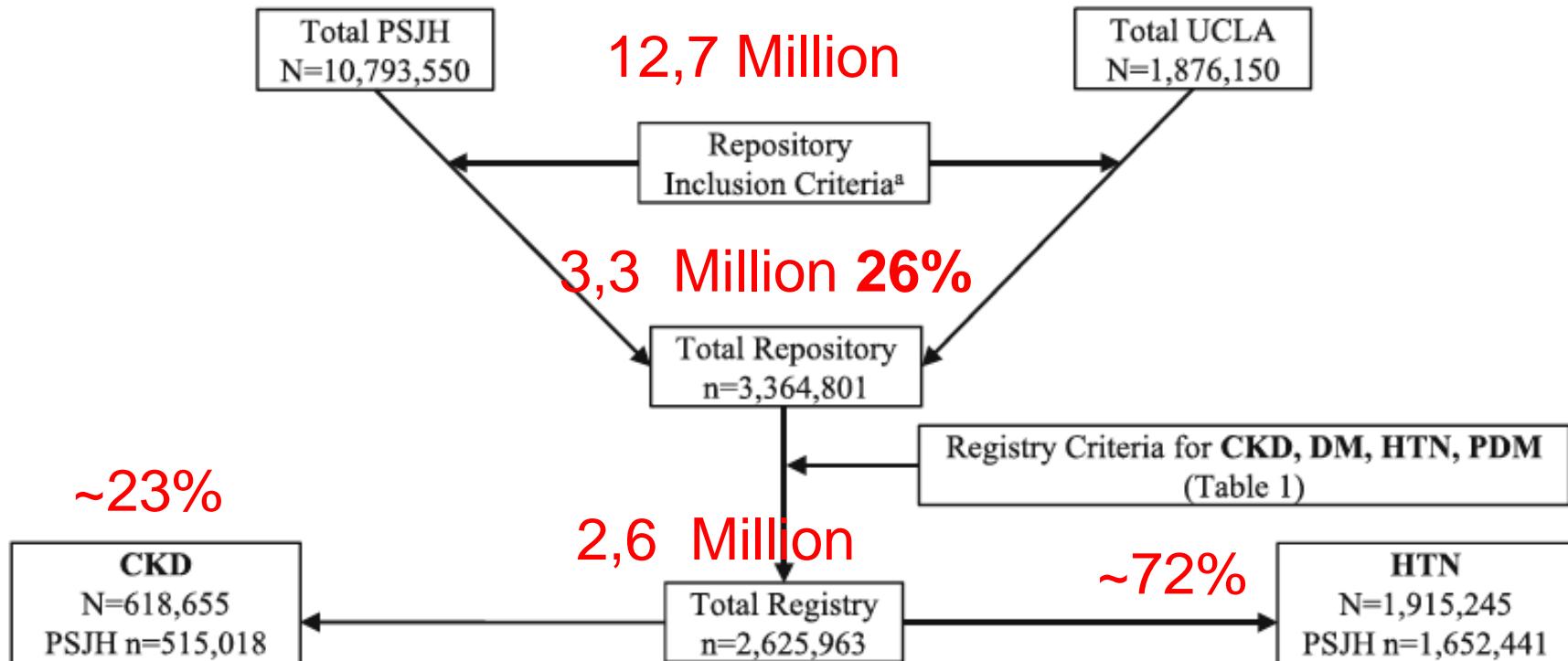
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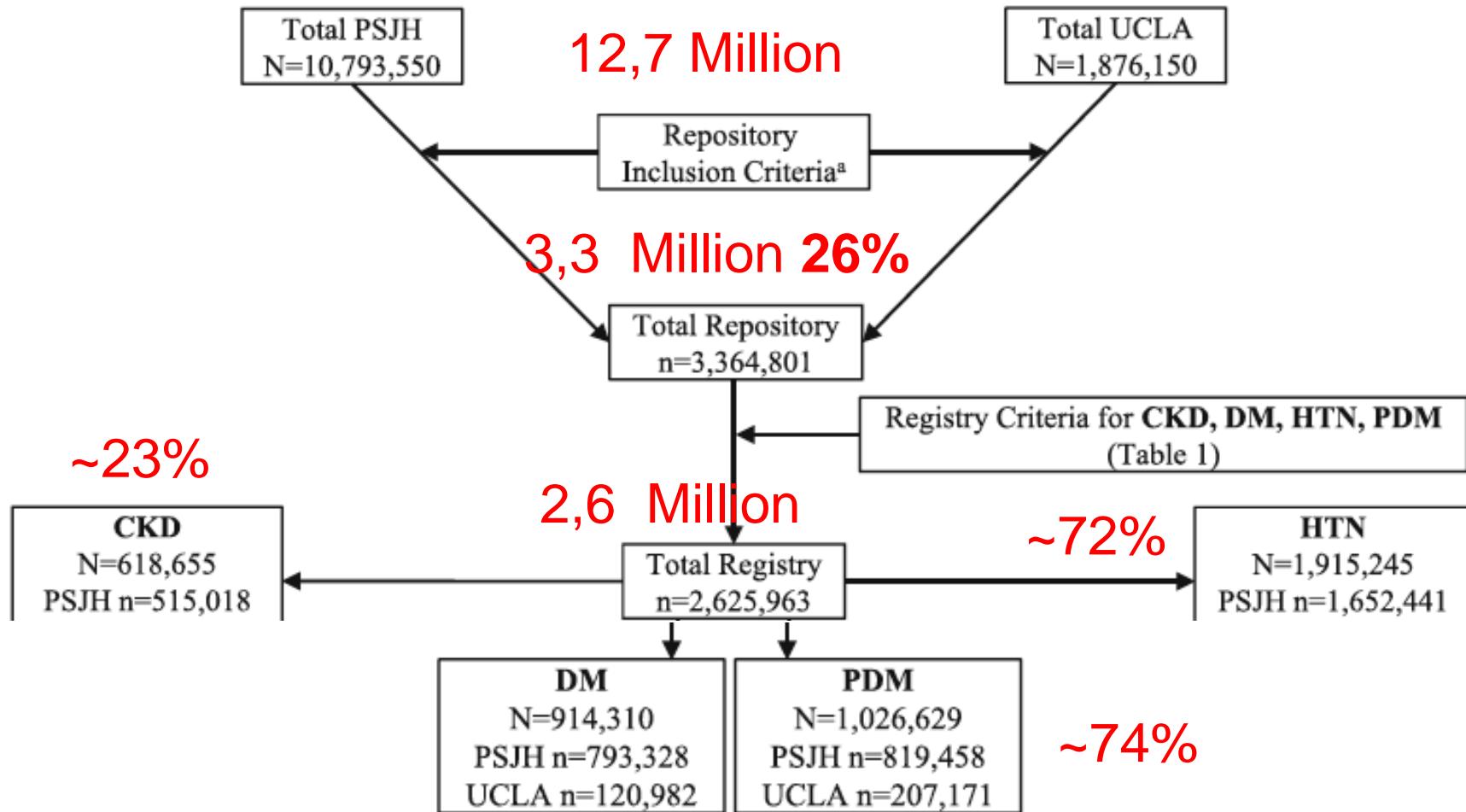
CKD electronic health records-based registry: CURE-CKD



CKD electronic health records-based registry: CURE-CKD



CKD electronic health records-based registry: CURE-CKD



Χρονία νεφρική νόσος (XNN)

Επιπολασμός (Prevalence) XNN σε ενήλικες:
4.8% συνολικά (606.064 από 12.669.700)

1.6% 2006 - 2009

5.7% 2010 - 2013

8.4% 2014 - 2017

($P < 0.001$)

Tuttle KR JAMA Network Open. 2019;2(12):e1918169

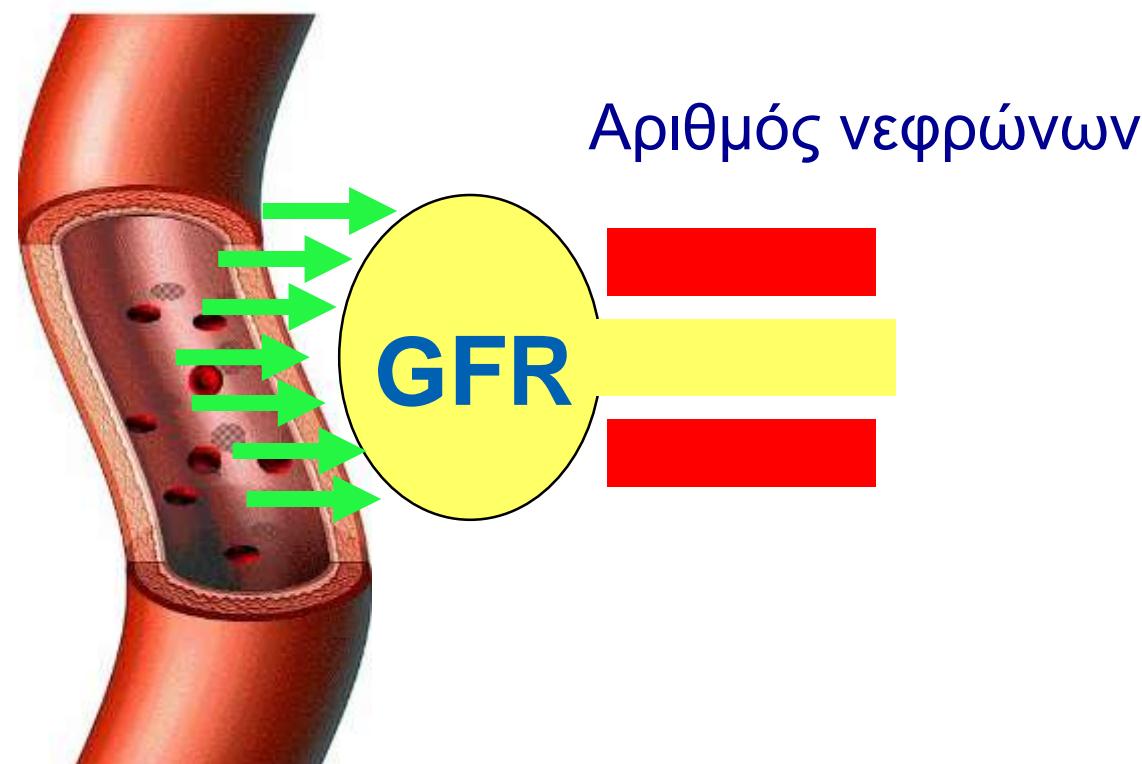
<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2757881>

Τι είνα η χρόνια νεφρική νόσος (XNN);

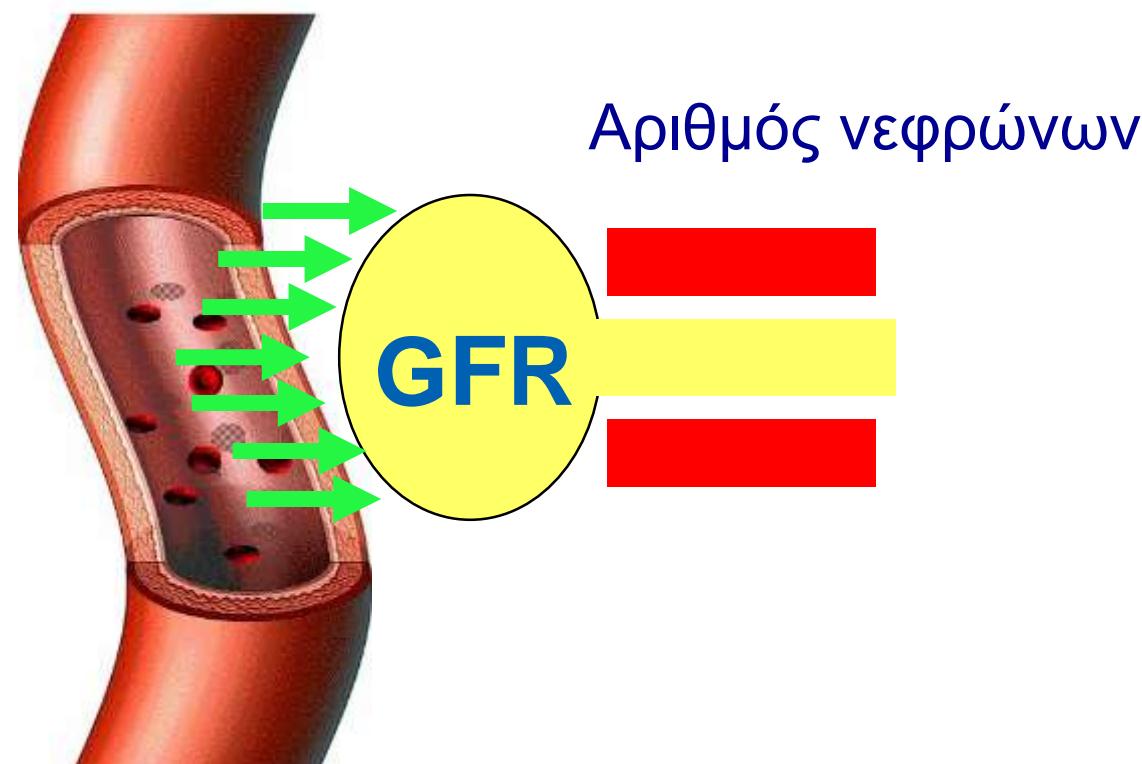
XNN είναι η μόνιμη νεφρική βλάβη, που συσχετίζεται με προοδευτική ελάττωση του αριθμού και της λειτουργίας των νεφρών



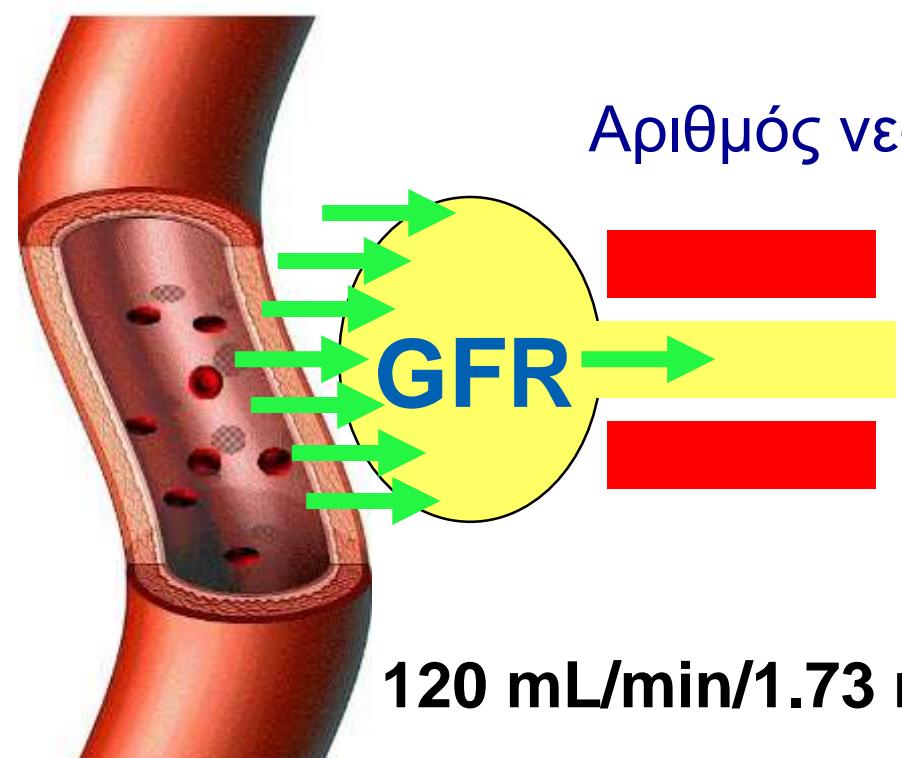
Ρυθμός σπειραματικής διήθησης (GFR)



Ρυθμός σπειραματικής διήθησης (GFR)



Ρυθμός σπειραματικής διήθησης (GFR)



Αριθμός νεφρώνων

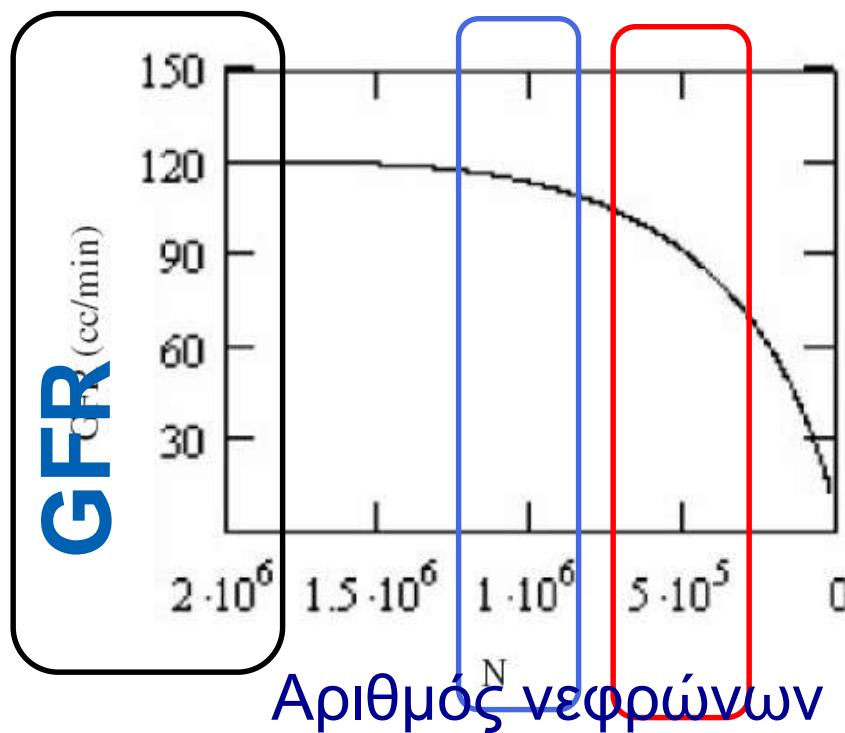
$120 \text{ mL/min}/1.73 \text{ m}^2$

$170 \text{ L}/24\text{ωρο}/1.73 \text{ m}^2$

Φυσιολογικές τιμές

$> 90 \text{ mL/min}/1.73 \text{ m}^2$

GFR και αριθμός νεφρώνων



Όταν οι νεφρώνες ελαττωθούν κατά 50%

Όταν οι νεφρώνες ελαττωθούν κατά 75%



CLINICAL PRACTICE GUIDELINES

***For Chronic Kidney Disease:
Evaluation, Classification
and Stratification***

Χρονία νεφρική νόσος (XNN)

Για > 3 μήνες:

GFR <60 ml/min/1.73 m² ή

GFR >60 ml/min/1.73 m² + νεφρική βλάβη

Παθολογικά ευρήματα:

1. Στα ούρα (λευκωματινουρία, πρωτεΐνουρία)
2. Στις απεικονιστικές εξετάσεις (ΥΧΓ, σπινθηρογράφημα)
3. Στη νεφρική βιοψία
4. **Νεφρική σωληναριακή βλάβη**
5. **Μεταμόσχευση νεφρού**



KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease

VOLUME 3 | ISSUE 1 | JANUARY 2013

<http://www.kidney-international.org>

NKF-K/DOQI Classification of the Stages of CKD

Stage	GFR /1.73 m ²	Description
G1	≥90	Kidney damage* with normal or increased GFR
G2	60–89	Kidney damage with mild reduction of GFR

NKF-K/DOQI Classification of the Stages of CKD

Stage	GFR /1.73 m ²	Description
G1	≥90	Kidney damage* with normal or increased GFR
G2	60–89	Kidney damage with mild reduction of GFR
G3	30–59	moderate reduction of GFR
G4	15–29	severe reduction of GFR
G5	<15 (or dialysis)	Kidney failure

Stages of CKD (KDIGO 2012)

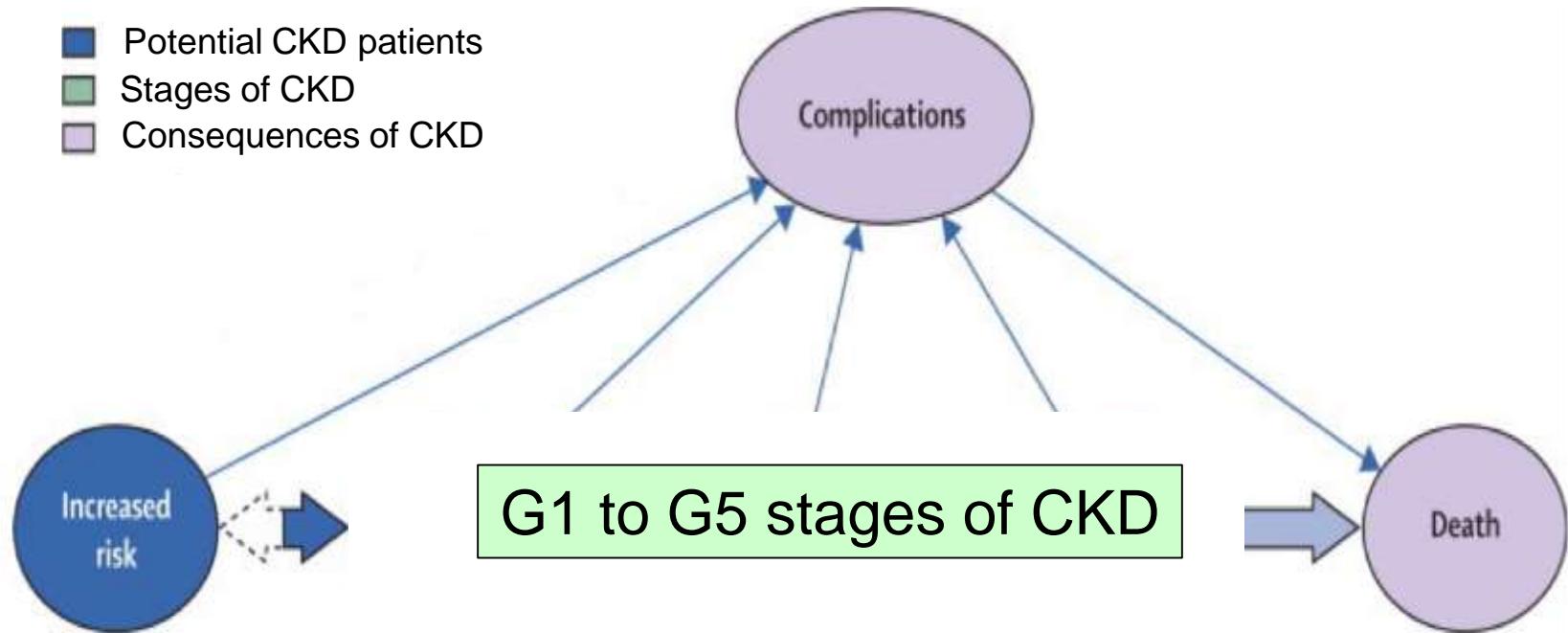
GFR categories (ml/min/ 1.73 m ²) Description and range	G1	Normal or high	≥90
	G2	Mildly decreased	60-89
	G3a	Mildly to moderately decreased	45-59
	G3b	Moderately to severely decreased	30-44
	G4	Severely decreased	15-29
	G5	Kidney failure	<15

Stages of CKD (KDIGO 2012)

Complication	GFR category (ml/min/1.73 m ²)				
	≥ 90	60-89	45-59	30-44	< 30
Anemia ¹	4.0%	4.7%	12.3%	22.7%	51.5%
Hypertension ²	18.3%	41.0%	71.8%	78.3%	82.1%
25(OH) Vit D deficiency ³	14.1%	9.1%	10.7%		27.2%
Acidosis ⁴	11.2%	8.4%	9.4%	18.1%	31.5%
Hyperphosphatemia ⁵	7.2%	7.4%	9.2%	9.3%	23.0%
Hypoalbuminemia ⁶	1.0%	1.3%	2.8%	9.0%	7.5%
Hyperparathyroidism ⁷	5.5%	9.4%	23.0%	44.0%	72.5%

G₁ G₅ Kidney failure <15

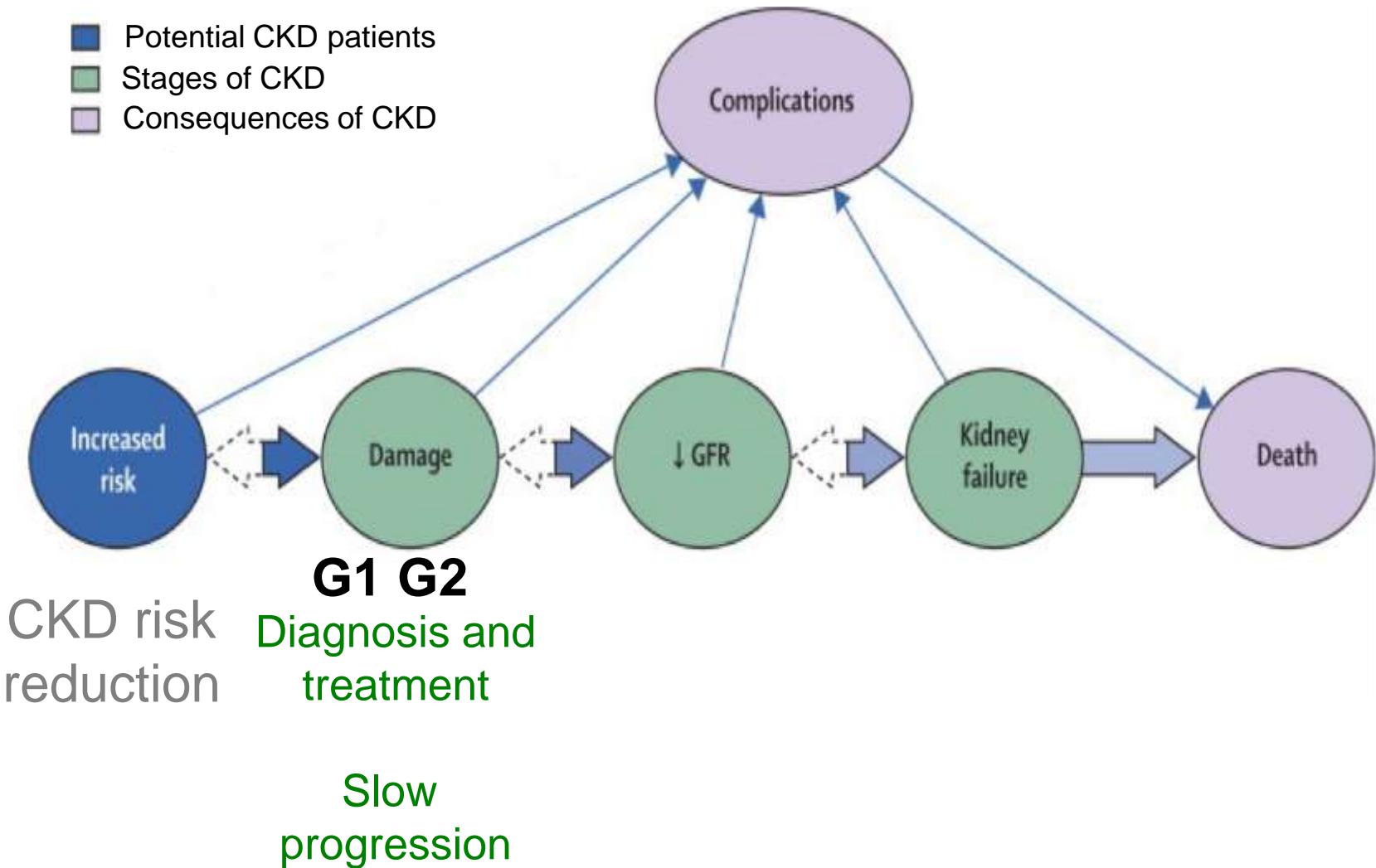
- Potential CKD patients
- Stages of CKD
- Consequences of CKD



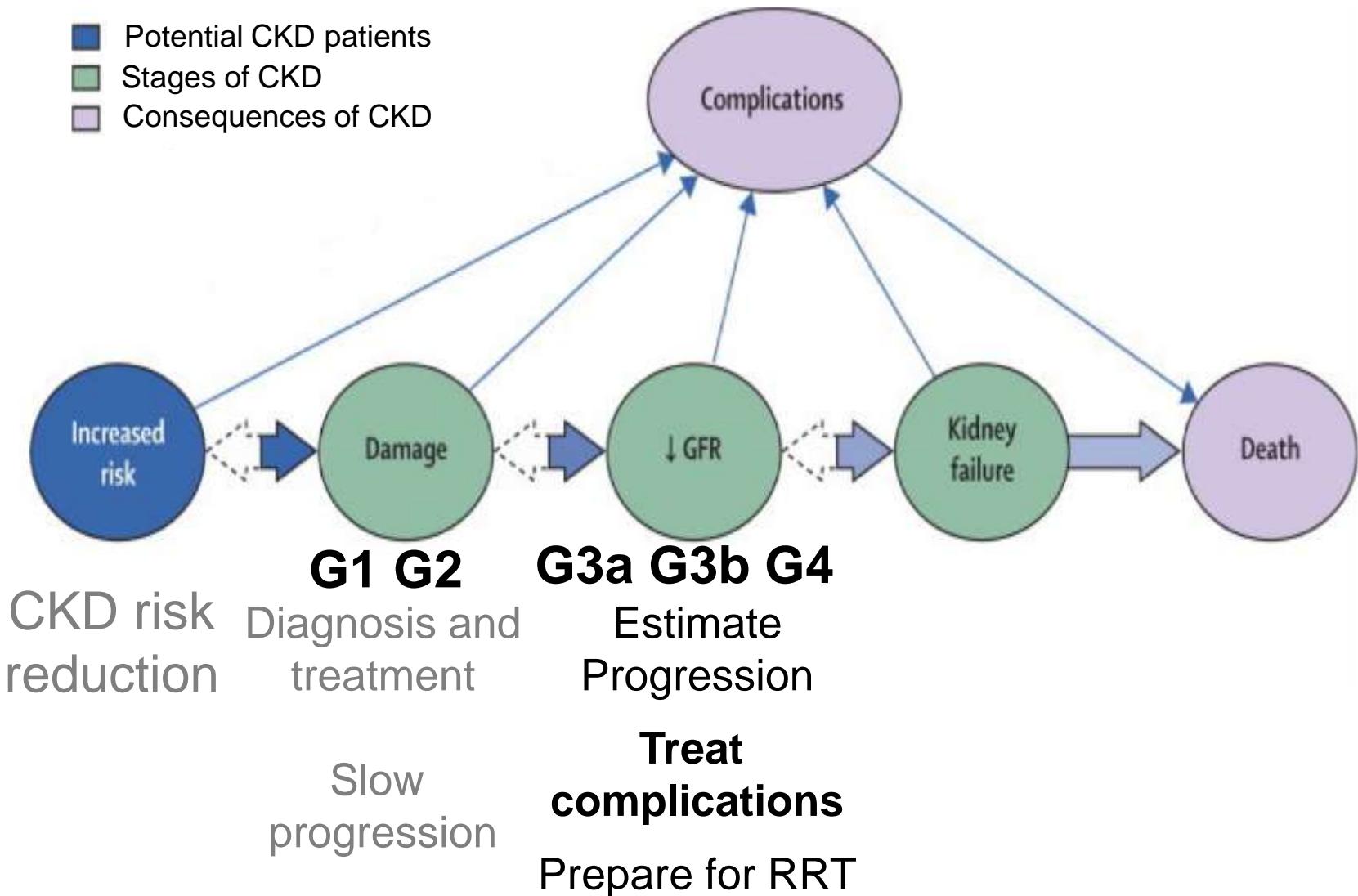
CKD risk reduction

Identify patients who are at highest risk for complications of kidney failure

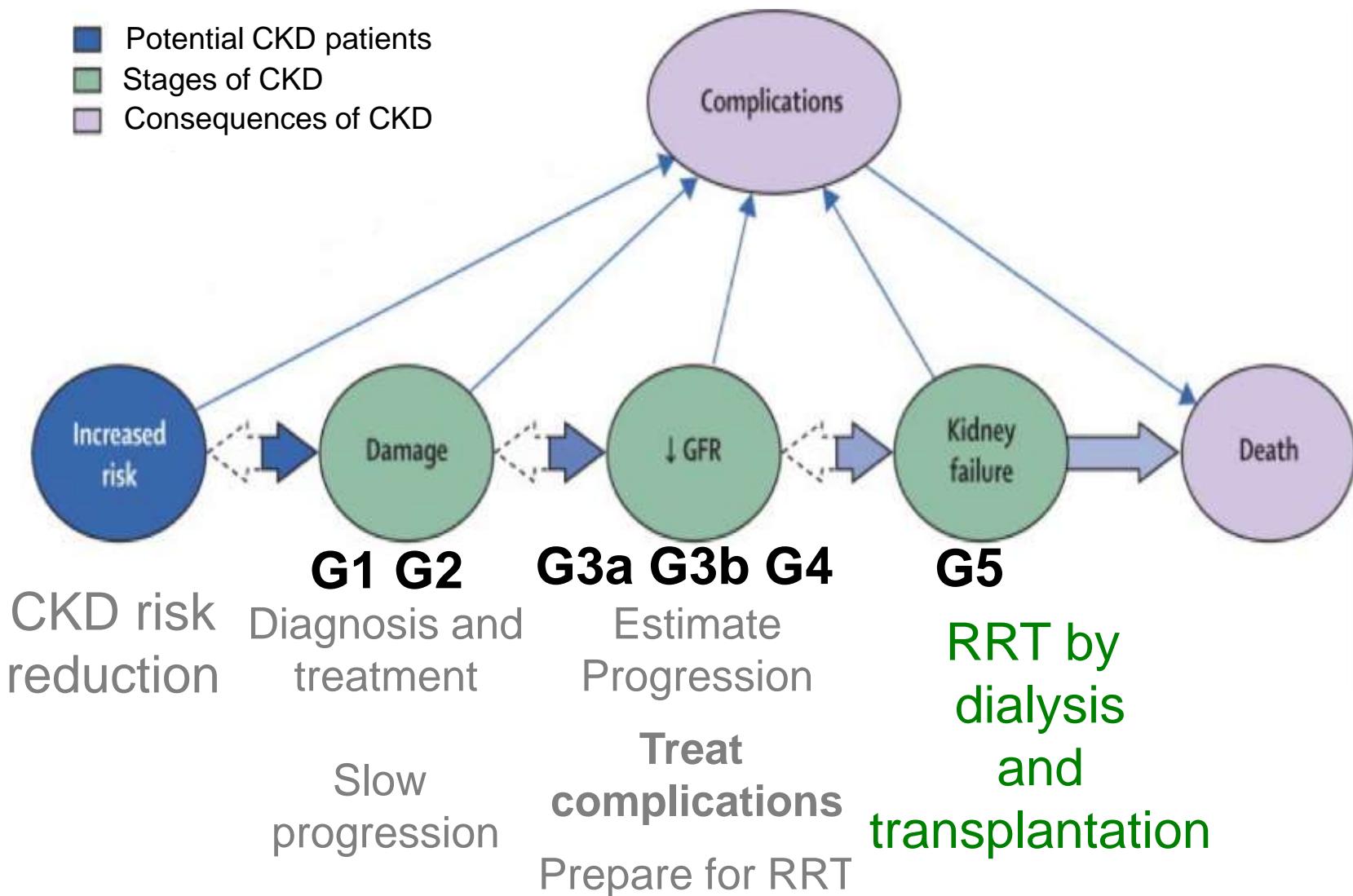
- Potential CKD patients
- Stages of CKD
- Consequences of CKD



- Potential CKD patients
- Stages of CKD
- Consequences of CKD



- Potential CKD patients
- Stages of CKD
- Consequences of CKD



Defining CKD in children < 2 years

This definition is not applicable to children < 2 years, because they normally have a low GFR.

The criteria for duration >3 months does not apply to newborns or infants <3 months of age.

GFR > 1 SD below the mean (> -1 SDS): normal

GFR < 1 SD below the mean: moderately reduced GFR

GFR < 2 SD below the mean: severely reduced GFR

GFR in children < 2 years

Reduced GFR

Age months	Mean	moderately Mean -1SD	severely Mean -2SD
<1.2	50	40	30
1.2 to 4	60	45	30
4.1 - 8	70	55	40
8.1 - 12	80	65	50
12.1 - 24	90	75	55

<http://cjasn.asnjournals.org/content/4/11/1832.full>

Piepsz A, et al. Eur J Nucl Med Mol Imaging, 2006

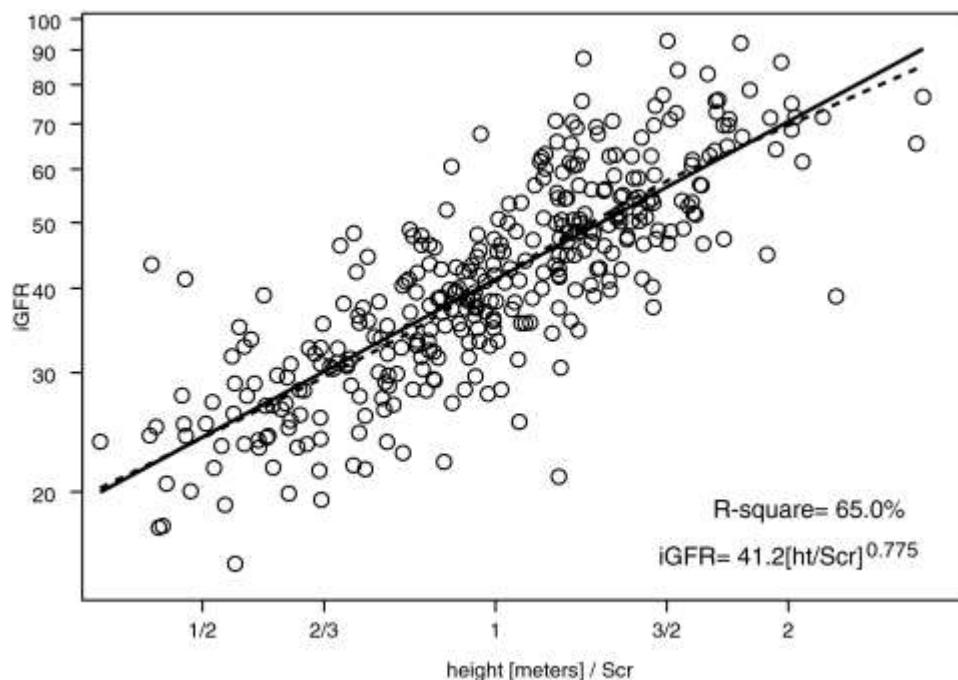
Glomerular filtration rate (GFR)

- Estimated GFR (eGFR)
- Creatinine clearance (CCr)
- Isotopic measurement (iGFR)
- Inulin clearance
- Iohexol clearance and urinary protein
- Cystatin C

Equations to Estimate GFR in Children with CKD

Updated Schwartz bedside formula:

$$eGFR = \frac{\text{Ύψος} \times 0.41}{\text{Κρεατινίνη}}$$



GJ Schwartz et al, J Am Soc Nephrol. 2009

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2653687/>

Υπολογιζόμενη GFR (τύπος του Schwartz)

Κρεατινίνη = 0.8 mg/dl

· Ύψος x 0.41

= _____

Κρεατινίνη

· Ύψος 100 cm

~50 ml/min/1.73 m²

· Ύψος 140 cm

~70 ml/min/1.73 m²

Υπολογιζόμενη GFR

Η συλλογή ούρων 24ώρου και η μέτρηση της κρεατινίνης ούρων για τον υπολογισμό της κάθαρσης κρεατινίνης δεν είναι πιο αξιόπιστη από την υπολογιζόμενη κάθαρσης για την αξιολόγηση του GFR.

National Kidney Foundation's Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines for Chronic Kidney Disease in Children and Adolescents: Evaluation, Classification, and Stratification
Pediatrics 2003

Cystatin C to estimate GFR in Children with CKD

The sensitivity of s-CysC for detecting impaired GFR in pediatric patients seems superior to that of plasma creatinine, especially in selected populations of children with low muscle mass

Cystatin C to estimate GFR in Children with CKD

1. Less affected by diet and muscle mass than creatinine
2. Recommended to confirm CKD when
eGFR is 45-59 mL/min/1.7m² (Stage 3A CKD)
3. Is a better predictor of mortality in patients with CKD
4. Rises sooner than creatinine in AKI

Equations to Estimate GFR in Children with CKD

The CKiD study is the first multicentered study to generate estimating equations in children.

Updated Schwartz formula :

$$\begin{aligned} \text{eGFR} = & 39.1 \times [\text{height (m}^2\text{)}/S_{\text{cr}}(\text{mg/dl})]^{0.516} \\ & \times [1.8/\text{cystatin C (mg/L)}]^{0.294} \times [30/\text{BUN (mg/dl)}]^{0.169} \times [1.099^{\text{male}}] \\ & \times [\text{height (m)}/1.4]^{0.188}. \end{aligned}$$

http://nephron.com/peds_nic.cgi

GJ Schwartz et al, CJ Am Soc Nephrol. 2009
<http://cjasn.asnjournals.org/content/4/11/1832.full>,

Defining CKD: determine the cause

In any child with GFR<60 ml/min/1.73m²
or more than 1 SD below expected for their age and sex
or with markers of kidney damage

Consider:

- a complete review of their past history
- previous measurement or estimate of renal function

Defining CKD: determine the cause

In any child with GFR<60 ml/min/1.73m²
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Consider:

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- previous measurement or estimate of renal function
- prenatal history, drug exposures of fetus or mother
- genetic conditions, coincident organ abnormalities

Defining CKD: determine the cause

In any child with GFR<60 ml/min/1.73m²
or more than 1 SD below expected for their age and sex
or with markers of kidney damage

Consider:

- a complete review of their past history
- previous measurement or estimate of renal function
- prenatal history, drug exposures of fetus or mother
- genetic conditions, coincident organ abnormalities
- physical examination
- **fetal and post-natal laboratory measures**
(amniotic fluid, pre- and post-natal imaging, placenta)

Defining CKD: the cause of CKD

Examples of primary kidney diseases (absence of systemic diseases affecting the kidney)

Glomerular diseases	Diffuse, focal or crescentic proliferative GN; focal and segmental glomerulosclerosis, membranous nephropathy, minimal change disease
Tubulointerstitial diseases	Urinary-tract infections, stones, obstruction
Vascular diseases	ANCA-associated renal limited vasculitis, fibromuscular dysplasia
Cystic and congenital diseases	Renal dysplasia, medullary cystic disease, podocytopathies

Pediatric Considerations

The principles inherent in this guideline are fully applicable to children.

AKI and CKD: Two distinct syndromes

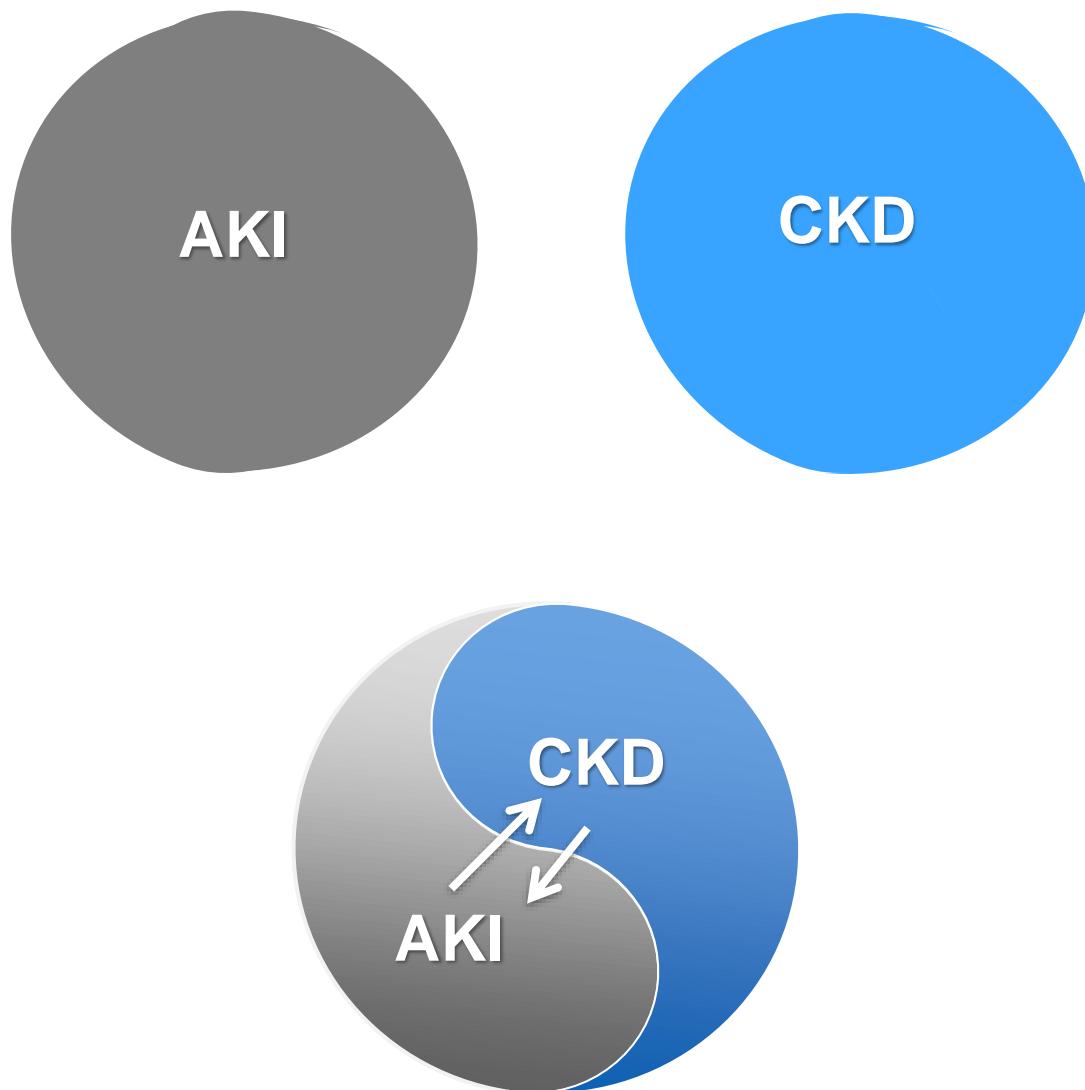
Diminished kidney function was classified as two distinct syndromes for more than 40 years

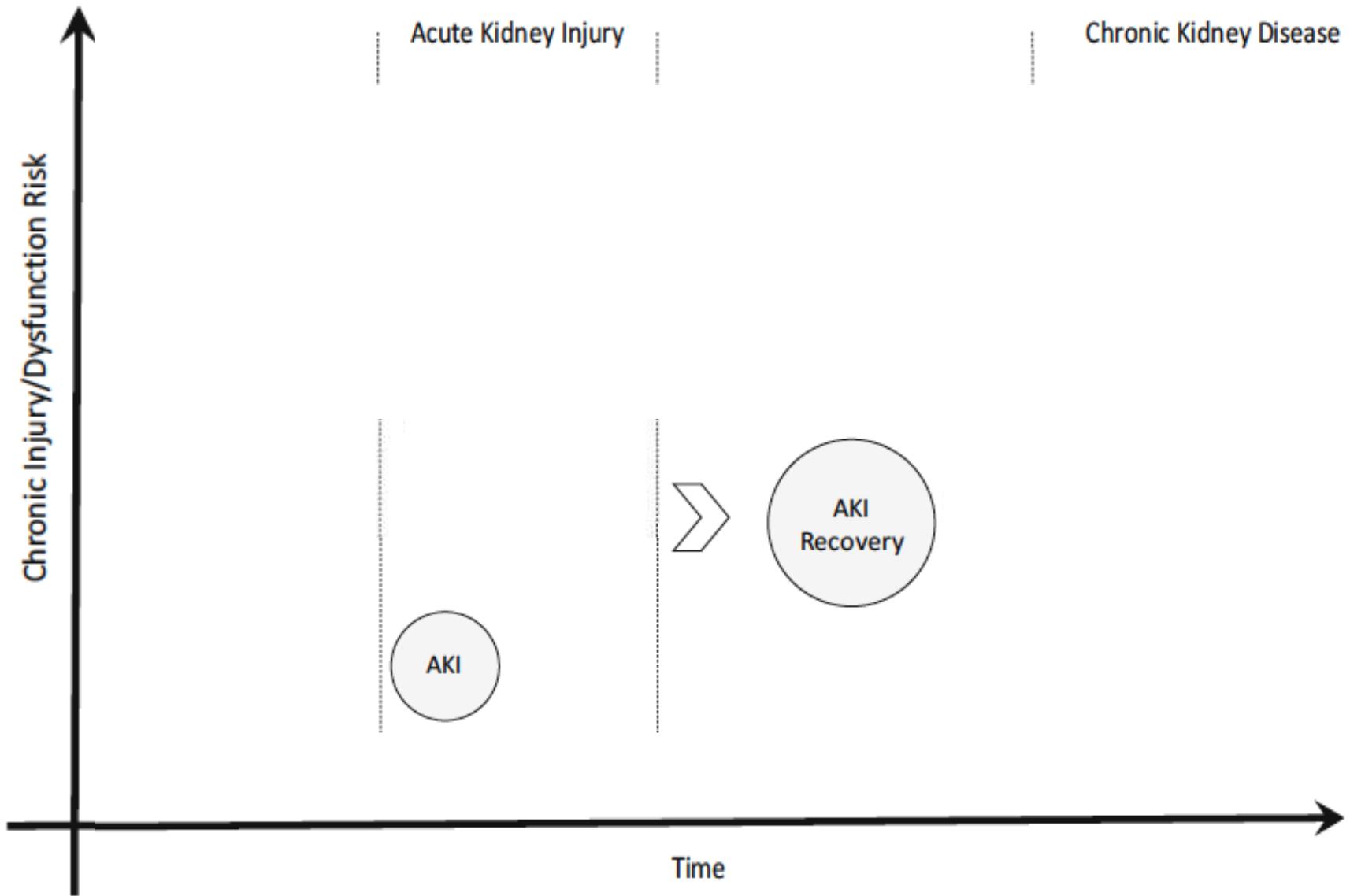
AKI: an acute problem

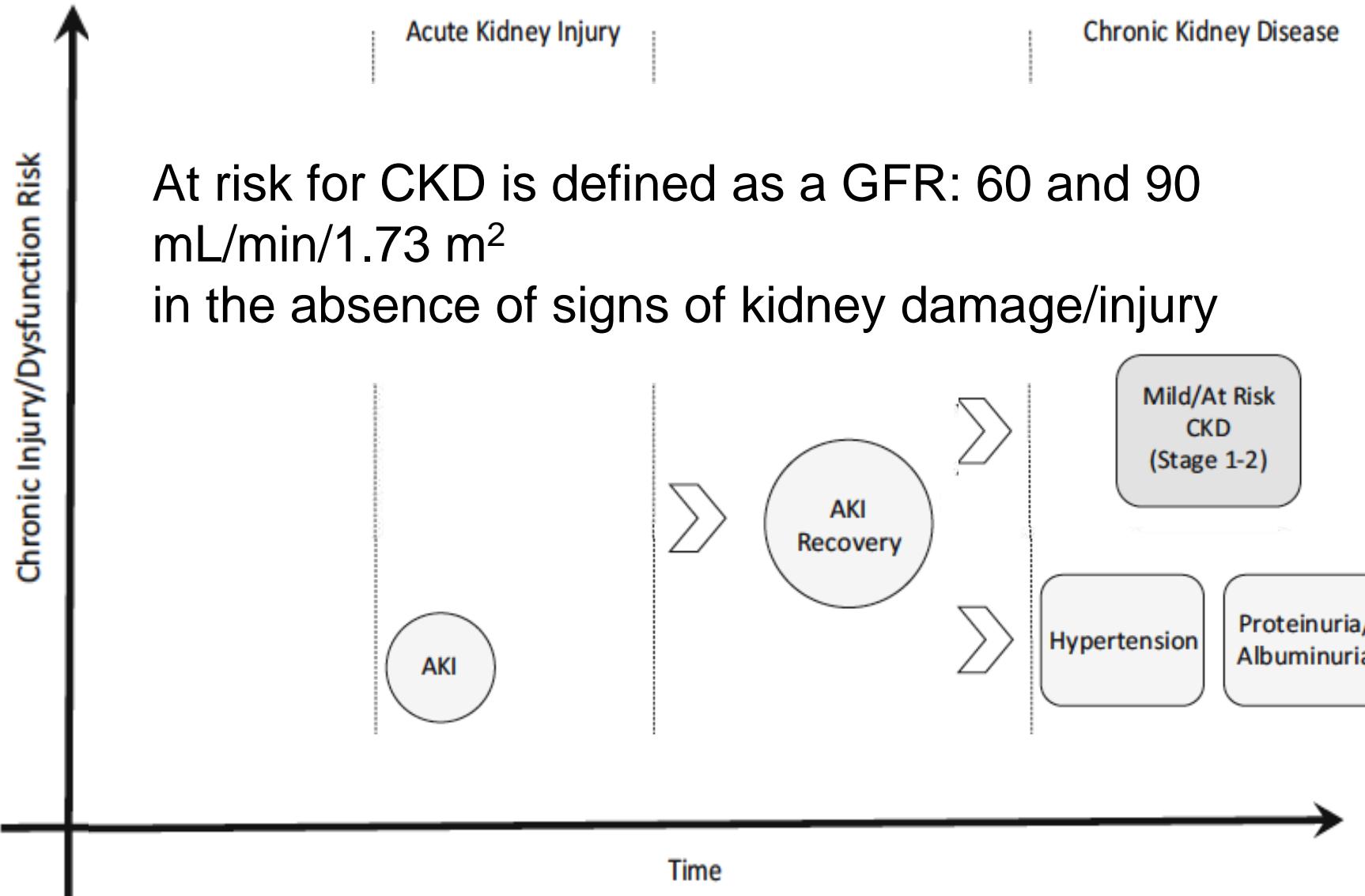
CKD has a long term outcome



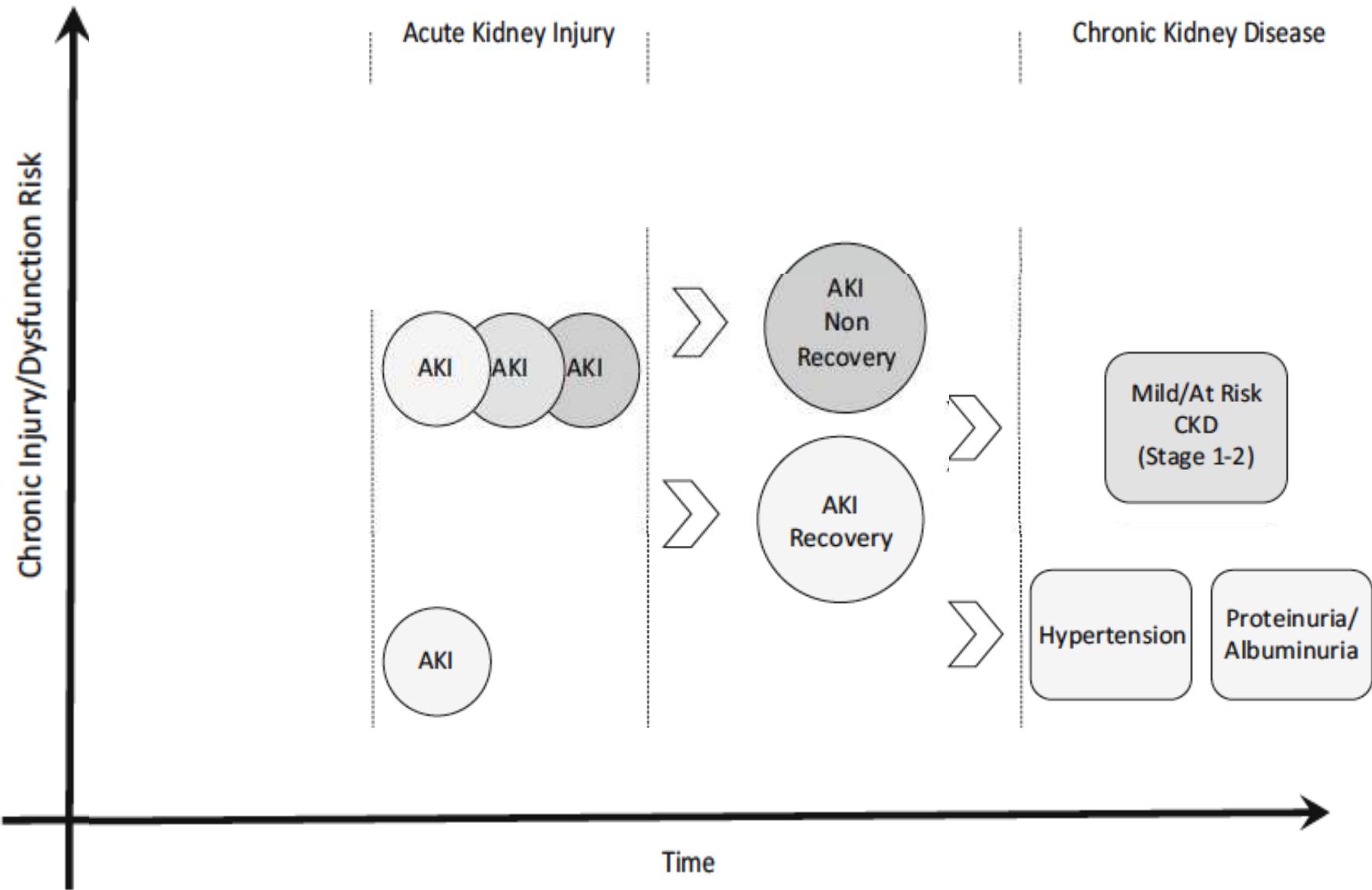
AKI and CKD: An Interconnected Syndrome

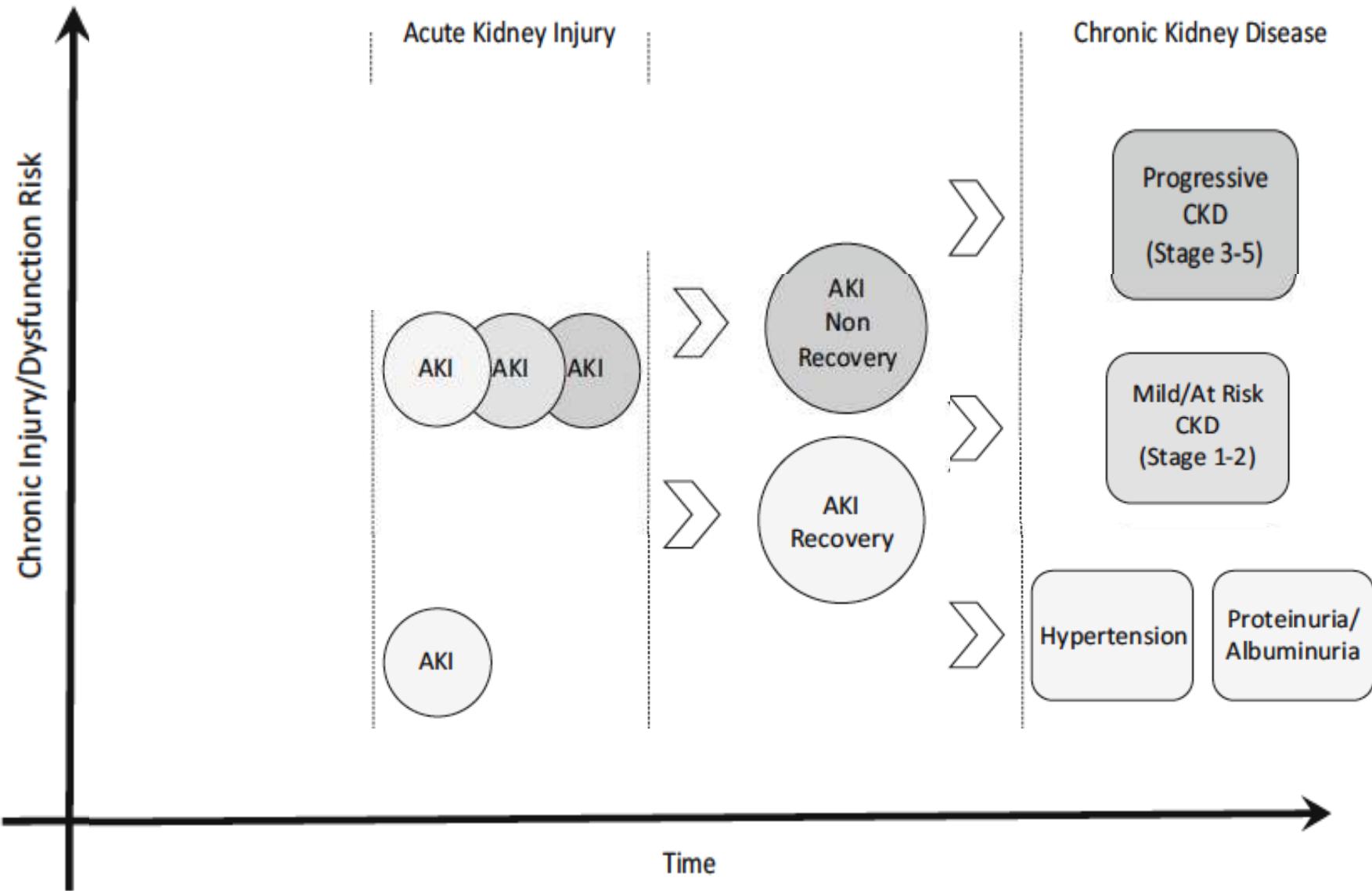


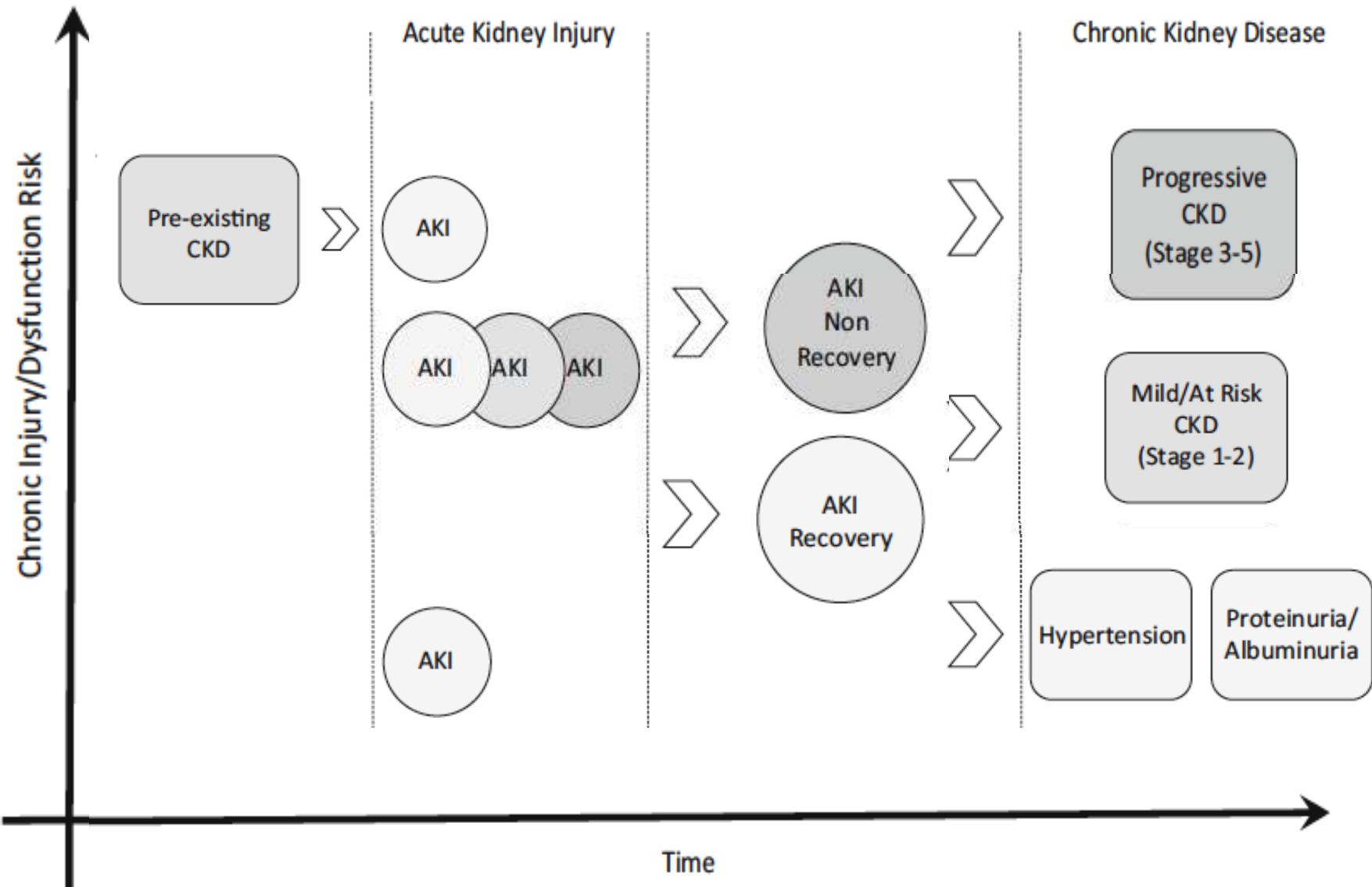




At risk for CKD is defined as a GFR: 60 and 90 mL/min/1.73 m²
in the absence of signs of kidney damage/injury







CKD and risk of AKI

We recommend that all people with CKD are considered to be at increased risk of AKI. (1A)

People with CKD, should be followed for management when undergoing investigation and procedures that are likely to increase the risk of AKI. (Not Graded)

How does CKD present?

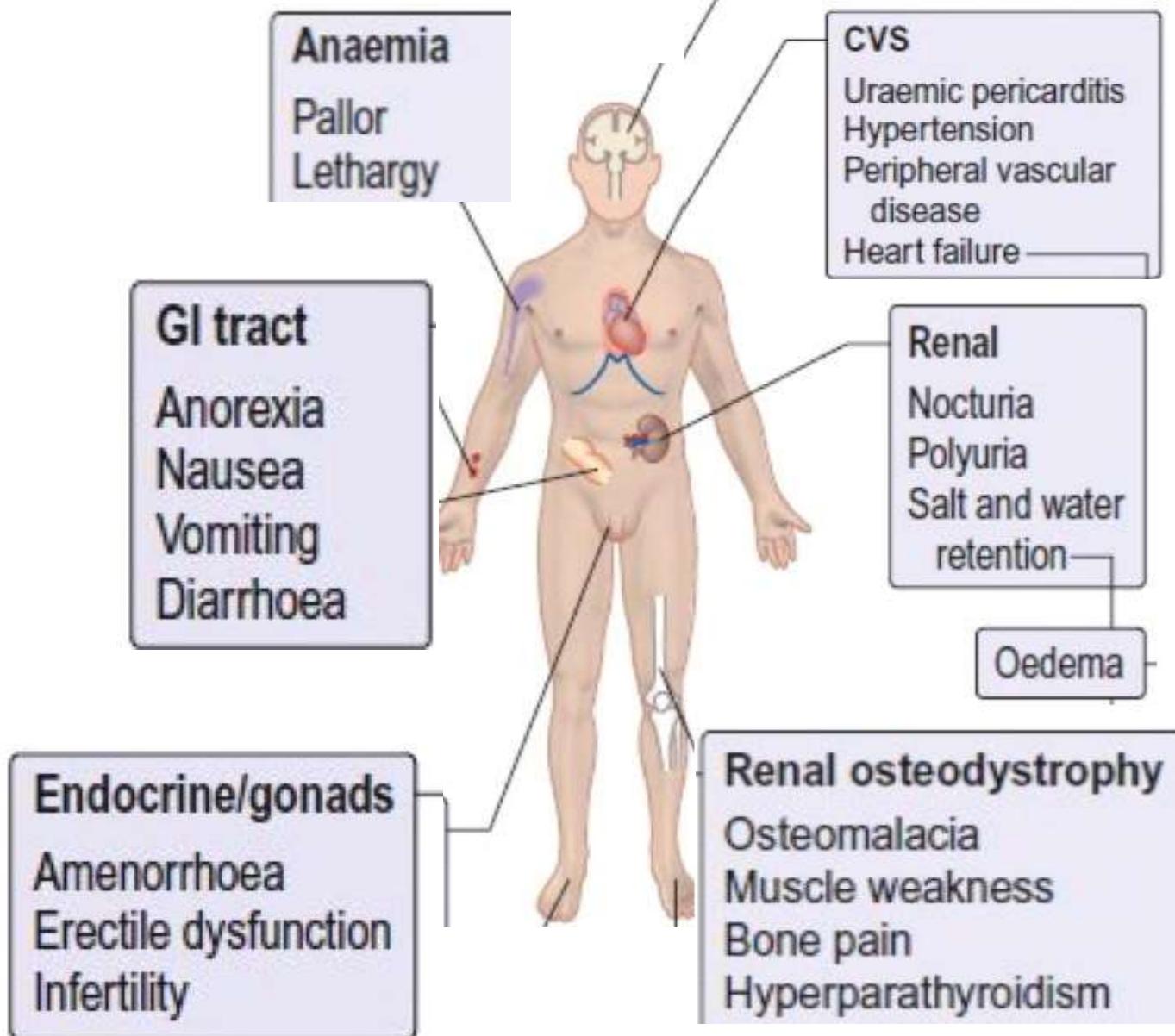
Asymptomatic Disease

Especially early despite the
accumulation of harmful
metabolites



Incidental finding of urine
abnormalities or raised creatinine

Ευρήματα XNN



OFFICIAL JOURNAL OF THE INTERNATIONAL SOCIETY OF NEPHROLOGY



kidney INTERNATIONAL

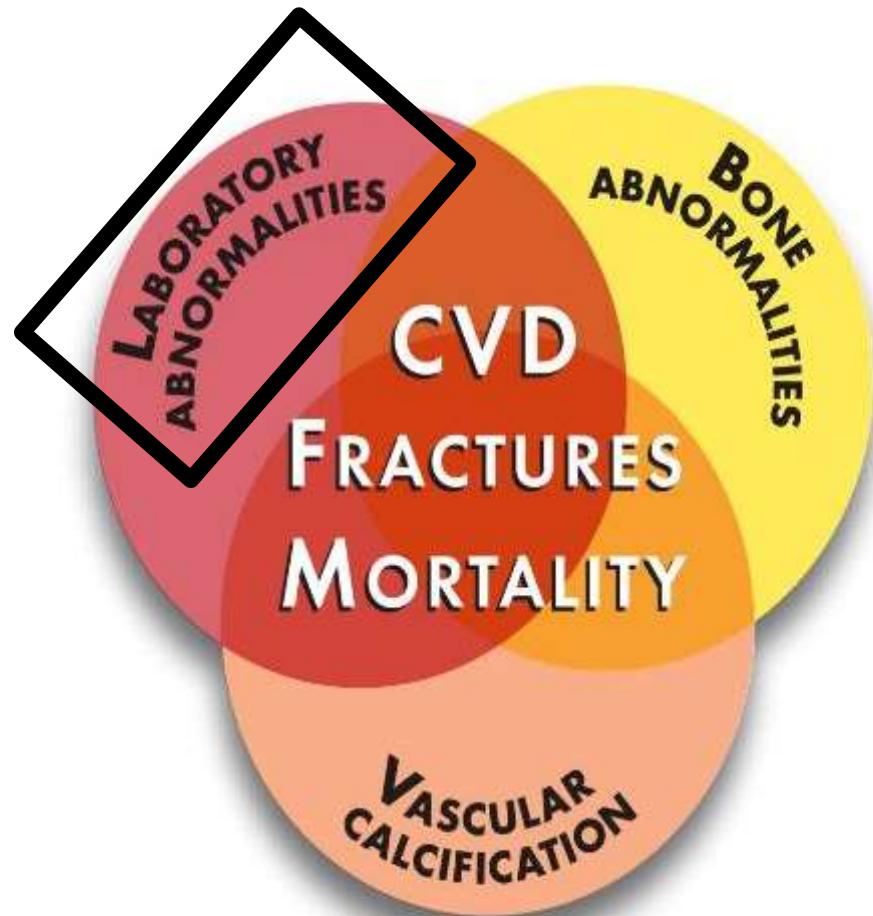


KDIGO Clinical Practice Guideline for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease-Mineral and Bone Disorder (CKD-MBD)

Chronic Kidney Disease – Mineral Bone Disorder (CKD – MBD)

A systemic disorder of bone and mineral metabolism due to CKD manifested by either one or a combination of the following:

- Abnormalities of Ca, P, PTH, or vit. D metabolism

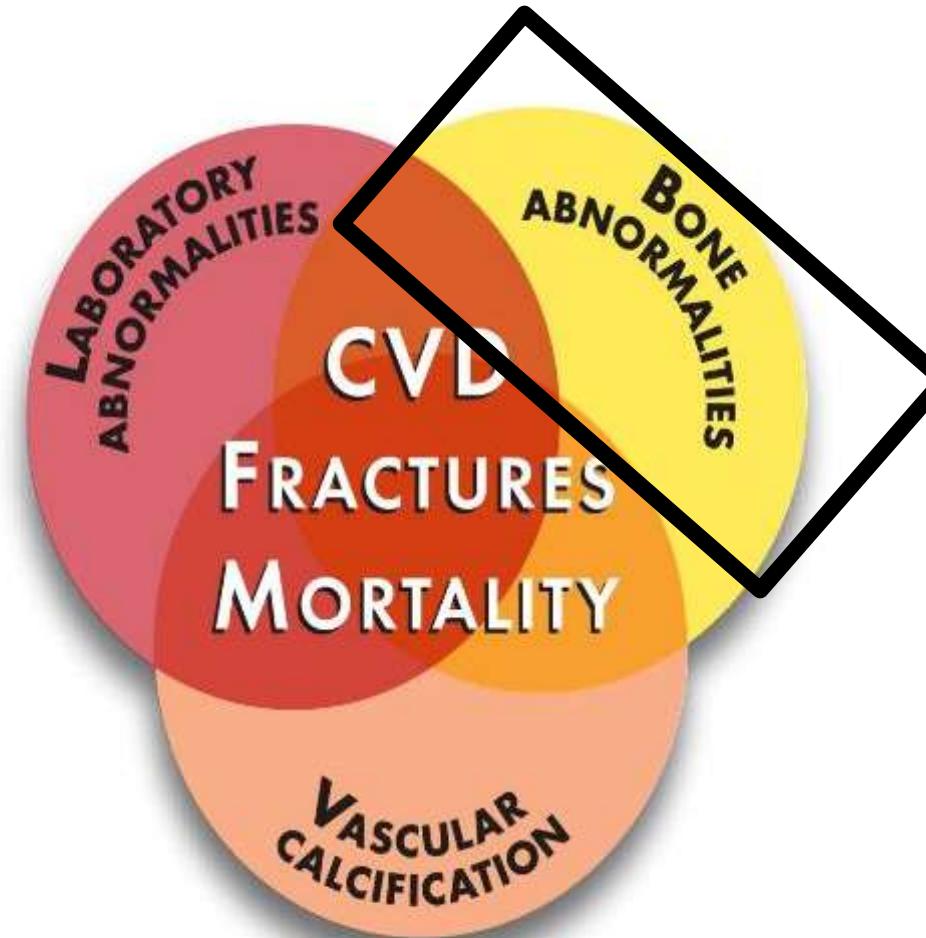


CKD-MBD

Chronic Kidney Disease – Mineral Bone Disorder (CKD – MBD)

A systemic disorder of bone and mineral metabolism due to CKD manifested by either one or a combination of the following:

- Abnormalities of Ca, P, PTH, or vit. D metabolism
- Abnormalities in bone turnover, mineralization, volume, linear growth, or strength

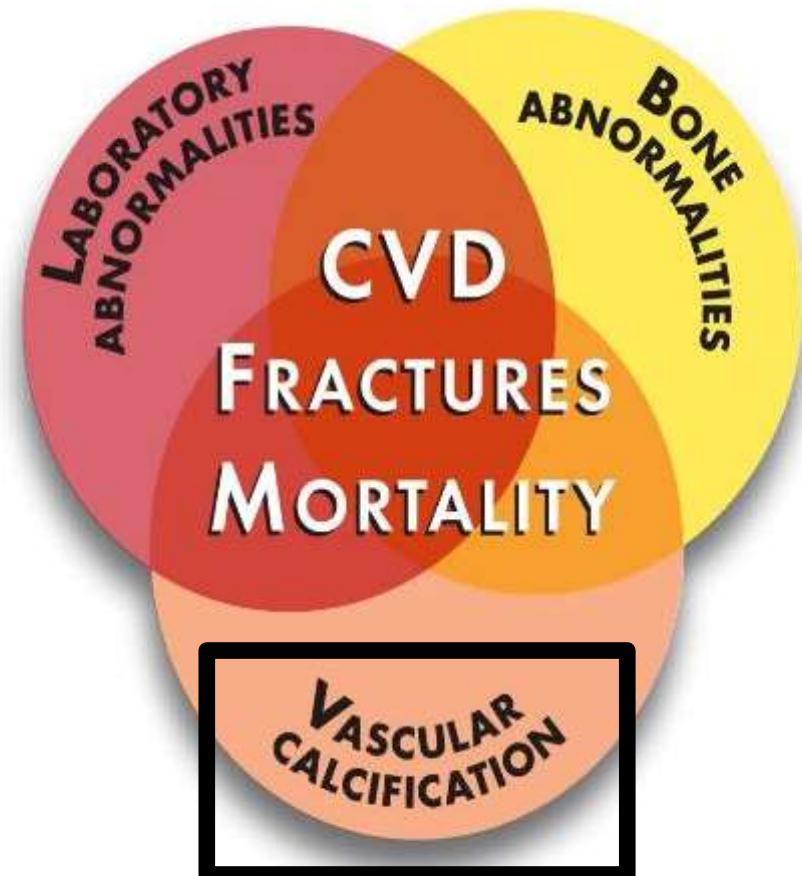


CKD-MBD

Chronic Kidney Disease – Mineral Bone Disorder (CKD – MBD)

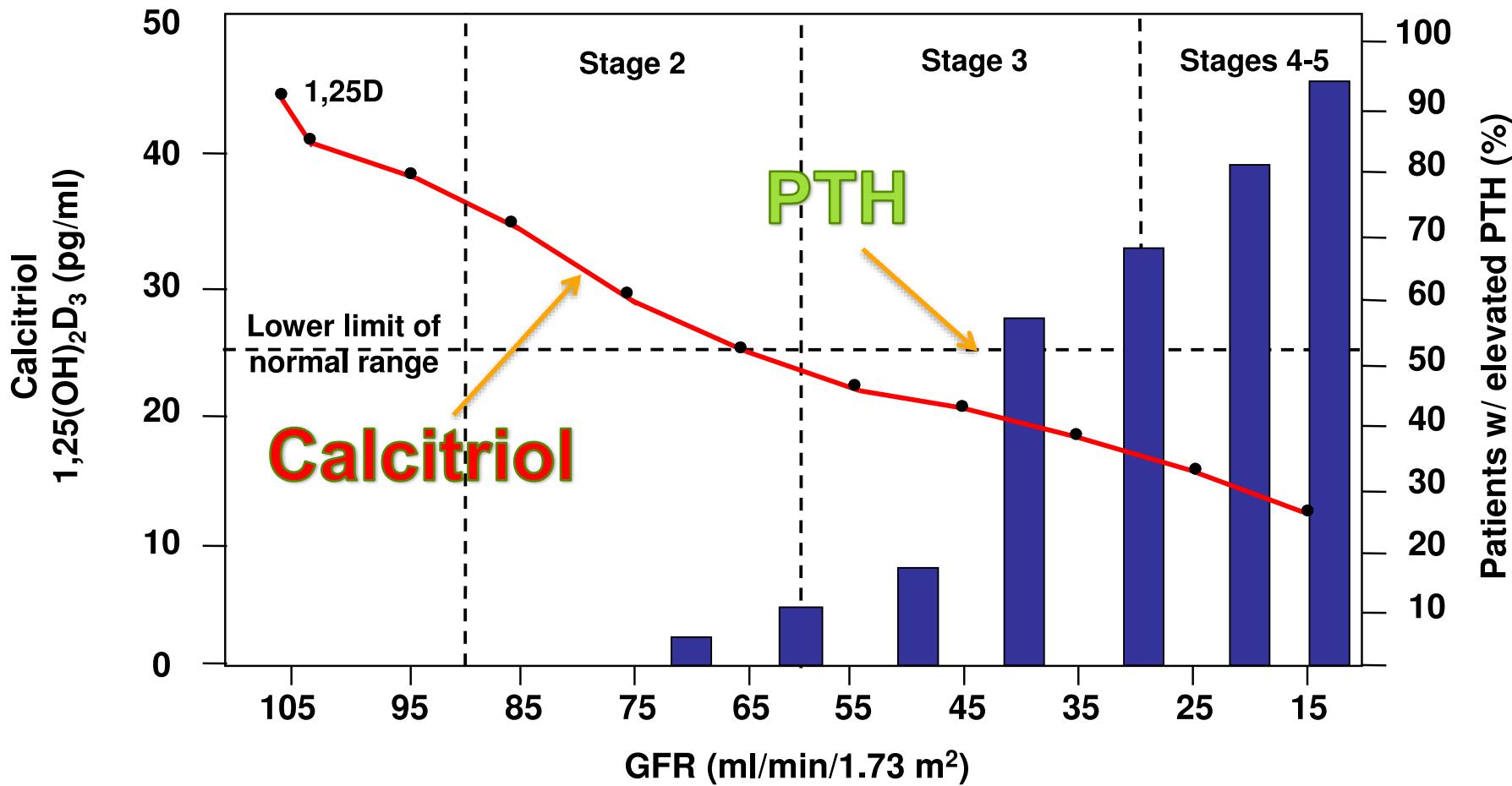
A systemic disorder of bone and mineral metabolism due to CKD manifested by either one or a combination of the following:

- Abnormalities of Ca, P, PTH, or vit. D metabolism
- Abnormalities in bone turnover, mineralization, volume, linear growth, or strength
- Vascular or other soft tissue calcification



CKD-MBD

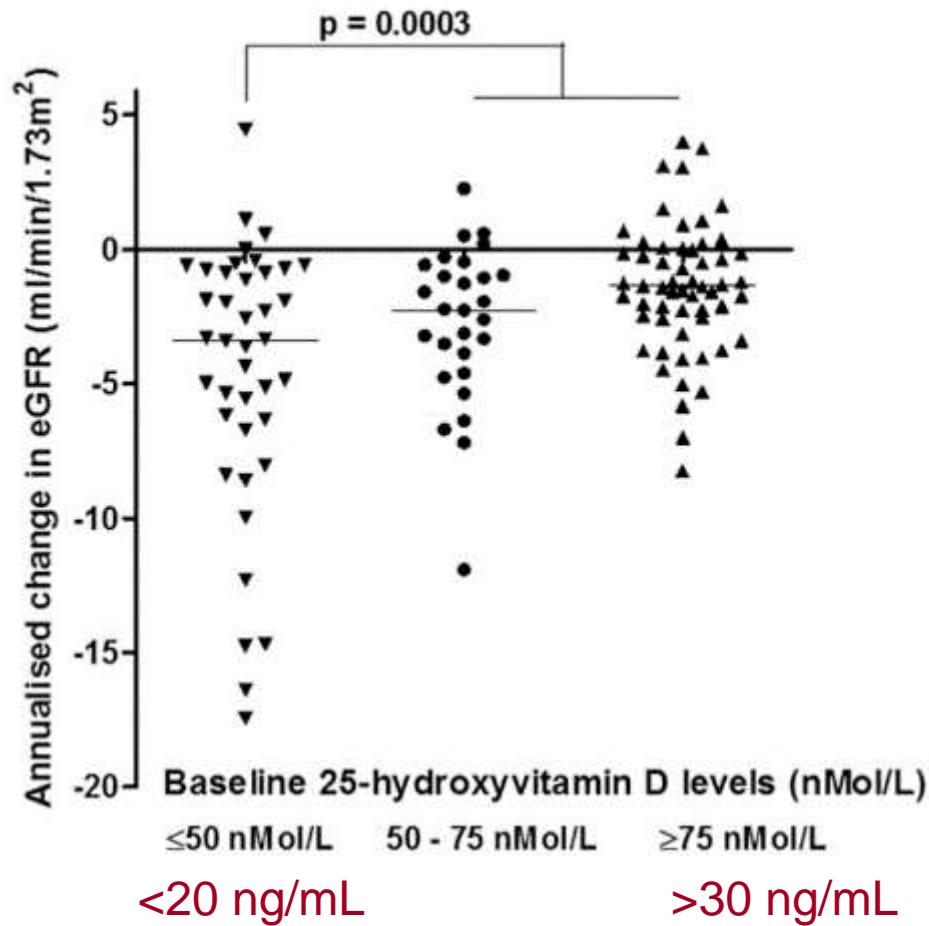
Calcitriol, PTH and stages of CKD



The Cardiovascular Comorbidity in Children with Chronic Kidney Disease (4C)

N	All	CKD Stage		
		3	4	5
N	556	219	296	41
Serum bicarbonate (mM)	21.2 ± 3.8	21.6 ± 3.5	21.0 ± 3.8	20.5 ± 4.4
Serum calcium (mM)	2.21 ± 0.23	2.20 ± 0.21	2.22 ± 0.23	2.22 ± 0.27
Hypocalcemia	74 (13.3%)	31 (14.6%)	38 (12.8%)	5 (12.2%)
Serum phosphate (mM)	1.54 ± 0.37	1.47 ± 0.36	1.63 ± 0.35	1.67 ± 0.64
Hyperphosphatemia	183 (32.9%)	54 (24.7%)	102 (18.4%)	27 (65.9%)
Serum iPTH (pmol/l)	12.3 (7.1, 20.2)	9.2 (5.9, 15.2)	14.6 (8.7, 23.9)	17.8 (9.4, 36.3)
Serum 25OHD (μ g/l)	11.0 (6.6, 18.1)	12.4 (7.34, 17.6)	10.7 (6.4, 18.3)	9.2 (5.5, 20.0)

Normal 25-OH D3 Attenuate Renal Failure Progression in Children with CKD



25(OH)D levels $>30\text{ng/mL}$ in children with CKD 2–3

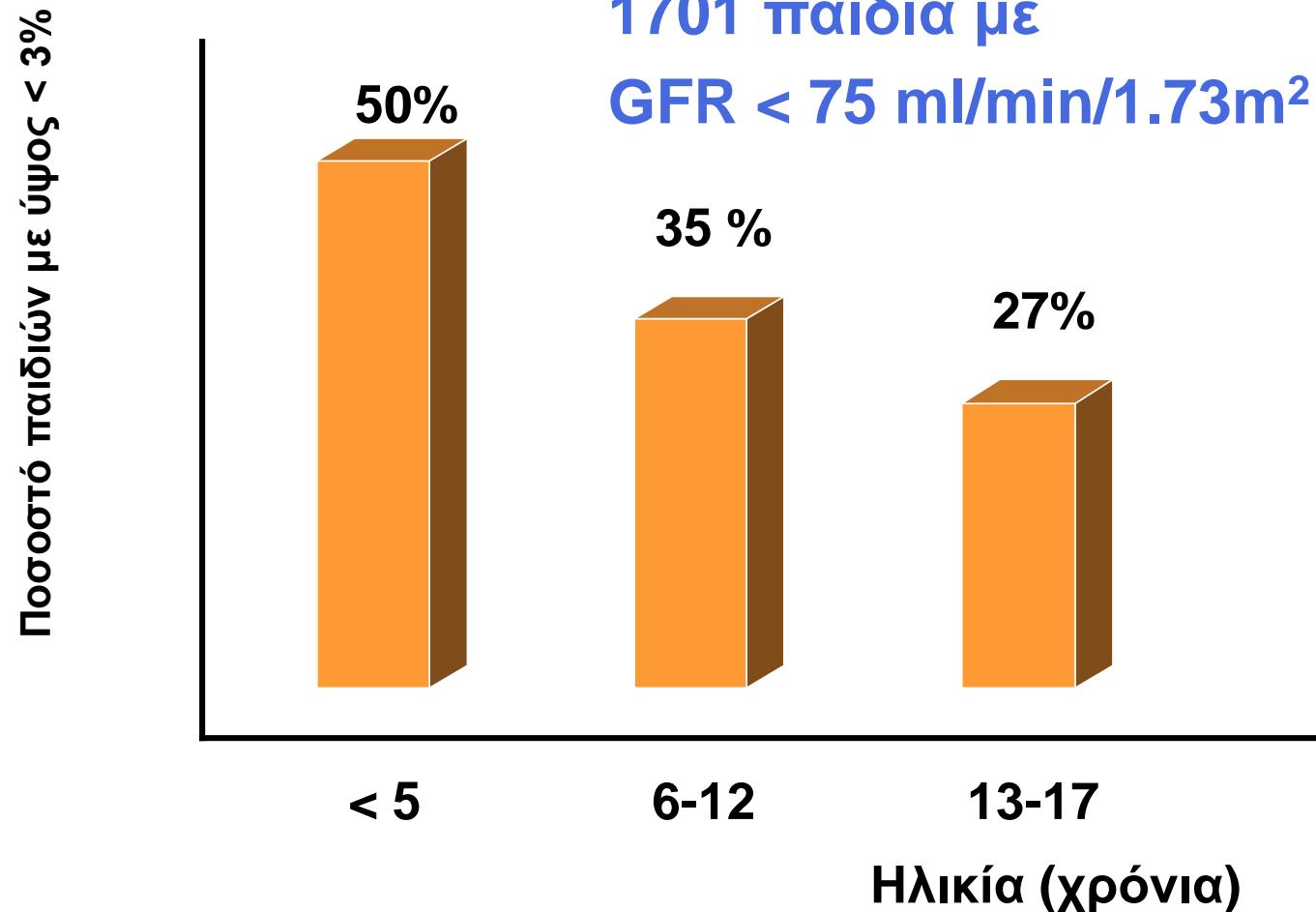
CKD – behavioral and learning problems

Children with (CKD) may have a negative self-image and may have relationship problems with family members.

The condition can lead to behavior problems and make participating in school and extracurricular activities more difficult.

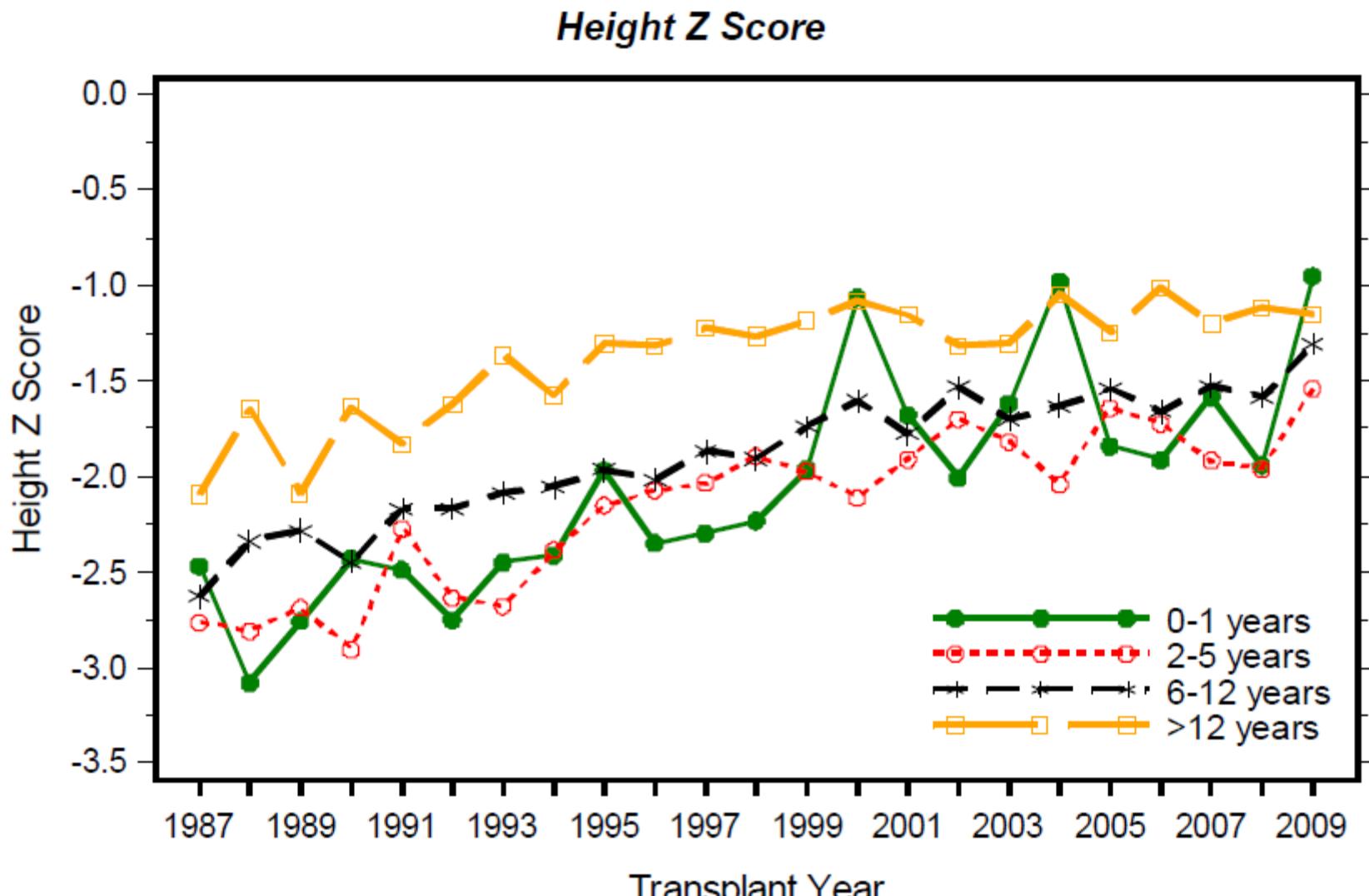
Children with CKD may have trouble concentrating
CKD can cause learning problems

Καθυστέρηση της αύξησης



North American Pediatric Renal Transplant Cooperative Study, 1996 Annual Report

STANDARDIZED SCORES (MEAN) AT TRANSPLANT BY AGE AT TRANSPLANT AND YEAR OF TRANSPLANT



CV Phenotypes in Children with CKD: The 4C Study

Patient Characteristics	Stage 3a	Stage 3b	Stage 4	Stage 5
N	50	216	370	52
Age, yr	12.3 (2.9)	12.2 (3.3)	12.2 (3.4)	12.1 (3.0)
Time since CKD	5.6 (4.5)	6.3 (4.8)	6.1 (4.5)	4.2 (3.8)
Height SDS	-0.81 (1.06)	-1.13 (1.34)	-1.54 (1.44)	-1.60 (1.43)
Height less than third	16.0	25.5	35.9	36.5

Ψυχοκοινωνικά προβλήματα

2036 παιδιά < 21 χρονών σε εξωνεφρική κάθαρση 1992-2000

Τα παιδιά πολύ χαμηλό ύψος
παρακολουθούσαν το σχολείο
λιγότερο συχνά σε σχέση με τα
παιδιά με ικανοποιητική αύξηση.



Furth SL et al., Pediatrics 2002

Αποκατάσταση

Τα παιδιά με ΧΝΝ και πολύ χαμηλό
ύψος έχουν διαταραγμένη εικόνα
του εαυτού τους και έχουν
συχνότερα ψυχολογικά
προβλήματα



Henning P Arch Dis Child (1988)

Law CM. Arch Dis Child (1987)

Καθυστέρηση της αύξησης

Καθυστέρηση αύξησης	Νοσηλείες /χρόνο	Δείκτης κινδύνου
Σοβαρή (z < -3)	1.65	1.50
Μέτρια (z < -2)	1.59	1.51
Φυσιολογική αύξηση	1.05	1.0

Furth SL et al., Pediatr Nephrol 2002

Καθυστέρηση της αύξησης

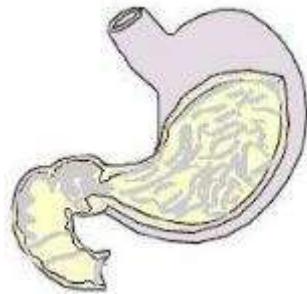
Καθυστέρηση αύξησης	Νοσηλείες /χρόνο	Δείκτης κινδύνου
Σοβαρή (z < -3)	1.65	1.50
Μέτρια (z < -2)	1.59	1.51
Φυσιολογική αύξηση	1.05	1.0

Καθυστέρηση αύξησης	Θνητότητα /χρόνο	Δείκτης κινδύνου
Σοβαρή (z < -3)	16.2	3.2
Μέτρια (z < -2)	11.5	2.1
Φυσιολογική αύξηση	5.6	1.0

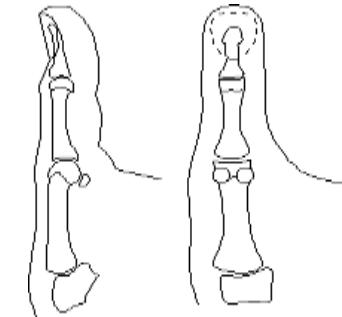
Furth SL et al., Pediatr Nephrol 2002

Ευρήματα XNN σταδίου 3 ή 4

Ανορεξία



Νεφρική οστεοδυστροφία



Υποθρεψία

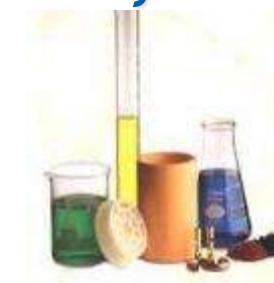
Αναιμία



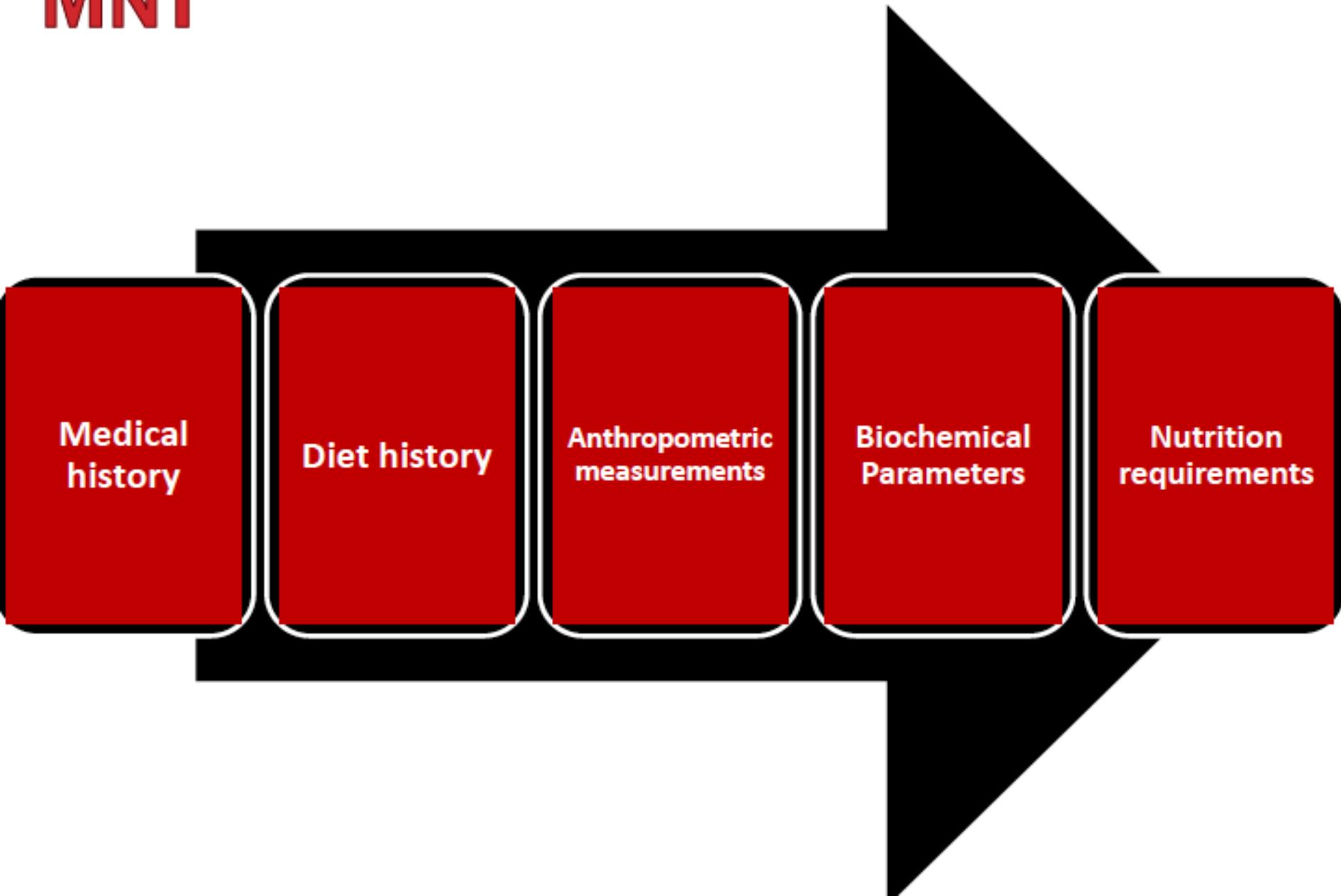
Μεταβολικές διαταραχές

Ενδοκρινικές διαταραχές

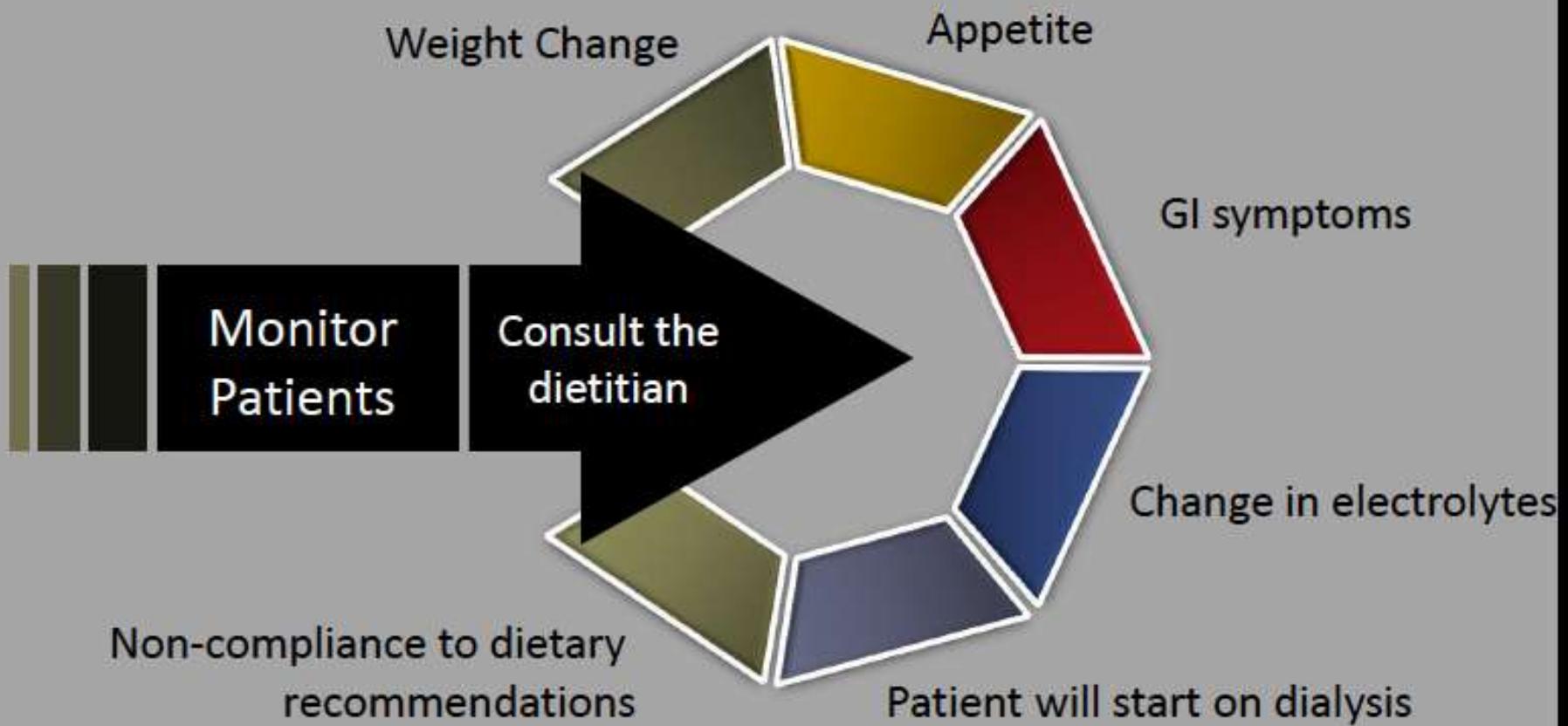
Μεταβολική
οξέωση

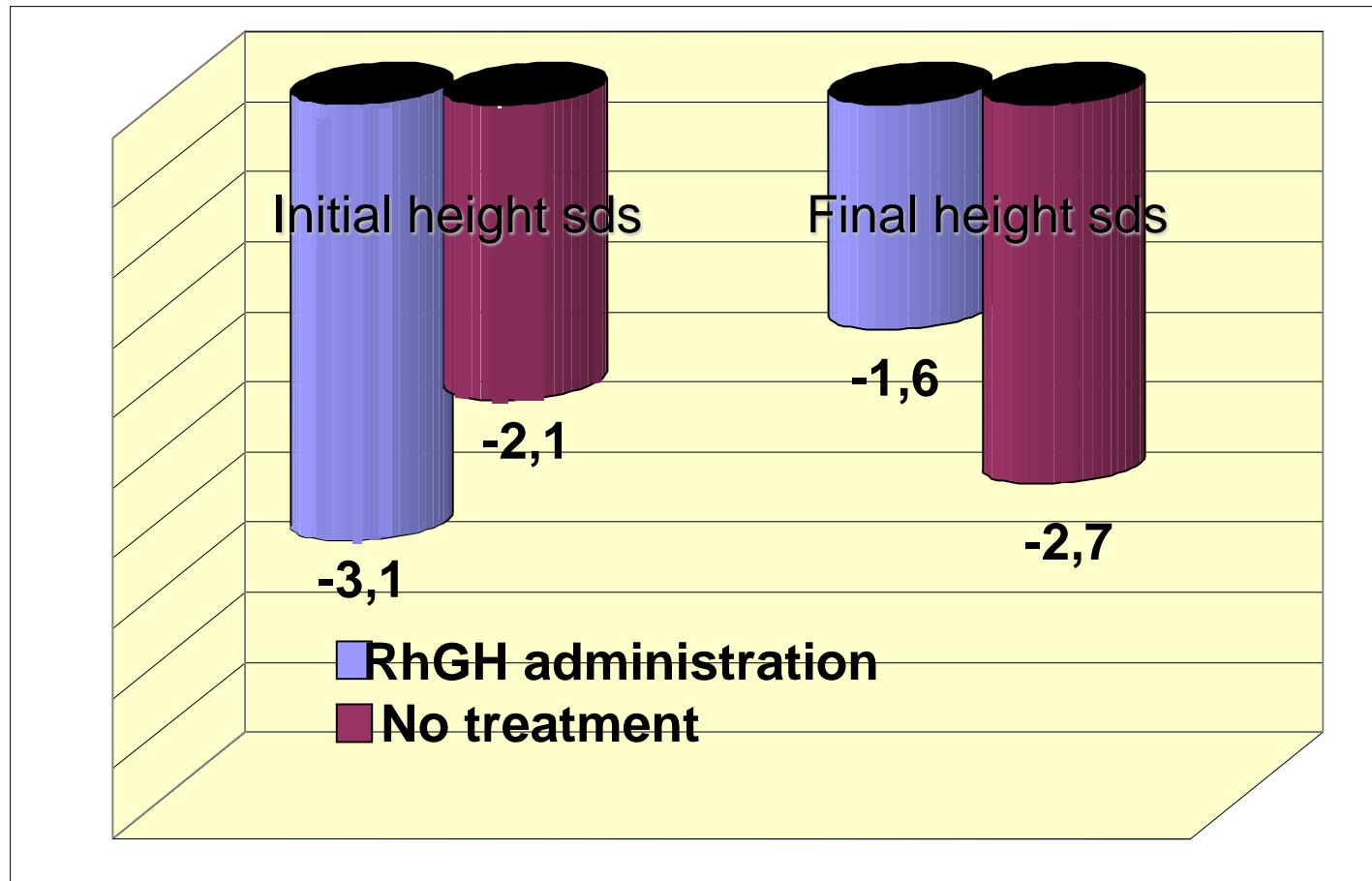


MNT



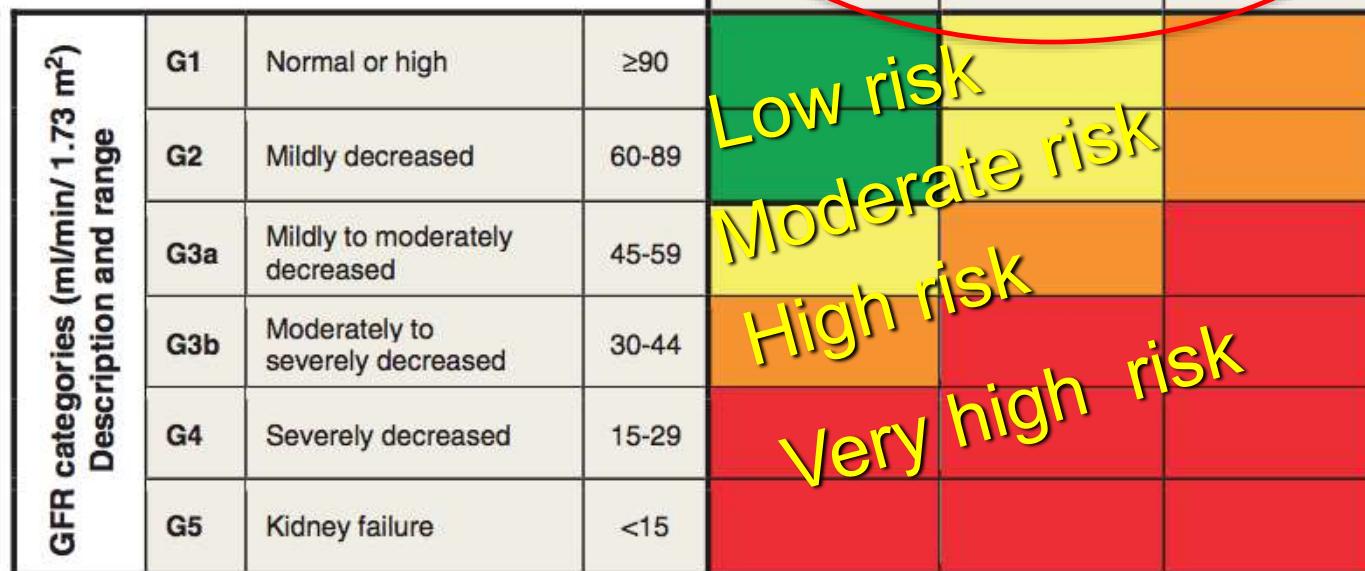
KEEP IN MIND:





Prognosis by GFR and albuminuria

Prognosis of CKD by GFR
and Albuminuria Categories:
KDIGO 2012



Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk;
Orange: high risk; Red, very high risk.

ESCAPE trial

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Strict Blood-Pressure Control and Progression of Renal Failure in Children

The ESCAPE Trial Group*

Effect of Strict Blood Pressure Control and ACE Inhibition on the Progression of CRF in PEdiatric Patients (ESCAPE trial).

N Engl J Med 2009;361:1639-50.

ESCAPE trial

385 children of age 3-18 years GFR 15-80 ml/min/1.73m²

Patients were randomly assigned to:

Intensified BP control

(with a target 24-hour mean arterial pressure <50th percentile) or

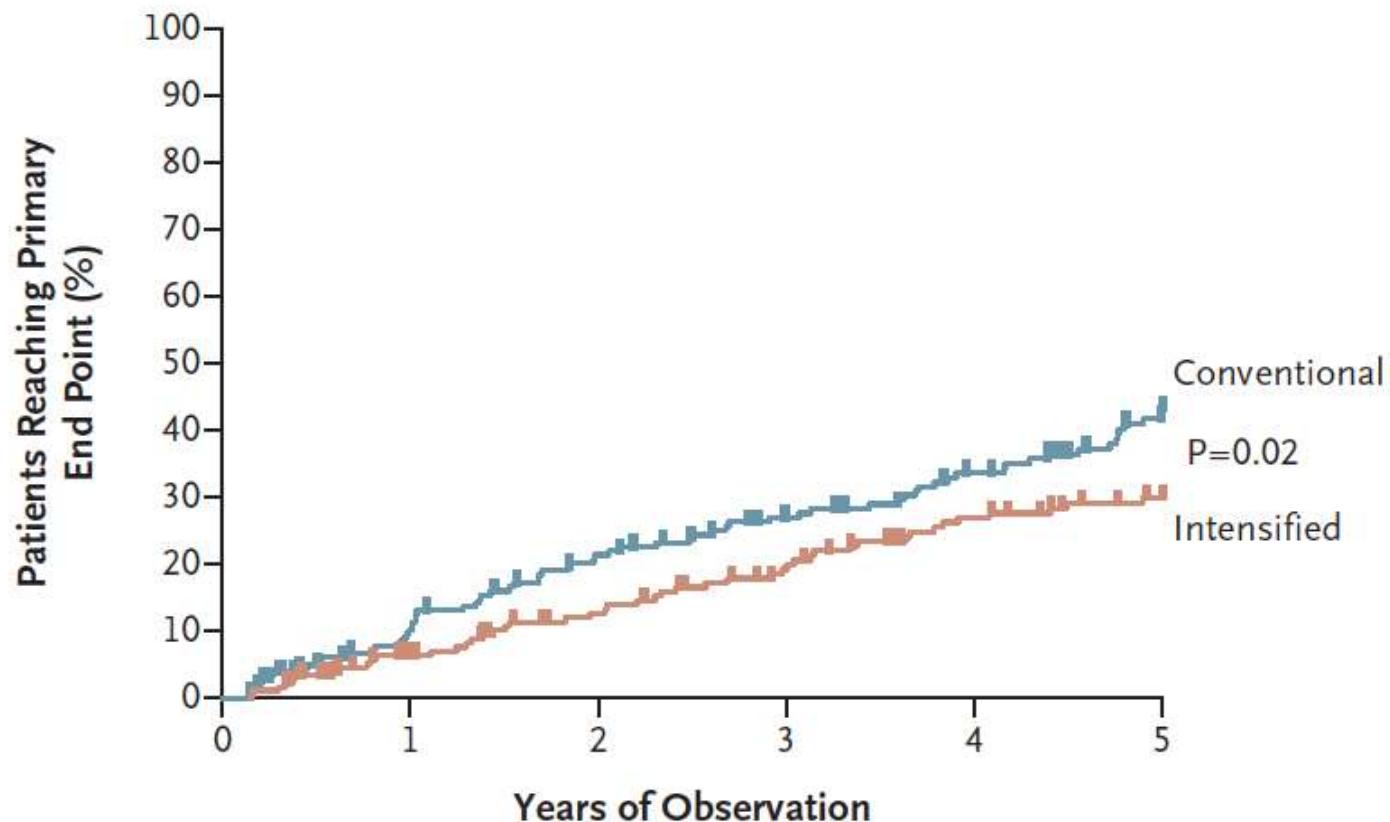
Conventional BP control

(mean arterial pressure in the 50th to 95th percentile)

Ramipril 6 mg/m²/day

ESCAPE trial

All Patients



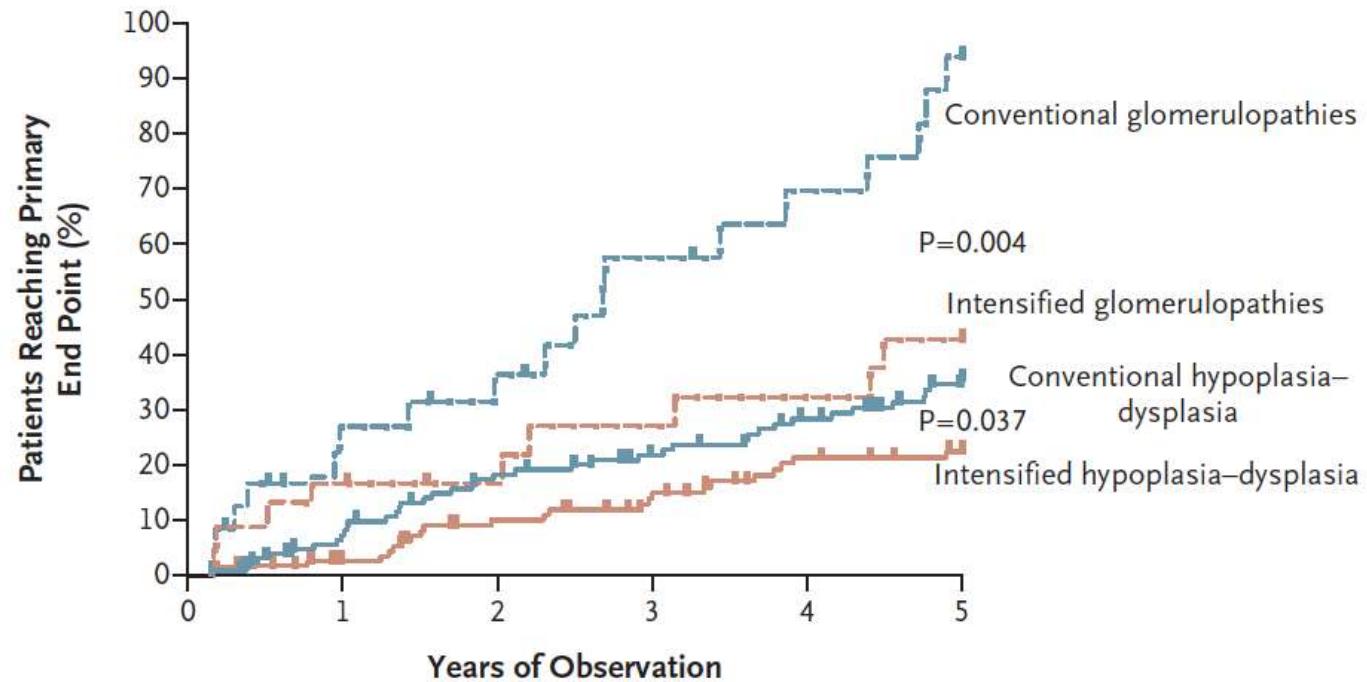
No. at Risk

Intensified
Conventional

182	167	152	142	135	126	119	110	102	97	90
190	168	154	142	131	122	112	107	97	86	75

ESCAPE trial

Glomerulopathies or Hypoplasia–Dysplasia



No. at Risk

Intensified glomerulopathies	28	21	19	18	17	15	15	14	14	12	12
Conventional glomerulopathies	24	20	16	15	13	11	8	6	5	4	1
Intensified hypoplasia–dysplasia	125	118	112	102	97	93	88	81	76	74	71
Conventional hypoplasia–dysplasia	139	127	116	108	101	98	91	88	78	70	63

Estimating time to ESRD in Children With CKD

1232 children aged 1-18 years enrolled in the North American Chronic Kidney Disease in Children (**CKiD**) cohort study and the European Effect of Strict Blood Pressure Control and ACE Inhibition on the Progression of CRF in Pediatric Patients (**ESCAPE**) trial.

Classifying individuals by GFR, proteinuria (urine protein-creatinine ratio [$\mu\text{P/C}$]) and CKD diagnosis

Estimating time to ESRD in Children With CKD

Outcome definition:

- (i) 50% reduction of baseline GFR,
- (ii) an estimated GFR less than 15 mL/min/1.73m²
- (iii) initiation of renal replacement therapy (RRT)

$\text{uPr/Cr} < 0.5\text{mg/mg}$, $0.5\text{-}2\text{mg/mg}$ and $> 2\text{mg/mg}$

$\geq 90\text{ml/min}/1.73\text{m}^2$ (G1), 60-89ml/min/1.73m² (G2), 45-59ml/min/1.73m² (G3a), 30-44 ml/min/1.73m² (G3b), and 15-29 ml/min/1.73m² (G4).

Estimating time to ESRD in Children With CKD

1269 children, 891 from CKiD and 378 from ESCAPE

75% of children had non-glomerular diagnoses including congenital anomalies of the kidney and urinary tract (CAKUT);

The predominant glomerular diagnosis was focal segmental glomerulosclerosis (29% of glomerular).

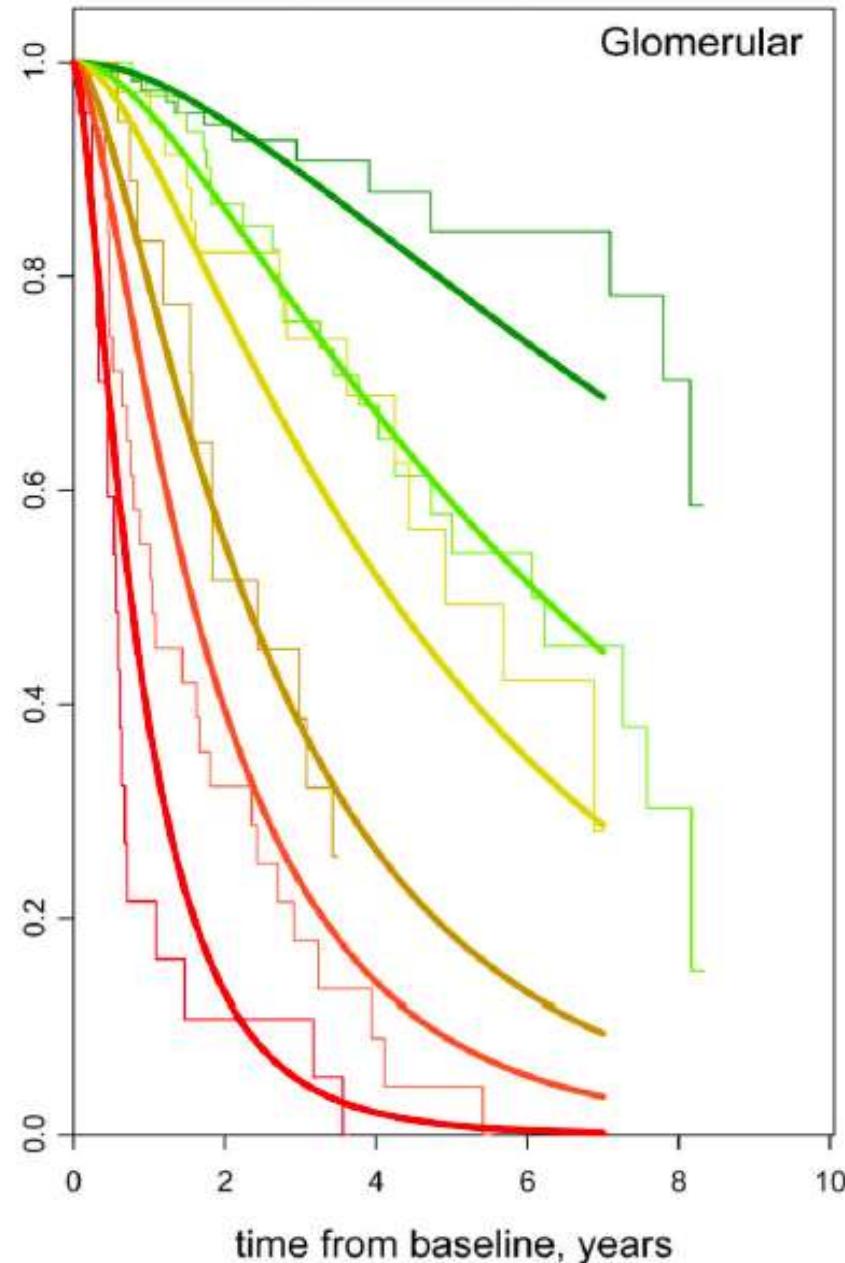
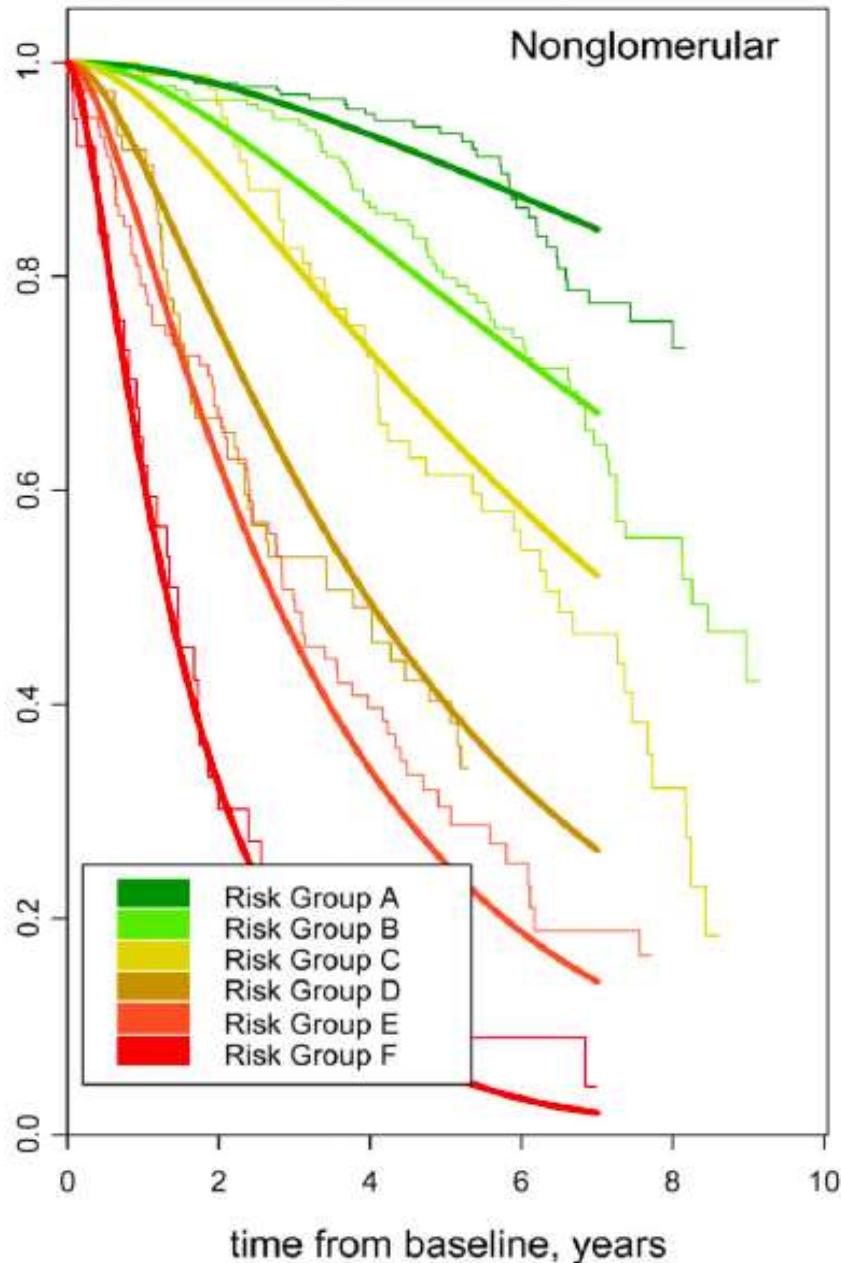
Estimating time to ESRD in Children With CKD

		<0.5	[0.5, 2.0]	>2.0
I	≥90	<p>n=44 CKID: 100% ESCAPE: 0% glomerular dx: 48%</p> <p>events=3 p-y=132.79 IR=2.3 (0.73, 7.00) per 100 p-y</p>	<p>n=12 CKID: 100% ESCAPE: 0% glomerular dx: 67%</p> <p>events=1 p-y=45.82</p>	<p>n=4 CKID: 100% ESCAPE: 0% glomerular dx: 100%</p> <p>events=1 p-y=11.40</p>
II	[60, 90)	<p>n=200 CKID: 95% ESCAPE: 5% glomerular dx: 29%</p> <p>events=12 p-y=814.40 IR=1.5 (0.84, 2.6) per 100 p-y</p>	<p>n=48 CKID: 94% ESCAPE: 6% glomerular dx: 58%</p> <p>events=14 p-y=171.93 IR=8.1 (4.8, 13.8) per 100 p-y</p>	<p>n=17 CKID: 100% ESCAPE: 0% glomerular dx: 88%</p> <p>events=6 p-y=42.26 IR=14.2 (6.4, 31.6) per 100 p-y</p>
IIIa	[45, 60)	<p>n=190 CKID: 73% ESCAPE: 7% glomerular dx: 18%</p> <p>events=34 p-y=956.79 IR=3.6 (2.5, 5.0) per 100 p-y</p>	<p>n=100 CKID: 78% ESCAPE: 22% glomerular dx: 25%</p> <p>events=30 p-y=469.27 IR=6.4 (4.5, 9.1) per 100 p-y</p>	<p>n=23 CKID: 91% ESCAPE: 9% glomerular dx: 57%</p> <p>events=15 p-y=65.91 IR=22.8 (13.7, 37.8) per 100 p-y</p>

Estimating time to ESRD in Children With CKD

Baseline GFR Stage	Age Group	CKD Stages		
		I	II	III
IIIa	[45, 60)	n=190 CKID: 73% ESCAPE: 7% glomerular dx: 18% events=34 p-y=956.79 IR=3.6 (2.5, 5.0) per 100 p-y	n=100 CKID: 78% ESCAPE: 22% glomerular dx: 25% events=30 p-y=469.27 IR=6.4 (4.5, 9.1) per 100 p-y	n=23 CKID: 91% ESCAPE: 9% glomerular dx: 57% events=15 p-y=65.91 IR=22.8 (13.7, 37.8) per 100 p-y
IIIb	[30, 45)	n=153 CKID: 54% ESCAPE: 46% glomerular dx: 8% events=47 p-y=797.97 IR=5.9 (4.4, 7.8) per 100 p-y	n=101 CKID: 75% ESCAPE: 25% glomerular dx: 21% events=51 p-y=476.89 IR=10.7 (8.1, 14.1) per 100 p-y	n=52 CKID: 69% ESCAPE: 31% glomerular dx: 46% events=40 p-y=125.12 IR=32.0 (23.5, 43.6) per 100 p-y
IV	[15-30)	n=69 CKID: 48% ESCAPE: 52% glomerular dx: 7% events=41 p-y=236.31 IR=17.4 (12.8, 23.6)	n=97 CKID: 46% ESCAPE: 54% glomerular dx: 8% events=65 p-y=262.01 IR=24.8 (19.5, 31.6)	n=59 CKID: 59% ESCAPE: 41% glomerular dx: 36% events=52 p-y=89.05 IR=58.4 (44.5, 76.6)

Estimating time to ESRD in Children With CKD



Prevention of CKD progression

We recommend that in children with CKD, BP-lowering treatment is started when BP is consistently above the 90th percentile for age, sex, and height. (1C)

We suggest that in children with CKD (particularly those with proteinuria), BP is lowered to consistently achieve systolic and diastolic readings less than or equal to the 50th percentile for age, sex, and height, (2D)

Prevention of CKD progression

We suggest that an ARB or ACE-I be used in children with CKD in whom treatment with BP-lowering drugs is indicated, irrespective of the level of proteinuria. (2D)

Prevalence of CKD complications

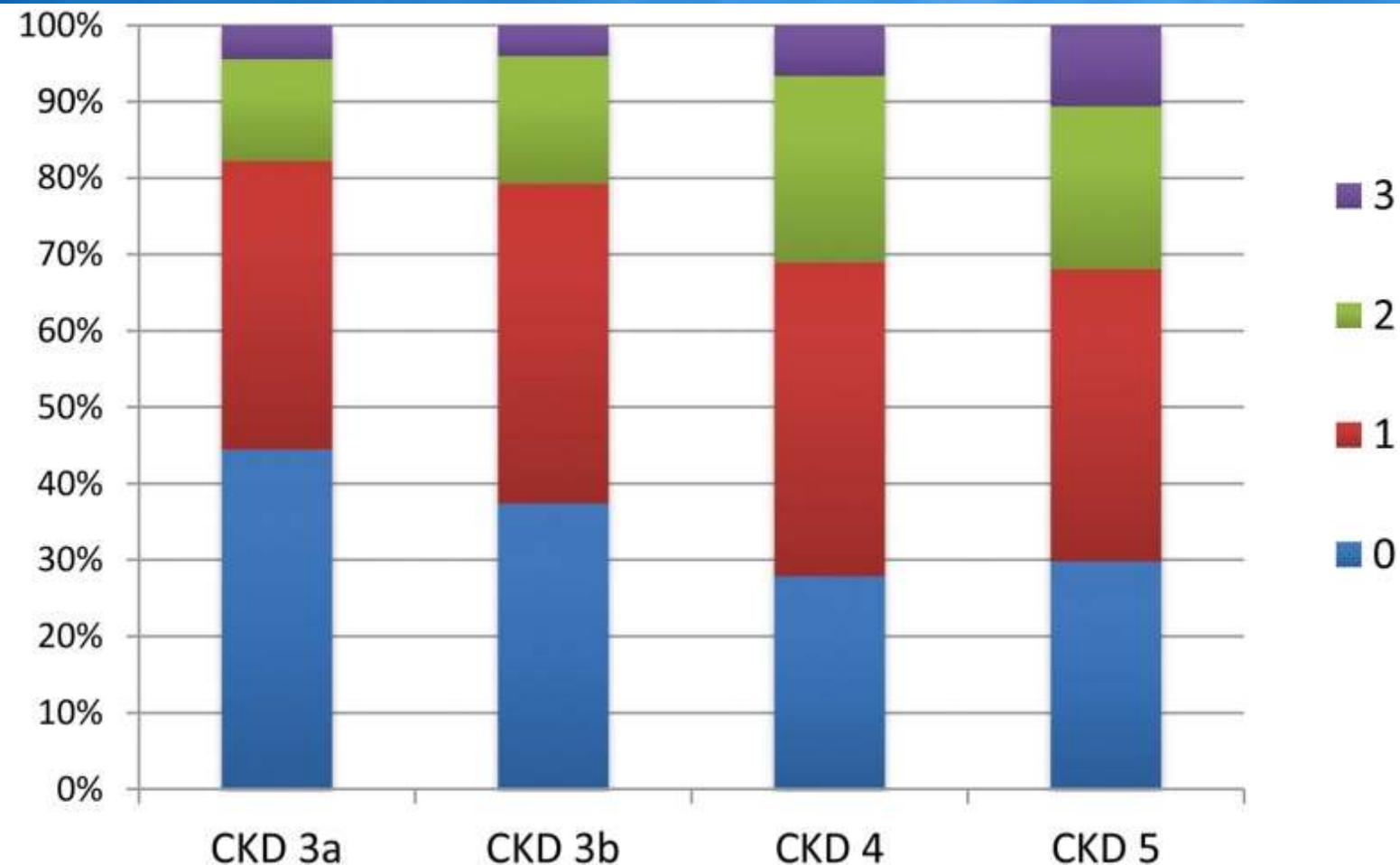
Complication	GFR category (ml/min/1.73 m ²)				
	≥ 90	60-89	45-59	30-44	< 30
Hypertension ²	18.3%	41.0%	71.8%	78.3%	82.1%

CV Phenotypes in Children with CKD: The 4C Study

Patient Characteristics	Stage 3a	Stage 3b	Stage 4	Stage 5
N	50	216	370	52
Age, yr	12.3 (2.9)	12.2 (3.3)	12.2 (3.4)	12.1 (3.0)
Time since CKD	5.6 (4.5)	6.3 (4.8)	6.1 (4.5)	4.2 (3.8)

Measurements and Classifications	Stage 3a	Stage 3b	Stage 4	Stage 5
Normotension without treatment, N (%)	13 (31.7)	35 (19.4)	58 (20.4)	6 (15.8)
Controlled hypertension, N (%)	18 (43.9)	101 (56.1)	157 (55.1)	14 (36.8)
Uncontrolled hypertension, N (%)	10 (24.4)	44 (24.4)	70 (24.8)	18 (47.4)

CV Phenotypes in Children with CKD: The 4C Study



Intermediate end points:

LVM index, carotid intima-media thickness,
central pulse wave velocity > the 95th percentile for height.

Shaeffer F. et al. Clin J Am Soc Nephrol. 2017

CKD electronic health records-based registry: CURE-CKD



Original Investigation | Nephrology

Clinical Characteristics of and Risk Factors for Chronic Kidney Disease Among Adults and Children An Analysis of the CURE-CKD Registry

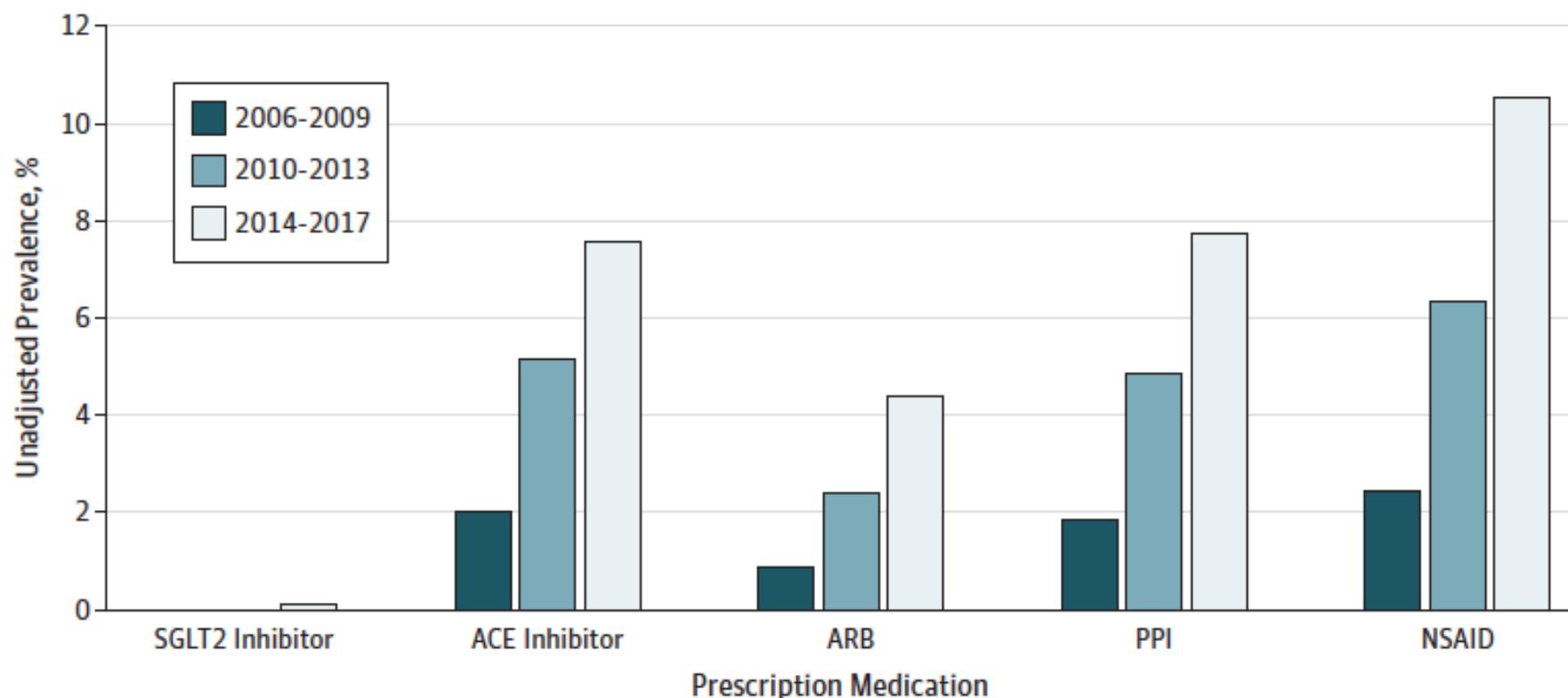
Katherine R. Tuttle, MD; Radica Z. Alicic, MD; O. Kenrik Duru, MD; Cami R. Jones, PhD; Kenn B. Daratha, PhD; Susanne B. Nicholas, MD, MPH, PhD; Sterling M. McPherson, PhD; Joshua J. Neumiller, PharmD; Douglas S. Bell, MD; Carol M. Mangione, MD; Keith C. Norris, MD, PhD

Tuttle KR JAMA Network Open. 2019;2(12):e1918169

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2757881>

CKD electronic health records-based registry: CURE-CKD

Figure 2. Prevalence of Prescription Medication Use in Chronic Kidney Disease Categories 3a to 5 in 2006 to 2009, 2010 to 2013, 2014 to 2017



Tuttle KR JAMA Network Open. 2019;2(12):e1918169

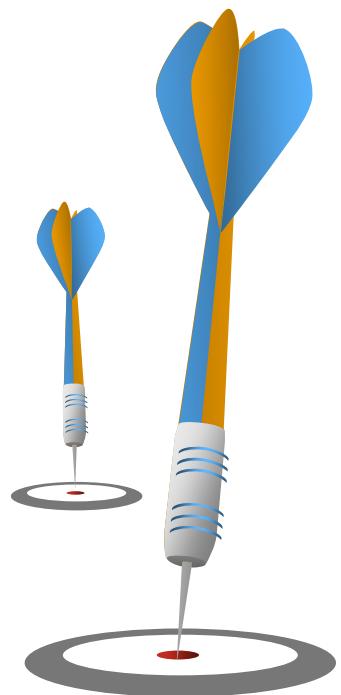
<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2757881>

Multiprofessional team



Take home messages

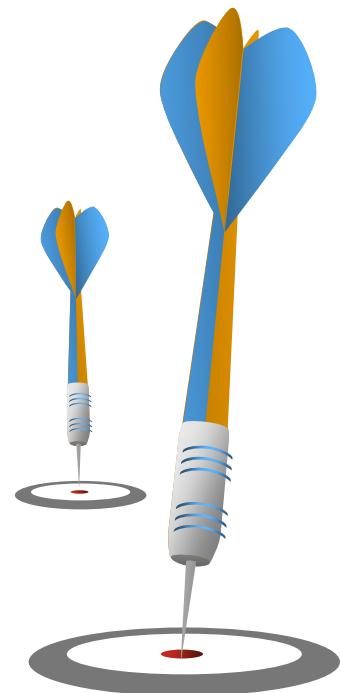
Early diagnosis and treatment of kidney damage



Take home messages

Early diagnosis and treatment of renal damage

Effective management to slow progression of CKD

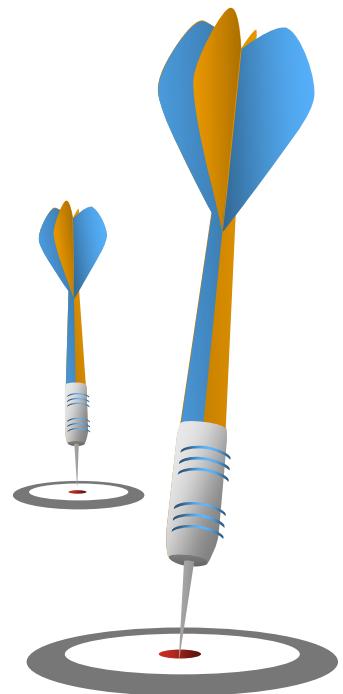


Take home messages

Early diagnosis and treatment of renal damage

Effective management to slow progression of CKD

Appropriate treatment of complications





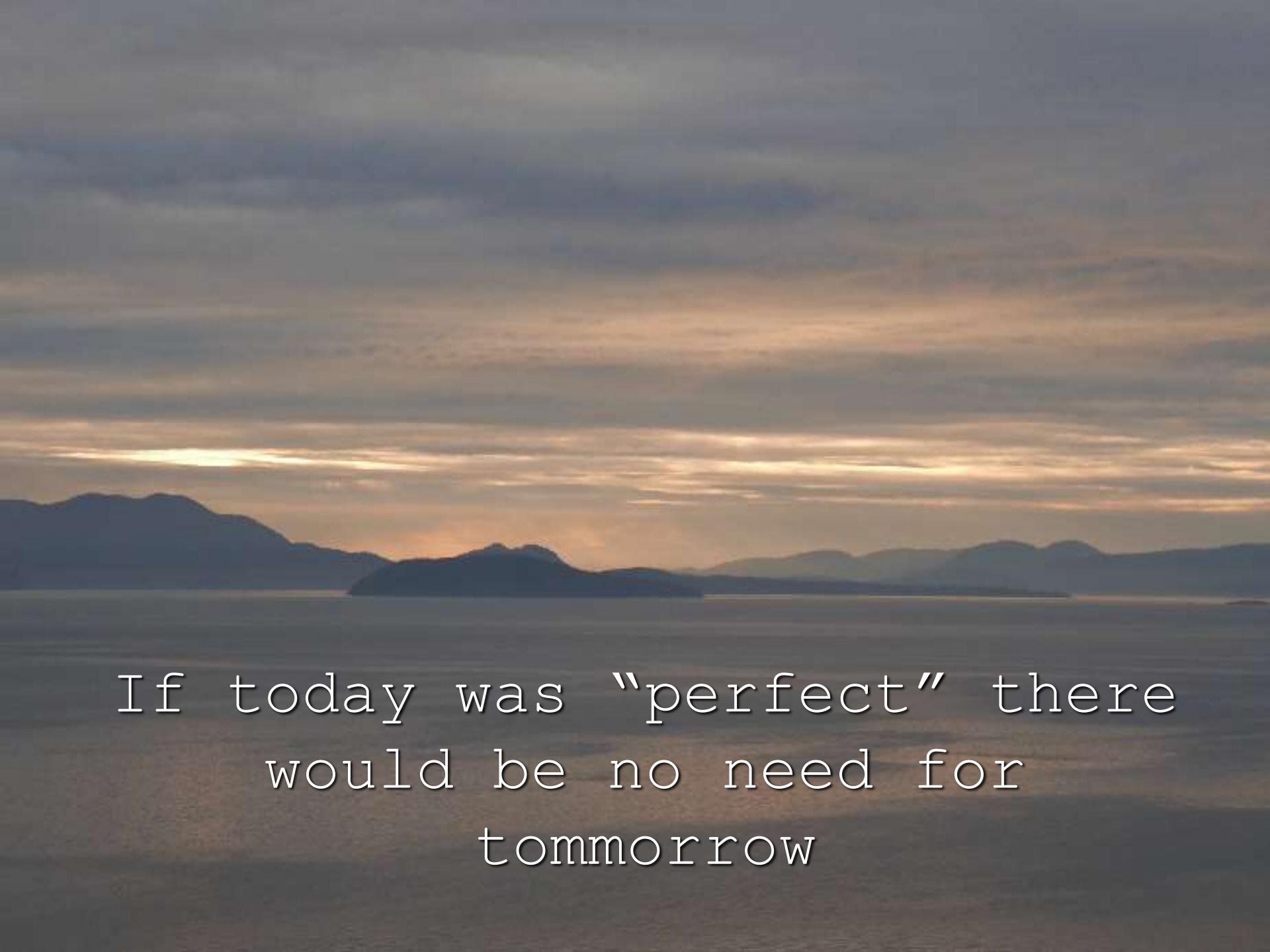
Χρονία νεφρική
νόσος

Management of children with CKD



The future

Today

A wide-angle photograph of a sunset or sunrise over a calm body of water. The sky is filled with horizontal clouds, transitioning from deep blue at the top to warm orange and yellow near the horizon. In the distance, a range of mountains is visible, their peaks dark against the bright sky. The overall atmosphere is peaceful and contemplative.

If today was “perfect” there
would be no need for
tomorrow