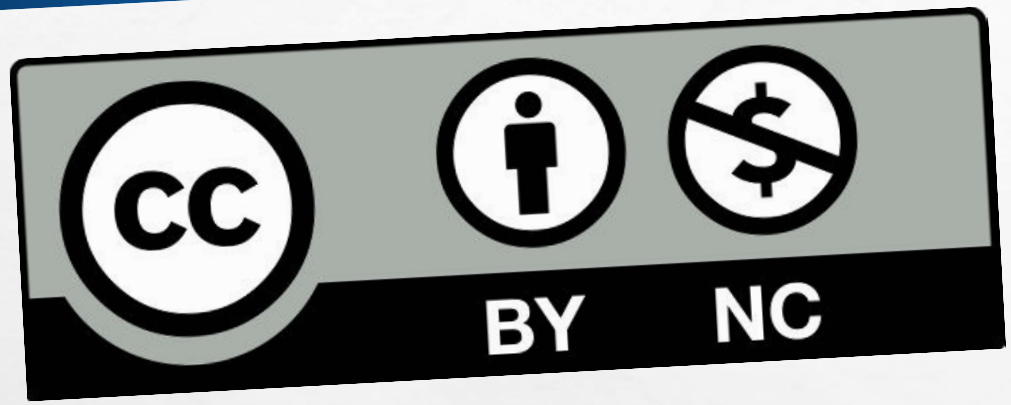


NUTRITION IN KIDNEY DISEASE

Ouppatham Supasyndh, M.D.

Nephrology & Clinical Nutrition; Phramongkutklao college of medicine

AIMS OF NUTRITION THERAPY

1) Maintain good nutrition status
2) Slow progression of the disease (chronic kidney disease)
3) Prevent disease recurrent (kidney stone)
4) Prevent metabolic (mineral& bone) and cardiovascular disorders

SCOPE

1) Chronic kidney disease
2) Nephrotic syndrome
3) Acute kidney injury
4) Kidney stone

CHRONIC KIDNEY DISEASE

A	-	Anemia & Albuminuria
B	-	Blood pressure
C	-	Calcium & Phosphate
D	-	Diet
E	-	Electrolyte
F	-	Fluid intake
G	-	Glucose
H	-	Heart

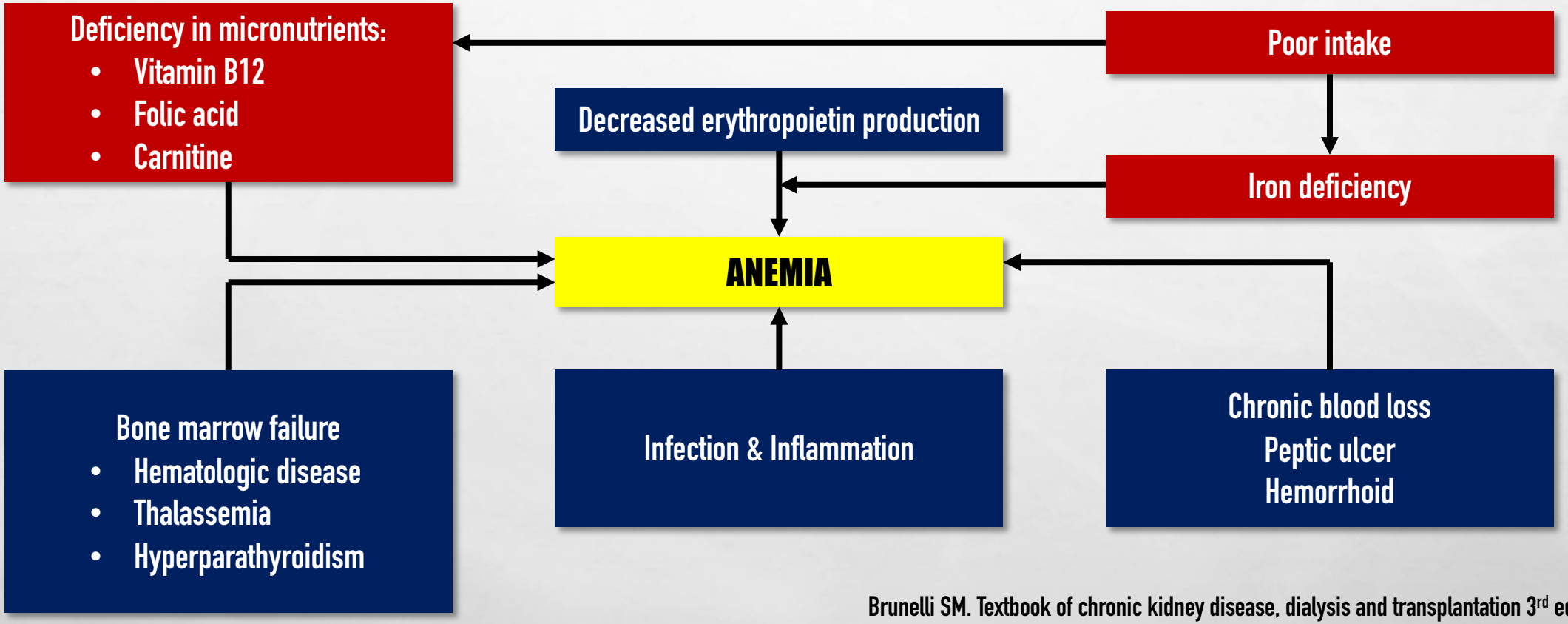
ANEMIA

- Normal Hemoglobin (Hb)
  - < 13.0 g/dL – Male
  - < 12.0 g/dL – Female
- Target Hb – KDIGO 2012
  - CKD not dialyze Hb ≥ 10, suggest ESA not be initiated
  - ESRD start ESA when HB 9–10 g/dL

KDIGO 2012 Clinical practice guideline for anemia in chronic kidney disease. Kidney Int 2012;2(4)

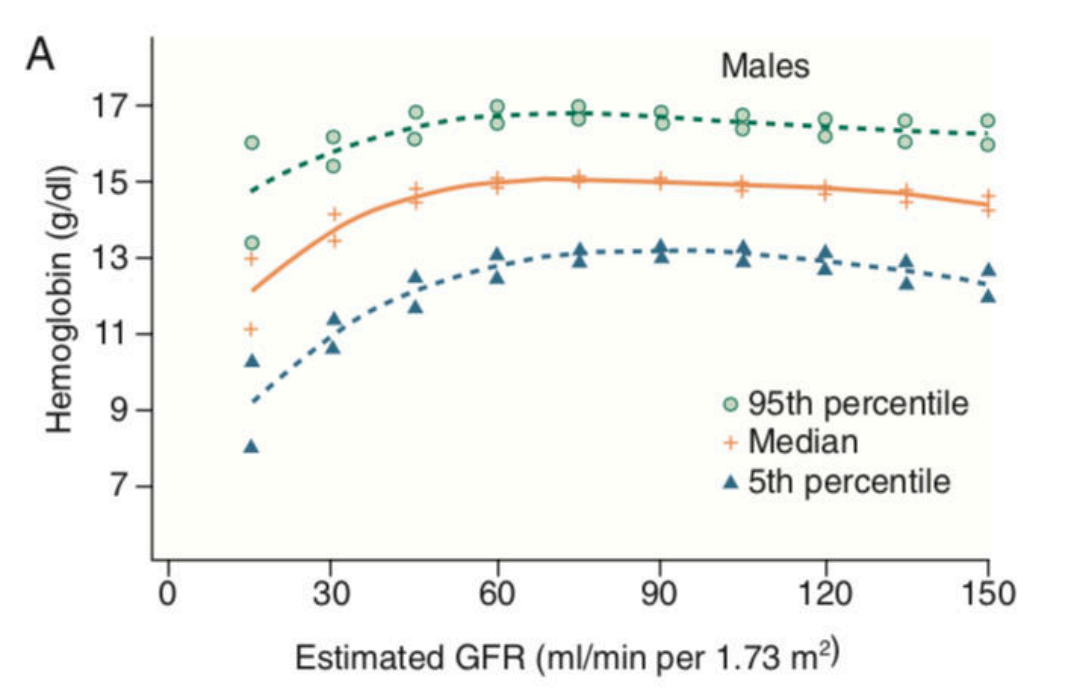
Chronic kidney disease

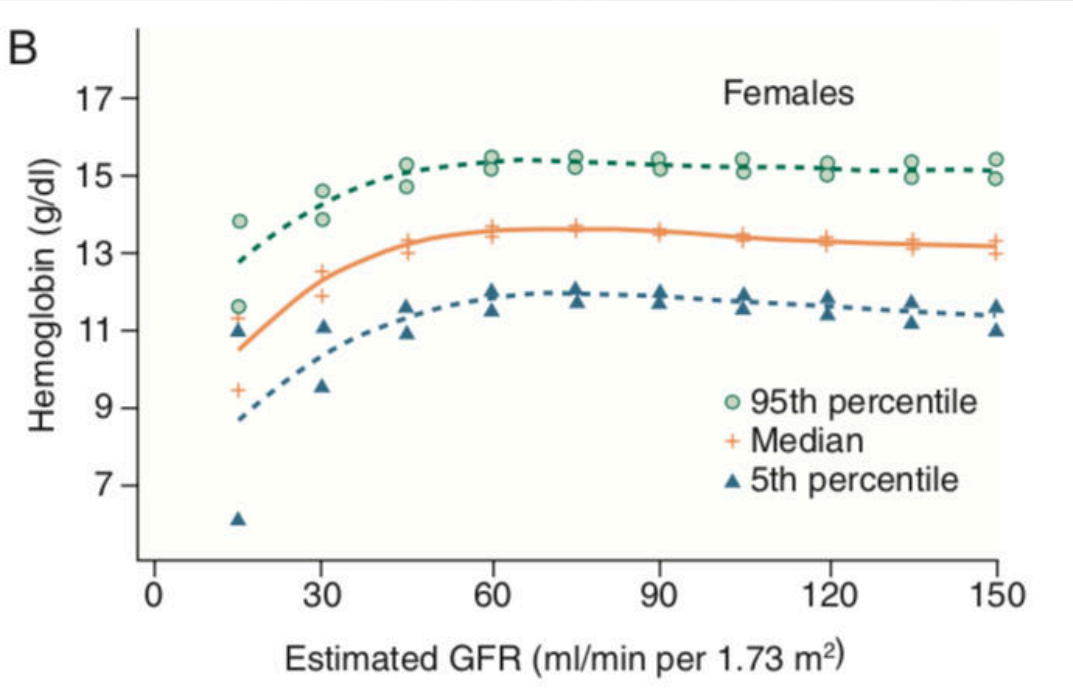
ANEMIA



Brunelli SM. Textbook of chronic kidney disease, dialysis and transplantation 3rd edition 2010; 88.

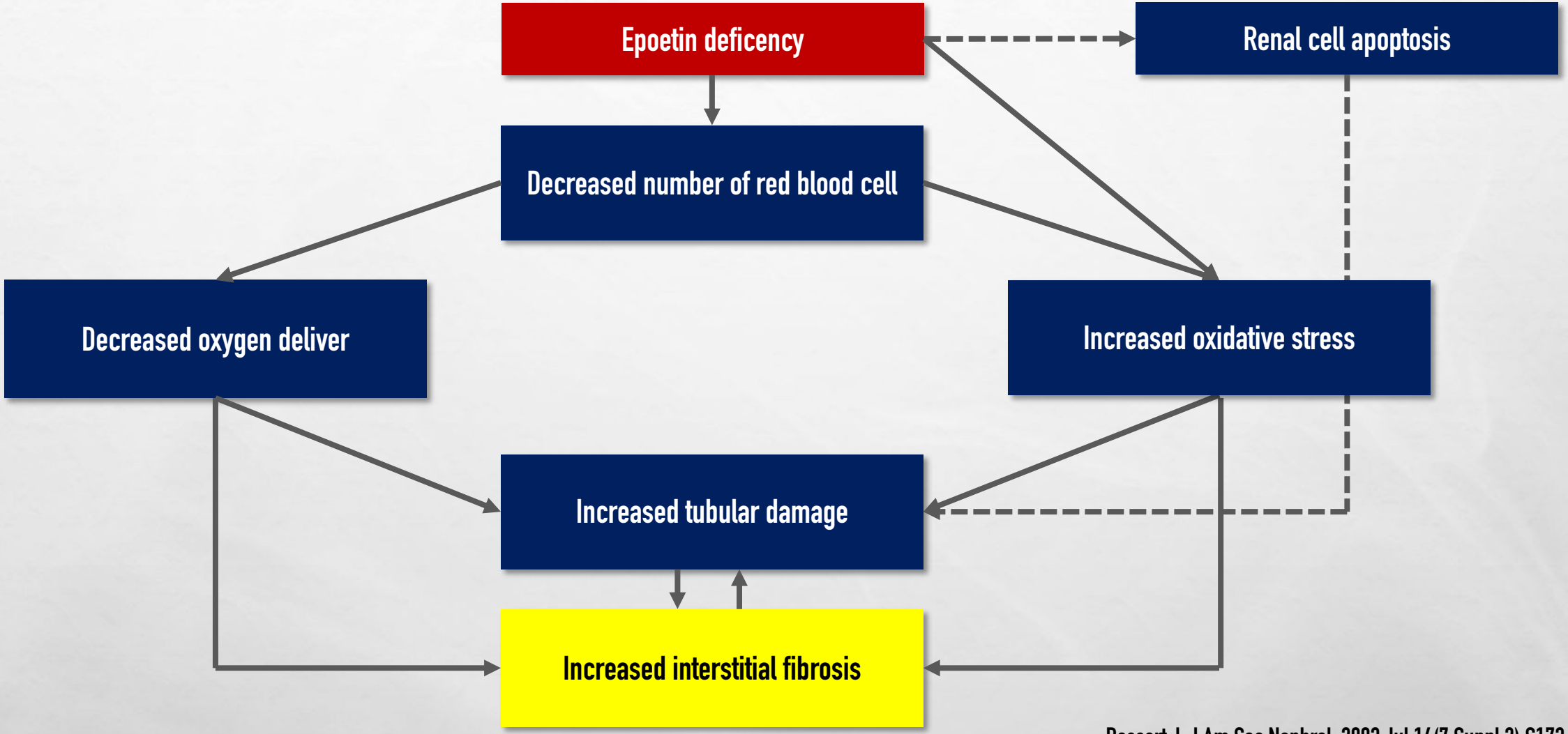
ANEMIA





Macdougall IC. Textbook of comprehensive clinical nephrology 6th edition 2019; 88.

Chronic kidney disease



Rossert J. J Am Soc Nephrol. 2003 Jul;14(7 Suppl 2):S173-7.

Chronic kidney disease

A – ALBUMINURIA/ PROTEINURIA

Measure	Categories		
	Normal to mildly increased (A1)	Moderately increased (A2)	Severely increased (A3)
AER (mg/24 hours)	<30	30–300	>300
PER (mg/24 hours)	<150	150–500	>500
ACR			
(mg/mmol)	<3	3–30	>30
(mg/g)	<30	30–300	>300
PCR			
(mg/mmol)	<15	15–50	>50
(mg/g)	<150	150–500	>500
Protein reagent strip	Negative to trace	Trace to +	+ or greater

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, Kidney Int 2013;3(1)

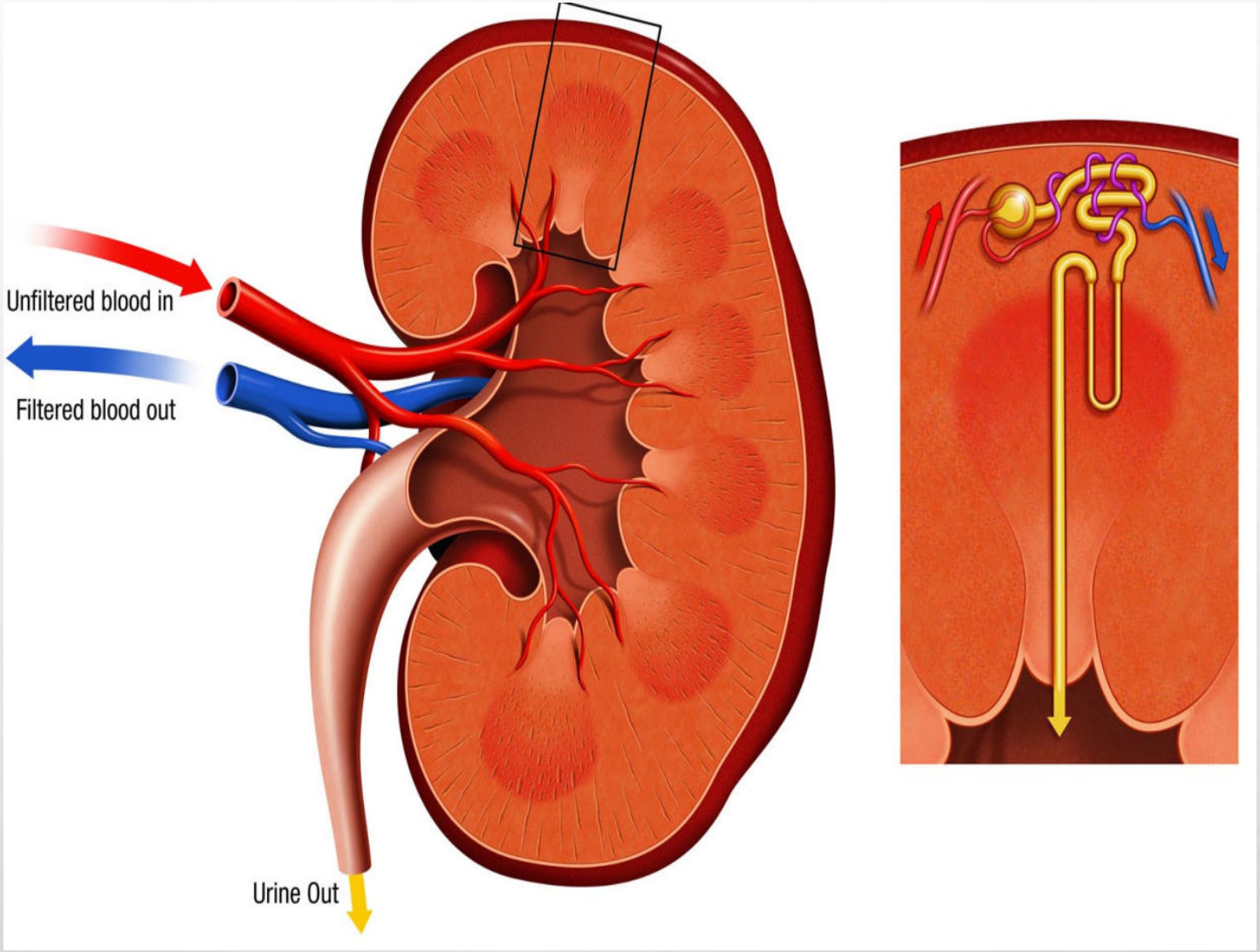
A – ALBUMINURIA/ PROTEINURIA

Albuminuria > 30 mg/ 24-hour

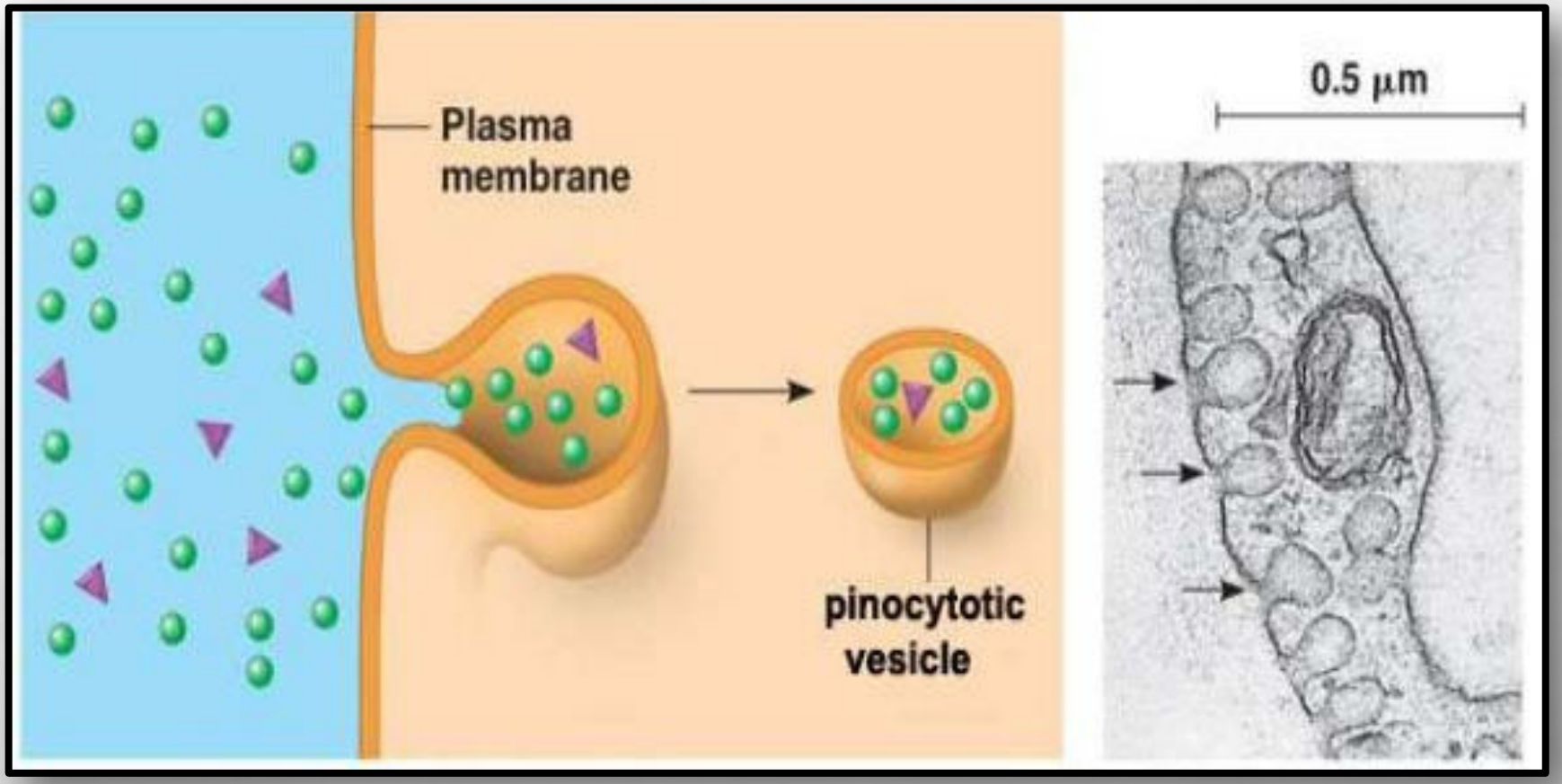
Proteinuria > 150 mg/ 24-hour
(including immunoglobulin, lysozyme, insulin etc.)

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, Kidney Int 2013;3(1)

Chronic kidney disease



Chronic kidney disease



Abbate MN. J Am Soc Nephrol. 2006. 17:2974–2984.

Chronic kidney disease

A – ALBUMINURIA/ PROTEINURIA

- Target
  - Non DM: < 500–1,000 mg/d in 6 months
  - DM: as low as possible without any side effect of treatment

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, Kidney Int 2013;3(1)

A – ALBUMINURIA/ PROTEINURIA

- Treatment
  - ACEIs or ARBs*
  - Aldosterone inhibitor
  - SGLT-2 inhibitor (in diabetic patient)
  - Protein restriction (decreased hyperfiltration)

B-BLOOD PRESSURE

Recommendation	
Age < 65 year-old:	< SBP 130/ 80
Age > 65 year-old:	SBP 140/ 90 mmHg

2020 Global Hypertension Guidelines. Hypertension 2020;75, 1134–1357

Chronic kidney disease

Hypertension staging	Other risk factors	Blood pressure grading			
		High normal SBP 130–139 DBP 85–89	Grade 1 SBP 140–159 DBP 90–99	Grade 2 SBP 160–179 DBP 100–109	Grade 3 SBP ≥ 180 DBP ≥ 110
Stage 1: Uncomplicated	No risk factor	Low risk	Low risk	Moderate risk	High risk
	1 or 2 risk factors	Low risk	Moderate risk	Moderate to high risk	High risk
	≥ 3 risk factors	Moderate risk	Moderate to high risk	High risk	High risk
Stage 2: Asymptomatic	CKD 3 or DM without organ damage	Moderate to high risk	High risk	High risk	High to very high risk
Stage 3: Established disease	Established CVD, CKD ≥ 4 DM without organ damage	Very high risk	Very high risk	Very high risk	Very high risk

2018 ESC/ESH Guidelines for the management of arterial hypertension. Eur Heart J (2018) 39, 3021–3104

Chronic kidney disease

Other risk factors	Blood pressure grading			
	High normal SBP 130–139 DBP 85–89	Grade 1 SBP 140–159 DBP 90–99	Grade 2 SBP ≥ 160 DBP 100–109	
No risk factor	Low	Low	Moderate	High
1 or 2 risk factors	Low	Moderate	High	
≥ 3 risk factors	Low	Moderate	High risk	
HMOD, CVD, CKD 3, DM	High risk	High risk	High risk	

2020 Global Hypertension Guidelines. Hypertension 2020;75, 1134–1357

Chronic kidney disease

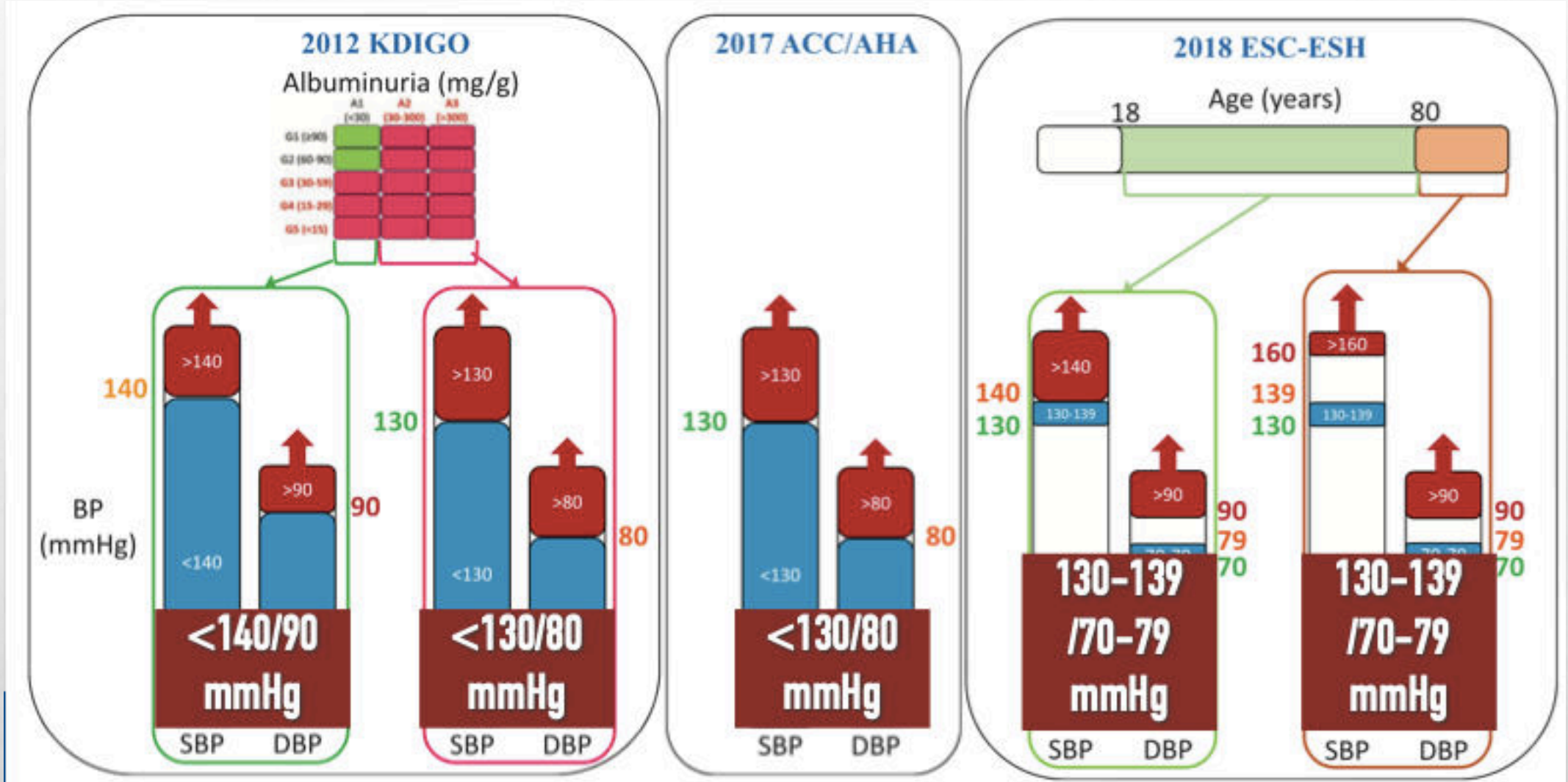
B-BLOOD PRESSURE

Recommendation	
Age < 65 year-old:	< SBP 130/ 80
Age > 65 year-old:	SBP 140/ 90 mmHg

2020 Global Hypertension Guidelines. Hypertension 2020;75, 1134–1357

Chronic kidney disease

THRESHOLD TO INITIATE ANTI-HTN IN CKD PATIENT



Castillo-Rodriguez E, et al. Clinical Kidney Journal, 2019: 6: 771-7.

LIFESTYLE MODIFICATIONS

Modification	Recommendation	Approximate Systolic BP Reduction (mm Hg)
Weight loss	Body mass index 18.5–24.9 kg/m^2	5–20 per 10-kg weight loss
DASH-type dietary patterns	Salt (Na 1.5-2 g/d),fruits, vegetables, and low-fat dairy products	8–14
Reduced salt intake	Reduce daily dietary sodium intake, ideally to 1.5 g/d sodium	2–8
Physical activity	Regular aerobic physical activity (at least 30 min/day, most days of the week)	4–9
Moderation of alcohol intake	2 drinks/day in men and 1 drink/day in women	2–4

Chronic kidney disease

DiPiro JT, Pharmacotherapy:A Pathophysiologic Approach, 7th Edition

คำแนะนำเกี่ยวกับเกลือ

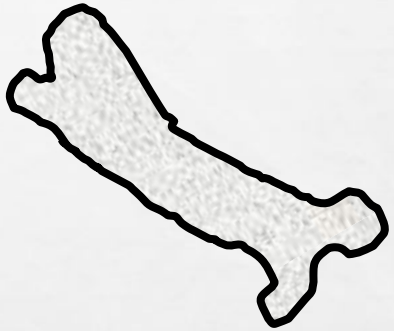
1) บริโภคเกลือ ไม่เกินวันละ 1 ช้อนชา ต่อ วัน
2) น้ำปลาไม่เกิน 1 ช้อนชา ต่อ มื้อ
3) เลี่ยงอาหารรสจัด ไม่กินส่วนที่เป็นน้ำ/ ซุป
4) เลี่ยงอาหารที่ผ่านการแปรรูป เก็บได้นาน
5) อาหารแห้ง หมักดอง ผงชูรส

Chronic kidney disease

C – CALCIUM & PHOSPHATE

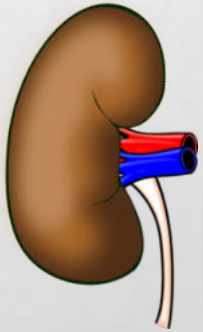
Consumption 800–1200 mg/day

Absorption 60–70%



Bone 85%

Extracellular 1%

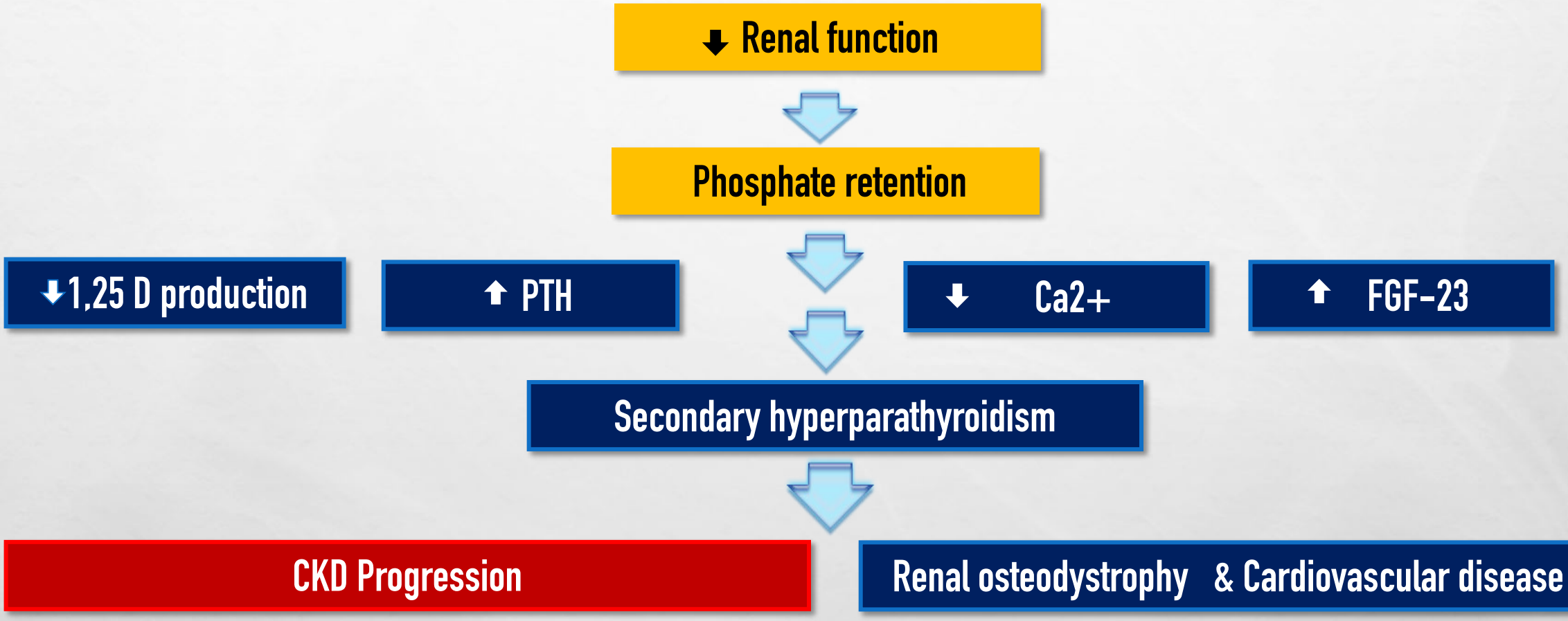


Urine: 800 mg/day

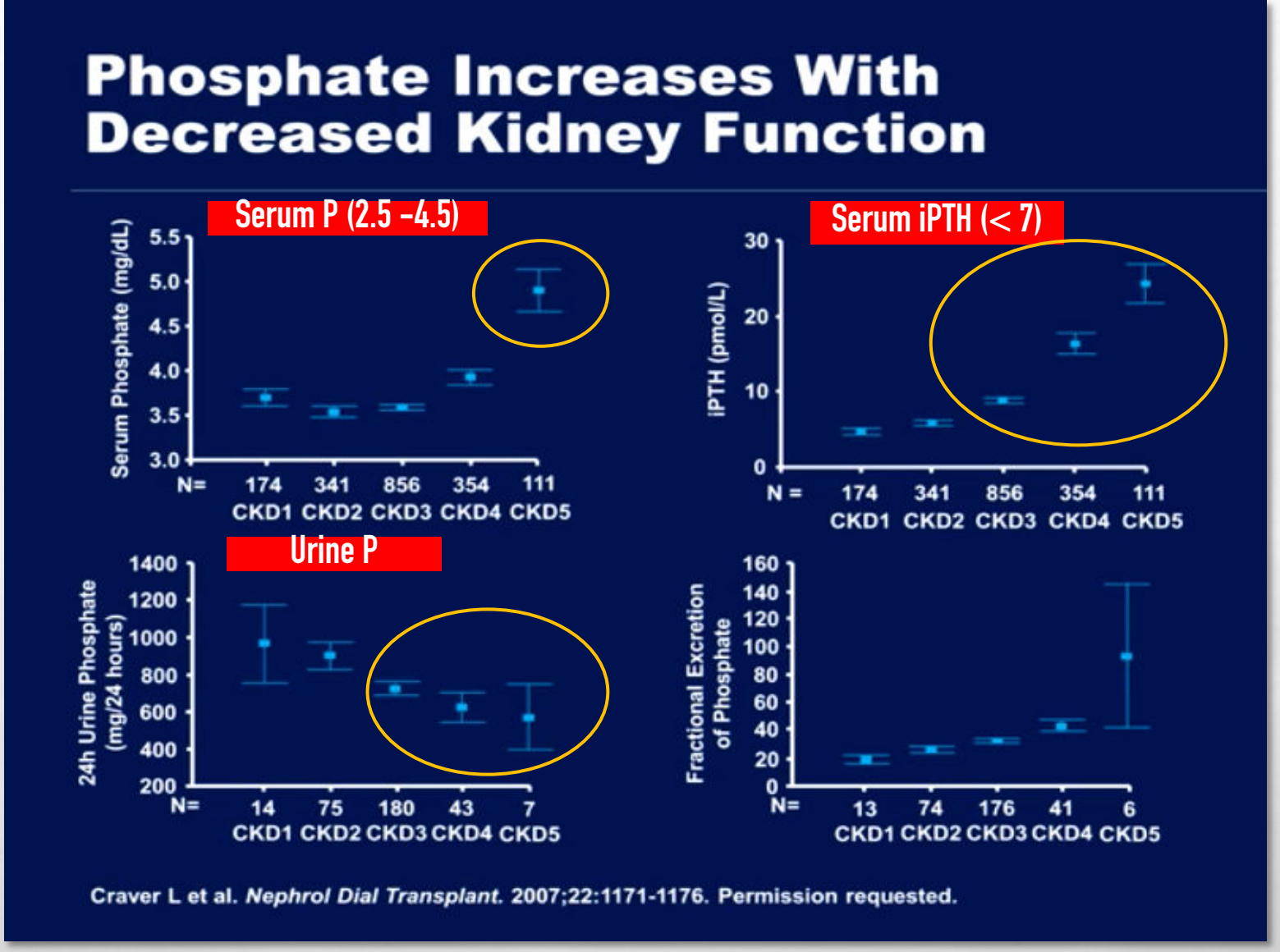
Feces: 200–400 mg/day

Chronic kidney disease

PATHWAY OF CKD- MBD



Chronic kidney disease



Chronic kidney disease

TARGET OF TREATMENT

	Stage of CKD		
	3 (GFR 30–59)	4 (GFR 15–29)	5 (GFR <15)
Serum Ca (mg/dL)	Normal*	Normal	Normal
Serum P (mg/dL)	Normal†	Normal	Near normal
iPTH (pg/dL)	Upper normal‡	Upper normal	2–9 x normal

Normal value of *serum calcium 9.0–10.2 mg/dL
†serum phsphate 2.7–4.6 mg/dL, ‡iPTH < 65 pg/mL

KDIGO 2012 Clinical Practice Guideline **Update for the Diagnosis, Evaluation, Prevention, and Treatment** CKD–MBD, Kidney Int 2017;3(1)

Chronic kidney disease

MANAGEMENT

- Restrict P diet (CKD stage 3)
- Phosphate in foods (mg P/ g Protein)
- Organic P: 70% absorb via the gut
- Inorganic P: 100% (additives)

P-TO-PROTEIN RATIO: < 5 MG

Egg white 1 large

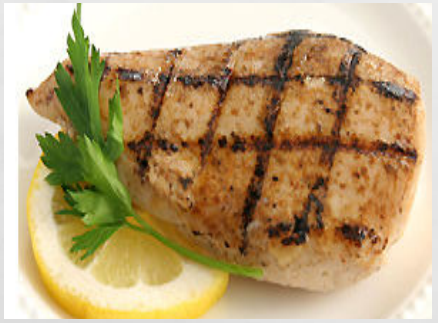
Pork rinds 30 g

Chronic kidney disease

P-TO-PROTEIN RATIO: 5 TO 10 MG/G

Beef 90 g

Tuna canned in water 90 g



Chicken breast ½ breast

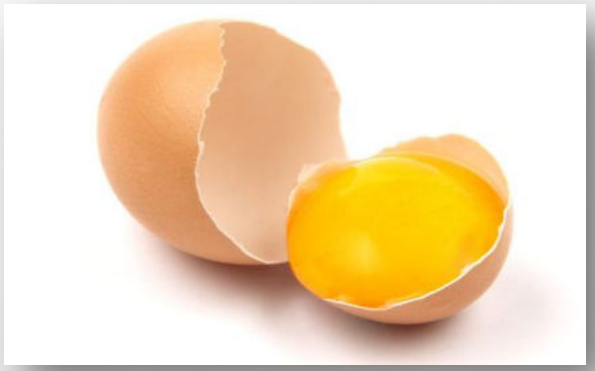
Pork sausage 2 serving

Chronic kidney disease

P-TO-PROTEIN RATIO: 15 TO 25 MG/G

Chicken liver 70 g

Kidney bean ½ Cup



Egg yolk 1 large

Cream cheese 1 Tbsp

Chronic kidney disease

P-TO-PROTEIN RATIO: >25 MG/G

Cashew 30 g

Sunflower seeds 3 tbsp

Biscuit 1 serving

Low fat milk 240 mL

Chronic kidney disease

D-DIET

Based on nitrogen balance studies,

- Minimum DPI for healthy adult is 0.6 g/kg
- Adding 0.33% safety margin (0.8 g/kg)

RDA of protein for a healthy adult is 0.6–0.8 g/ kg ideal BW

Kalantar-Zadehet al. BMC Nephrology(2016) 17:90

Chronic kidney disease

GUIDELINE SUMMARY

Guideline	Last updated	Target patient	Recommended (g/kg/day)	Comment
KDOQI Nutrition	2000	CKD IV	0.6–0.75	50% HBV
CARI	2005	CKD	≥ 0.75	50–66%HBV
British Renal Association	2010	CKD	0.75	
European Renal Care Association	2003	CKD	0.6–1.0 (>0.75 ,GFR>30)	< 0.5, need ketoamino acid
Canadian Society of Nephrology	2008	CKD	0.8–1.0	
KDIGO	2012	CKD IV	0.8, not over 1.3	
ISRNM	2013 (2019)	CKD	0.6–0.8	50% HBV

GUIDELINE SUMMARY

Guideline	Last updated	Target patient	Recommended (kcal/kg/day)
KDOQI Nutrition	2000	CKD Stage 4	30 –35 ; < 60 yrs < 30; > 60 yrs
CARI	2005	CKD	30–35
British Renal Association	2010	CKD	30–35
Canadian Society of Nephrology	2008	CKD	30–35
International Society of Renal Nutrition and Metabolism (ISRNM)	2013	CKD	30–35

Chronic kidney disease

SPENT GUIDELINE (ENDORSED BY NST)

- Energy 30–35 kcal/kg IDW/day
- Protein restriction
  - 0.6–0.8 g/kg IDW/day (CKD 3b–5)
  - 0.3–0.4 g/kg IDW/day + Keto-aminoacid (CKD 4–5)

Chronic kidney disease

GUIDELINE 3 PROTEIN & ENERGY INTAKE

ENERGY INTAKE

CKD 1-5D with metabolically stable

25-35 kcal/kg LBM/day (1C)

Based on

- Age
- Gender
- Physical activity
- BMI
- Stage of CKD
- Concurrent illness

GUIDELINE 3 PROTEIN & ENERGY INTAKE

PROTEIN INTAKE

CKD 3-5 with metabolically stable

Restricted protein intake with/without keto acid analogs

- Reduce risk of ESRD (1A)
- Reduce risk for death (1A)
- Improve QOL (1C)

GUIDELINE 3 PROTEIN & ENERGY INTAKE

PROTEIN INTAKE

- LPD 0.55 - 0.6 g/IBW/day
- VLPD 0.28-0.43 g /IBW/day with KAA to meet 0.55-0.6 g/kg/day

GUIDELINE 3 PROTEIN & ENERGY INTAKE

PROTEIN INTAKE

IBW (Ideal body weight)

- Male

50.0 kg + 2.3 kg every 2.5 cm over 152.4 cm

- Female

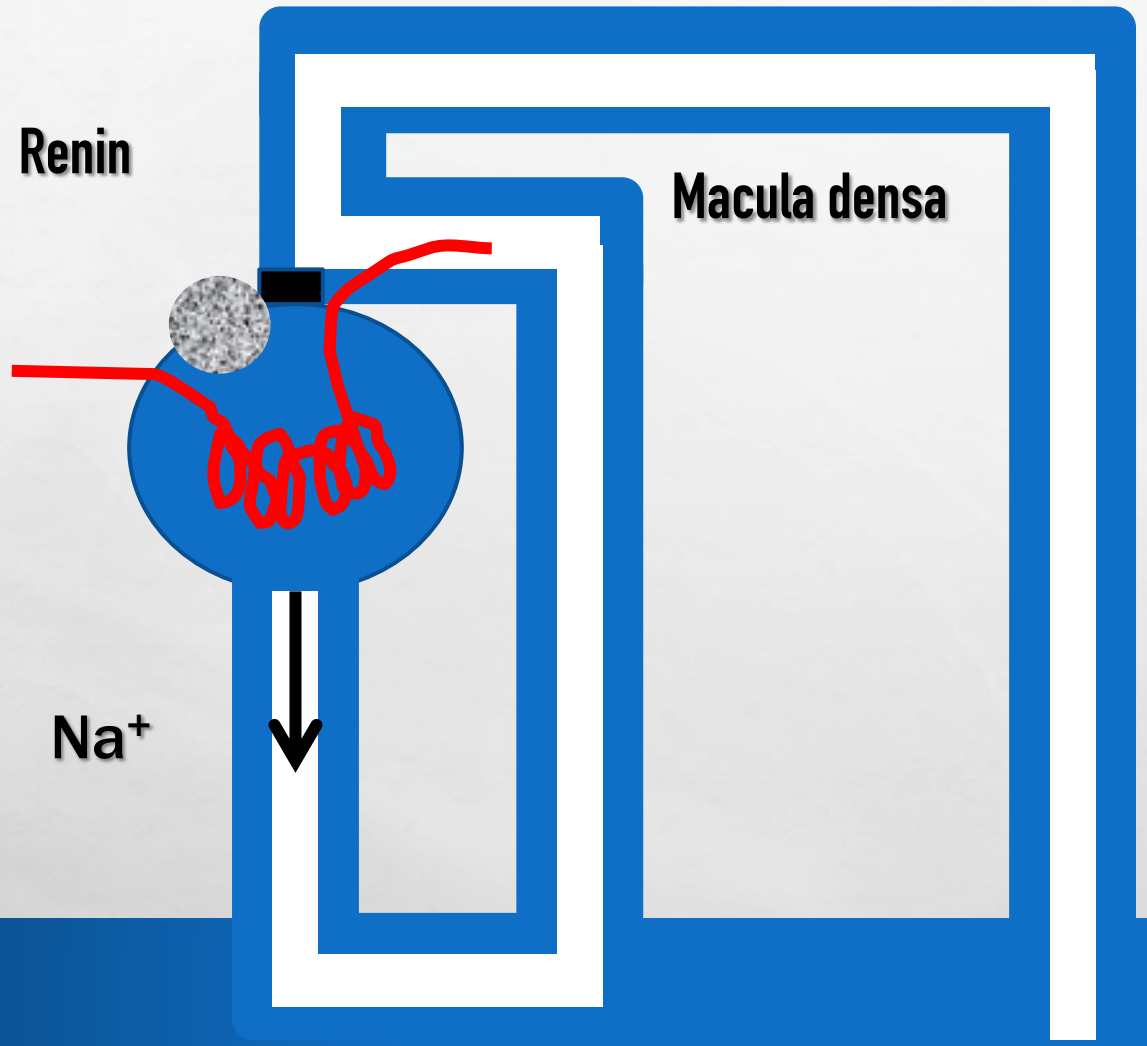
45.5 kg + 2.3 kg every 2.5 cm over 152.4 cm

MANAGEMENT GUIDELINES

	Hemodialysis		Peritoneal dialysis	
	Energy (Kcal/Kg IBW/day)	Protein (g/Kg IBW/day)	Energy (Kcal/Kg IBW/day)	Protein (g/Kg IBW/day)
SPENT 2019	30–35	1.0–1.4	30–35	1.2–1.3
KDOQI 2019	25–35	1.0–1.2	25–35	1.0–1.2

SPENT; Society of Parenteral and Enteral Nutrition, KDOQI: Kidney Disease Outcome and Quality Initiative

EFFECTS ON RENAL HEMODYNAMICS



Na delivery to macula densa in distal tubule

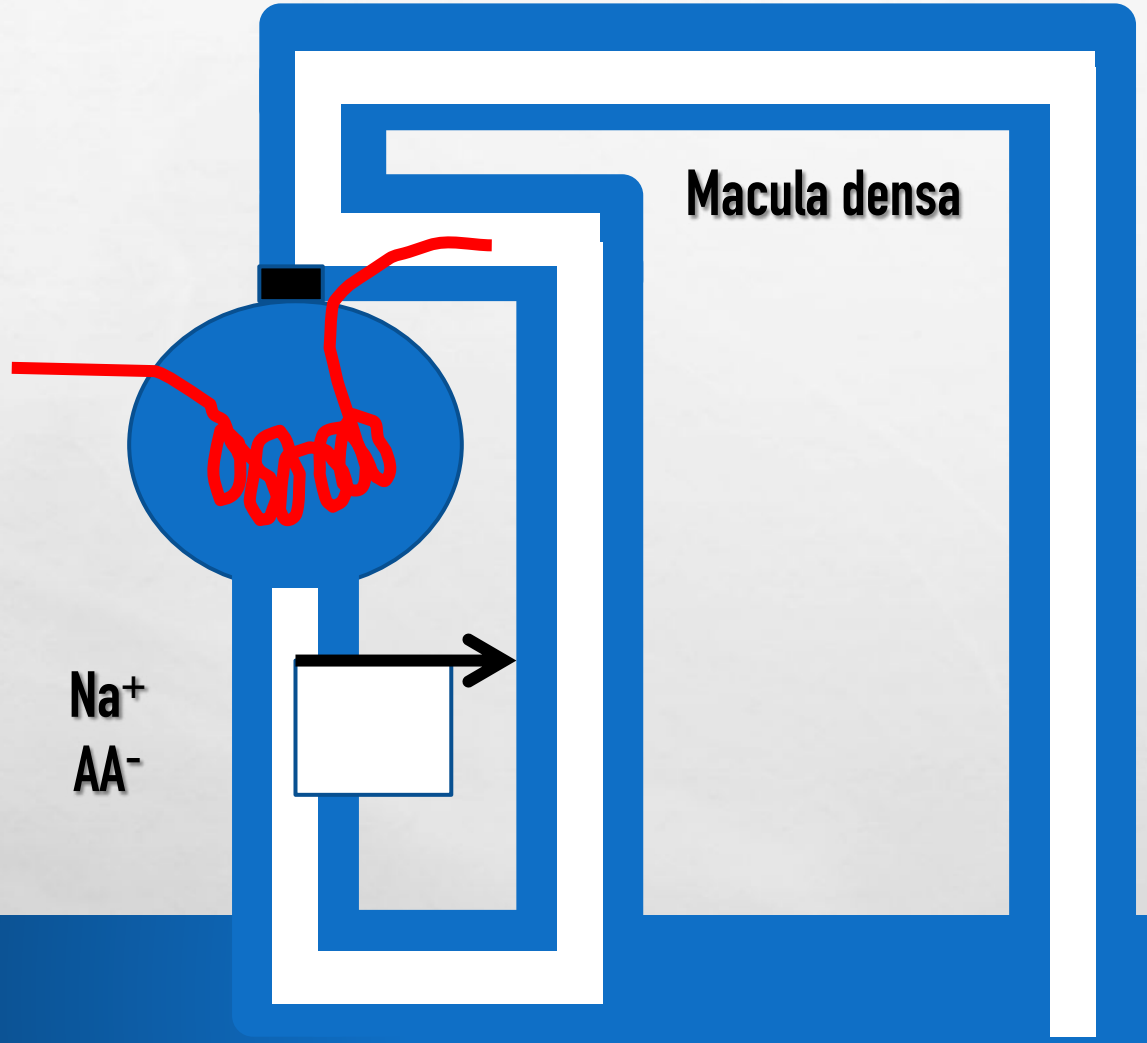
Renin release

Afferent vasoconstriction

Decrease GFR

Sallstrom J. Am J Physio Regul Integr Comp Physiol 2010; 299: 1263-1268

EFFECTS ON RENAL HEMODYNAMICS



- Na reabsorbtion with amino acids
- Renin not release
- Afferent vasoconstriction
- Increase GFR

Sallstrom J. Am J Physio Regul Integr Comp Physiol 2010; 299: 1263-1268

COUNSELING

Chronic kidney disease

MANAGEMENT

- Low protein diet

Prescribe 0.6–0.8 g/kg/day with HBV 50%

HBV = complete EAAs

LBV = missing one EAA

HBV = Egg white, meat and dairy products

= Soy protein

= Grains + beans (lysine)

70 Kcal

7 g protein

70 Kcal

2 g protein

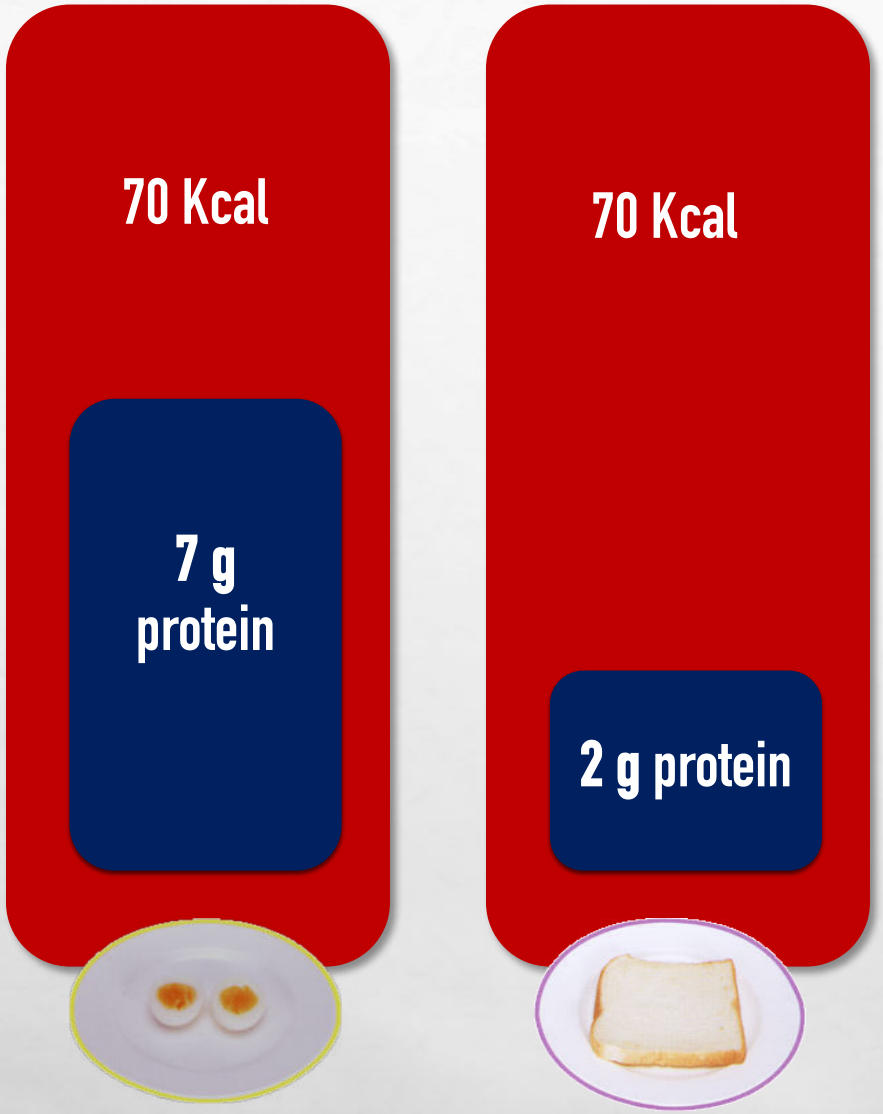
25 Kcal

1 g protein

70 Kcal

0.5 g protein

Chronic kidney disease



Chronic kidney disease

1.เนื้อสัตว์

- โปรตีน 7 กรัม
- พลังงาน 70 กิโลแคลอรี

เช่น

- เนื้อสัตว์ 2 ช้อนโต๊ะ
- ลูกชิ้น 4 ลูก
- ไข่ทั้งฟอง 1 ฟอง
- ไข่ขาว 2 ฟอง

2.ข้าวและแป้ง

- โปรตีน 2 กรัม
- พลังงาน 70 กิโลแคลอรี

ได้แก่

- ข้าวสวย 1 ทัพพี
- ข้าวต้ม 2 ทัพพี
- ก๋วยเตี๋ยว 1 ทัพพี
- ขนมปัง 1 แผ่น
- ข้าวเหนียว 3 ปั้น

PROTEIN COUNSELING

HBV (โปรตีนคุณภาพสูง)

- เนื้อสัตว์ 1.5 - 2 ช้อนอาหาร ทุก 10 กก.นน.ตัว
- โปรตีน 0.6 – 0.8 กรัม/ 1 กก/ วัน

ตัวอย่าง หนัก 60 กิโลกรัม (0.8 x 60 = 48 กรัม)

แนะนำ:

2 x 6 = 12 ช้อนอาหาร

2 ช้อนอาหาร ให้ 7 กรัมโปรตีน; 12 x 7/2 = 42 กรัม

Chronic kidney disease

CALORIES COUNSELING

เนื้อสัตว์ 12 ช้อนอาหาร
เนื้อสัตว์ 2 ช้อนอาหาร = 70 แคลอรี
ดังนั้นเนื้อสัตว์ 12 ช้อนอาหาร = 70x (12/2) = 420 แคลอรี

ผู้ป่วยต้องการ 60 kg x 30 Kcal = 1,800 แคลอรี
พลังงานส่วนที่เหลือ จึงควรได้จาก แป้ง ข้าว ผลไม้ น้ำมันพืช
หรือใช้ แป้งปลอดโปรตีน

Chronic kidney disease

แป้งปลอดโปรตีน

MONITORING

Daily protein intake (DPI) (g/day) .... (1)

= daily urea appearance x 6.25

Urea appearance .... (2)

= 24-hr urine urea nitrogen(N) + Non urine N

Non urine nitrogen = 0.031 x BW (kg) .... (3)

DPI = 24-hr urine N + 0.031 x BW] x 6.25

KIDNEY INJURY FROM HYPERFILTRATION

High protein intake

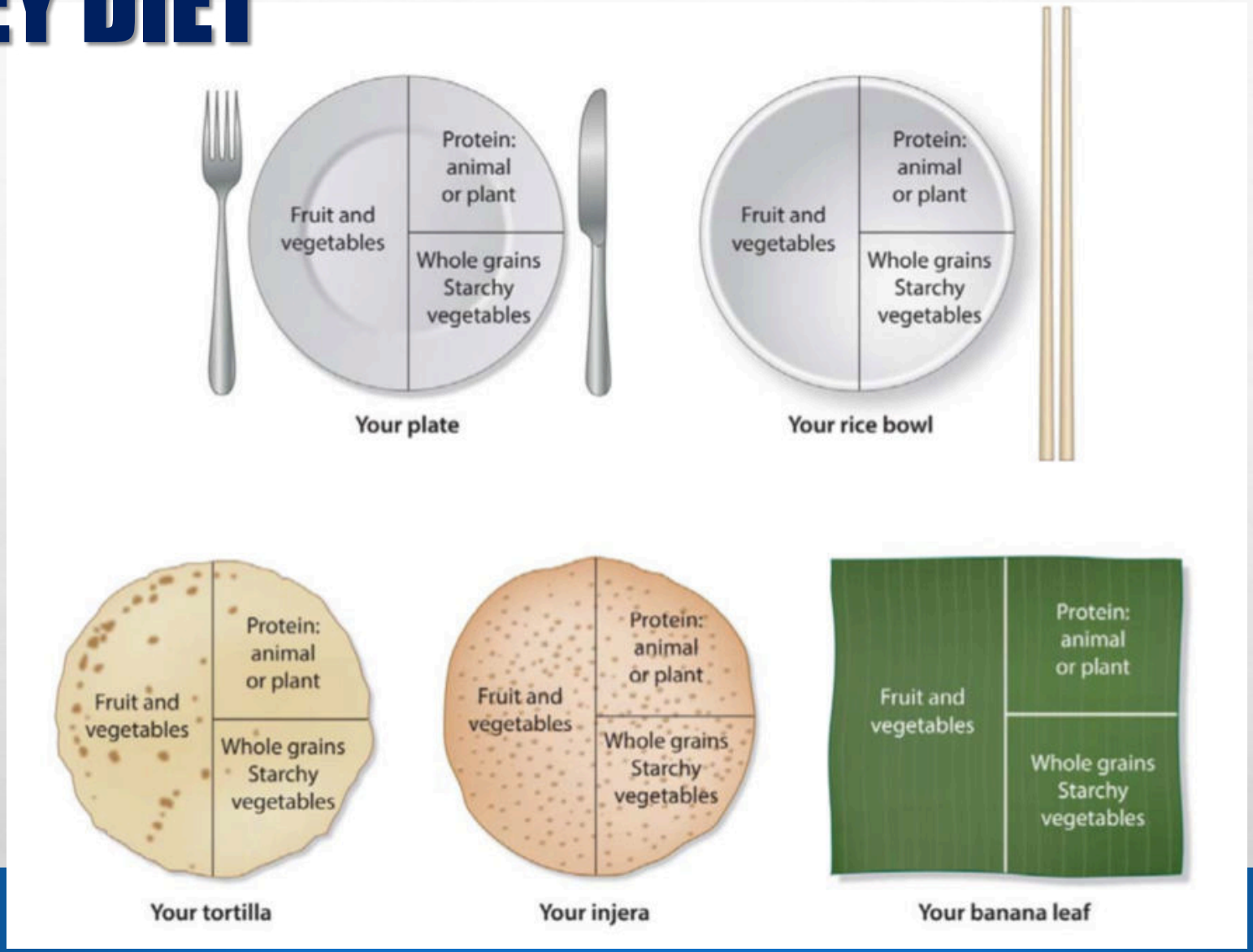
Glomerular hyperfiltration

Proteinuria

Glomerulosclerosis & Tubular injury

Chronic kidney disease

KIDNEY DIET



KDIGO CLINICAL PRACTICE GUIDELINE ON DIABETES MANAGEMENT IN CKD 2020: draft

E – ELECTROLYTE

- Target

1. Normal serum K
2. Serum bicarbonate 22–24 mEq/L

Chronic kidney disease

KDIGO guideline 2012

POTASSIUM

1. **Exclude medications: ACEIs, Beta blocker**
2. **Avoid high K diet**
   - ผักใบเขียวสด เช่น ผักคะน้า ผักกวางตุ้ง บรอคโคลี่ ดอกกะหล่ำ ยอดฟักแม้ว ใบแค ใบคื่นช่าย
   - พืชหัว เช่น มันเทศ เผือก มันฝรั่ง ฟักทอง
   - ผลไม้ที่มีรสหวานเนื้อนุ่ม เช่น กล้วย กล้วยตาก ฝรั่ง ขนุน ทุเรียน น้อยหน่า กระท้อน ลำไย ลูกพลับ ลูกพรุน ลูกเกด มะม่วง มะเฟือง มะปราง มะขามหวาน แคนตาลูป
   - น้ำผลไม้ เช่น น้ำมะพร้าว น้ำส้ม น้ำแครอท

Chronic kidney disease

Chronic kidney disease

Chronic kidney disease

F – FLUID

Water requirement is the amount necessary to

- balance the insensible losses
- maintain a solute load

Grandjean A. Water Requirements, Impinging Factors, and Recommended Intakes . WHO 2004

F – FLUID

If daily diet = 600 mOsm

Healthy kidney = 500-1,200 mOsm/L (Urine 500 ml/day)

Failed kidney = 300 mOsm/L (Urine 2,000 ml/day)

METHODS FOR ESTIMATING DAILY FLUID REQUIREMENT

Using Age

- Ages 55–65: 30 ml/kg/day
- Ages > 65: 25 ml/kg/day

Using caloric intake

- 1–1.5 ml/ kcal/day

Chronic kidney disease

FLUID THERAPY

RDA.USA 1-1.5 ml/Kcal/Day

- 30–45 ml/Kg/day
- 60 Kg – 8 glasses of water

Grandjean A. Water Requirements, Impinging Factors, and Recommended Intakes . WHO 2004

Water intake (ml) = Urine output + 500

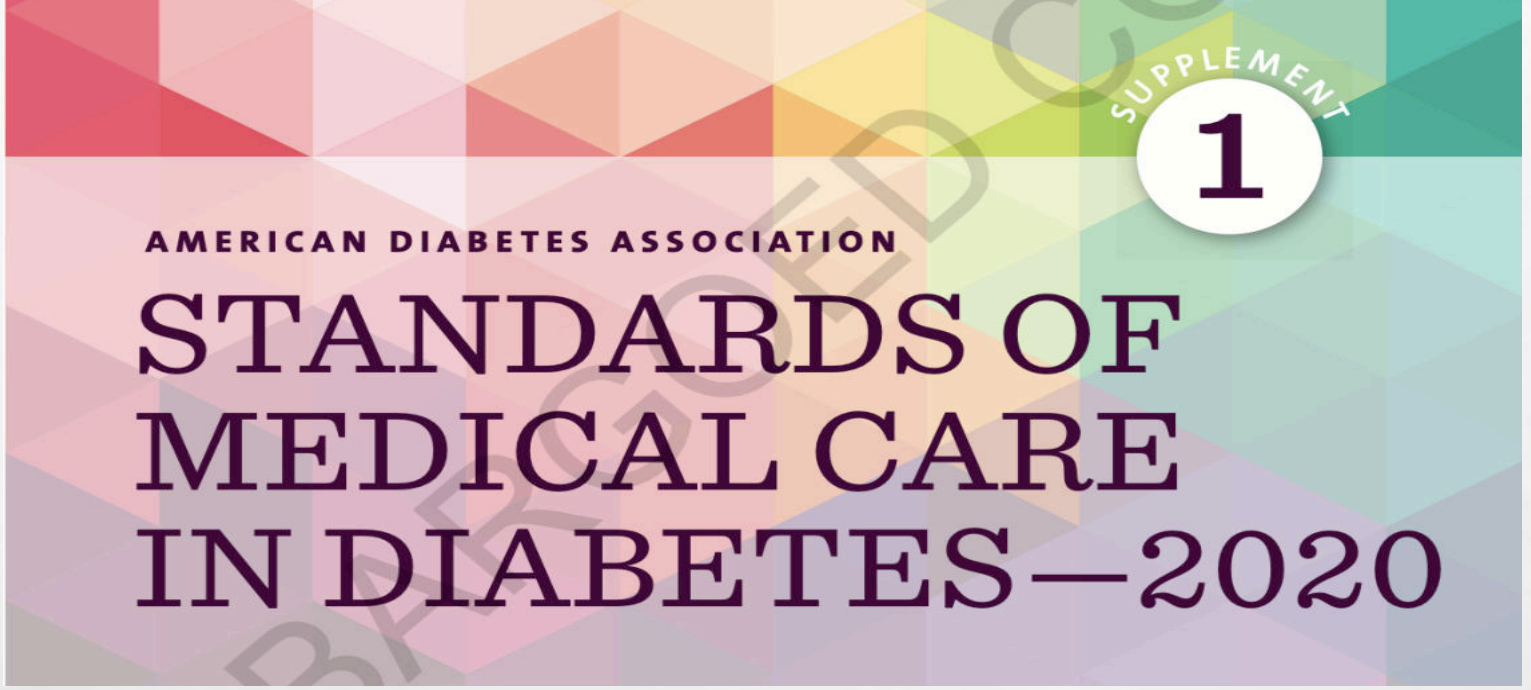
Chronic kidney disease

G- GLUCOSE

< 6.5%	HbA1c	< 8.0%
CKD G1	Severity of CKD	CKD G5
Few	Micro- and macrovascular complications/comorbidities	Many
Young	Age	Old
Long	Life expectancy	Short
Present	Resources for hypoglycemia management	Absent
Many	Hypoglycemia awareness	Few
Low	Propensity of treatment to cause hypoglycemia	High

KDIGO CLINICAL PRACTICE GUIDELINE ON DIABETES MANAGEMENT IN CKD 2020: draft

Chronic kidney disease



HA1C	<7%
Preprandial capillary plasma glucose	80–130 mg/dL
Peak postprandial capillary plasma glucose	<180 mg/dL

G- GLUCOSE

- Glycemic control

Target HbA1C 6.5 ~ 8% DM with non dialysis dependent CKD(1C)

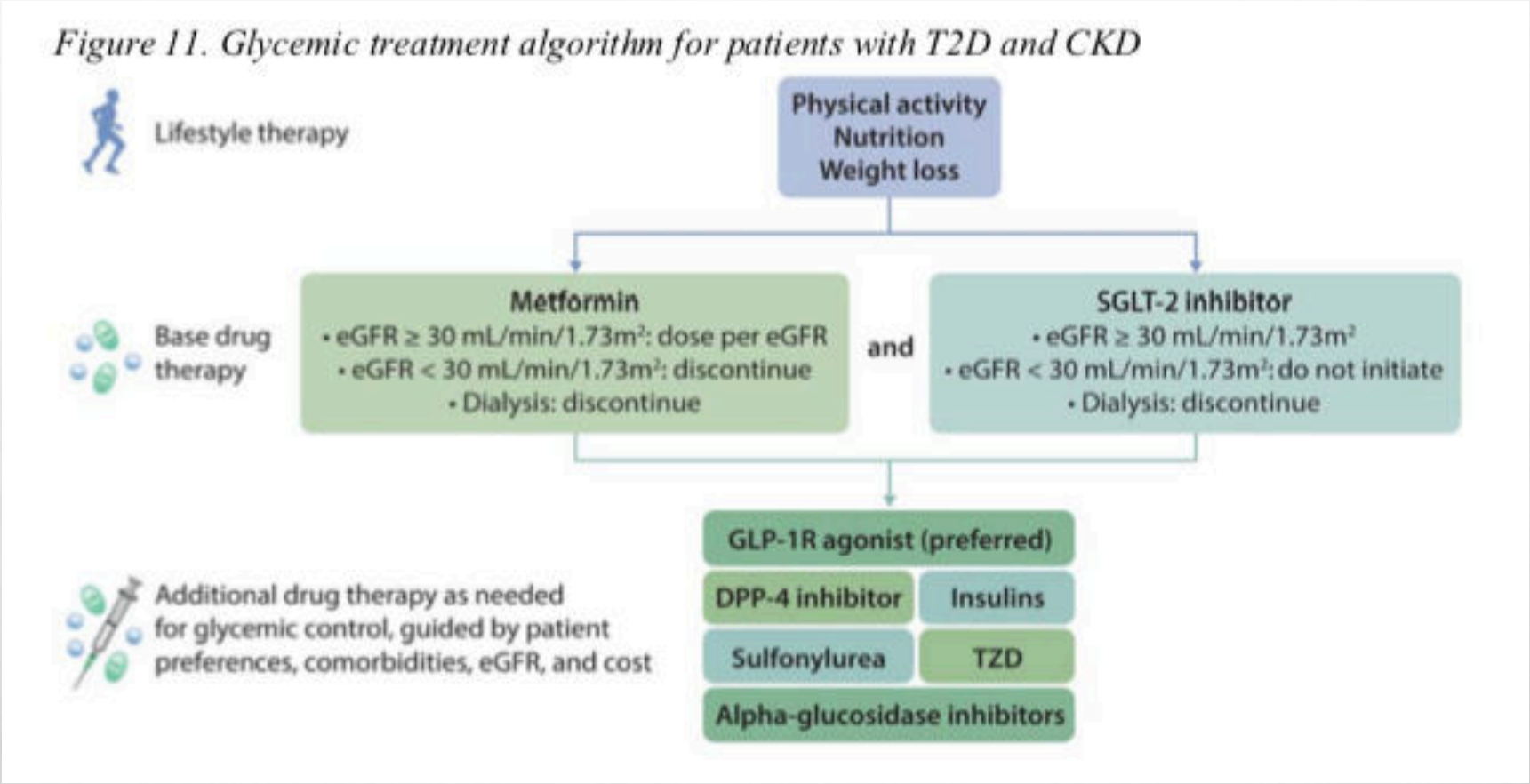
- Not below 7% in patient with the risk of hypoglycemia (1B)*
- Above 7% (not more than 8%) in patient with multiple comorbidities (2C)*

*KDIGO 2019 Clinical Practice Guideline on Diabetes DRAFT)

*KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, Kidney Int 2013;3(1)

Chronic kidney disease

G- GLUCOSE



*KDIGO 2019 Clinical Practice Guideline on Diabetes DRAFT)

G-GLUCOSE

Table 2. Frequency of HbA1c and use of CGMI in CKD

Population	Measure	Frequency of HbA1c	Reliability	CGMI
CKD G1–G3b	Yes	• Twice per year • Up to four times per year if not achieving target or change in therapy	High	Occasionally useful
CKD G4–G5 including treatment by dialysis or kidney transplant	Yes	• Twice per year • Up to four times per year if not achieving target or change in therapy	Low	Commonly useful

CGMI = continuous glucose management indicator, HbA1c = hemoglobin A1c

*KDIGO 2019 Clinical Practice Guideline on Diabetes DRAFT)

H – HEART (LIPID)

CV risk according to stage of CKD

Stage	CV Risk, ODD ratio
1	Depending on degree of proteinuria
2	1.5
3	2 – 4
4	4 –10
5	10 – 50
ESRD	20 – 1000

Chronic kidney disease

Schiffrin EL, et al. Circulation. 2007;116:85–97.

H – HEART (LIPID)

- Lipid metabolism in CKD patients: High TG, Low HDL and Normal-low LDL (high oxidized LDL)
- Statins decrease proteinuria and +/- improved GFR

H – HEART (LIPID)

KDIGO 2013 guideline

- CKD = CVS equivalent (Age> 50 yr)
- SHARP study: CKD (GFR<60) prefer statin or statin with ezetimide
- CKD patients should be based on regimens and statin doses that have been shown to be beneficial in RCT trial
- Treat according to a “fire-and-forget” strategy

LIPIDS

Very-high-risk	People with any of the following: Documented ASCVD, either clinical or unequivocal on imaging. Documented ASCVD includes previous ACS (MI or unstable angina), stable angina, coronary revascularization (PCI, CABG, and other arterial revascularization procedures), stroke and TIA, and peripheral arterial disease. Unequivocally documented ASCVD on imaging includes those findings that are known to be predictive of clinical events, such as significant plaque on coronary angiography or CT scan (multivessel coronary disease with two major epicardial arteries having >50% stenosis), or on carotid ultrasound. DM with target organ damage,[a] or at least three major risk factors, or early onset of T1DM of long duration (>20 years). Severe CKD (eGFR <30 mL/min/1.73 m^2). A calculated SCORE ≥10% for 10-year risk of fatal CVD. FH with ASCVD or with another major risk factor.

European Heart Journal (2020) 41, 111–188.

High-risk	People with: Markedly elevated single risk factors, in particular TC >8 mmol/L (>310 mg/dL), LDL-C >4.9 mmol/L (>190 mg/dL), or BP ≥180/110 mmHg. Patients with FH without other major risk factors. Patients with DM without target organ damage,[a] with DM duration ≥10 years or another additional risk factor. Moderate CKD (eGFR 30–59 mL/min/1.73 m^2). A calculated SCORE ≥5% and <10% for 10-year risk of fatal CVD.
Moderate-risk	Young patients (T1DM <35 years; T2DM <50 years) with DM duration <10 years, without other risk factors. Calculated SCORE ≥1 % and <5% for 10-year risk of fatal CVD.
Low-risk	Calculated SCORE <1% for 10-year risk of fatal CVD.

European Heart Journal (2020) 41, 111–188.

Recommendations	Class[a]	Level[b]
In secondary prevention for patients at very-high risk,[c] an LDL-C reduction of ≥50% from baseline[d] and an LDL-C goal of <1.4 mmol/L (<55 mg/dL) are recommended.[33–35,119,120]	I	A
In primary prevention for individuals at very-high risk but without FH,[c] an LDL-C reduction of ≥50% from baseline[d] and an LDL-C goal of <1.4 mmol/L (<55 mg/dL) are recommended.[34–36]	I	C
In primary prevention for individuals with FH at very-high risk, an LDL-C reduction of ≥50% from baseline and an LDL-C goal of <1.4 mmol/L (<55 mg/dL) should be considered.	IIa	C
For patients with ASCVD who experience a second vascular event within 2 years (not necessarily of the same type as the first event) while taking maximally tolerated statin-based therapy, an LDL-C goal of <1.0 mmol/L (<40 mg/dL) may be considered.[119,120]	IIb	B
In patients at high risk,[c] an LDL-C reduction of ≥50% from baseline[d] and an LDL-C goal of <1.8 mmol/L (<70 mg/dL) are recommended.[34,35]	I	A
In individuals at moderate risk,[c] an LDL-C goal of <2.6 mmol/L (<100 mg/dL) should be considered.[34]	IIa	A
In individuals at low risk,[c] an LDL-C goal <3.0 mmol/L (<116 mg/dL) may be considered.[36]	IIb	A

European Heart Journal (2020) 41, 111–188.

Recommendations	Class[a]	Level[b]
Treatment with statins is recommended for older people with ASCVD in the same way as for younger patients.[217]	I	A
Treatment with statins is recommended for primary prevention, according to the level of risk, in older people aged ≤75 years.[217]	I	A
Initiation of statin treatment for primary prevention in older people aged >75 years may be considered, if at high-risk or above.[217]	IIb	B
It is recommended that the statin is started at a low dose if there is significant renal impairment and/or the potential for drug interactions, and then titrated upwards to achieve LDL-C treatment goals.	I	C

ASCVD = atherosclerotic cardiovascular disease; LDL-C = low-density lipoprotein cholesterol.
[a]Class of recommendation.
[b]Level of evidence.

European Heart Journal (2020) 41, 111–188.

H – HEART (LIPID)

(1) Very high risk: ASCVD, score>10% and CKD stage 4/5

- High-intensity statin +/- ezetimide, LDL reduction>50% and LDL<55 mg/dL

(2) High risk: score 5-10% and CKD stage 3

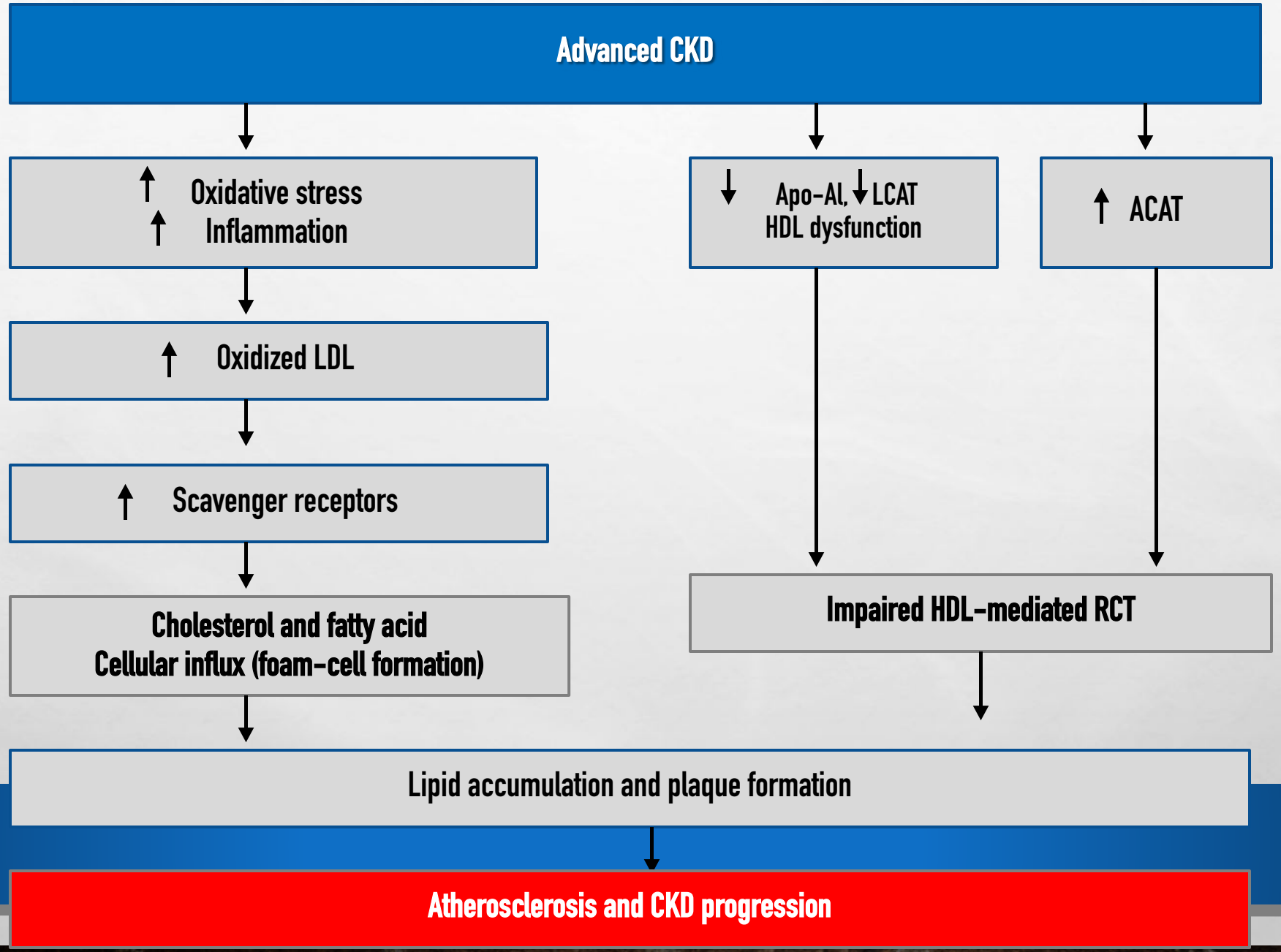
- High-intensity statin +/- ezetimide and LDL reduction>50% and LDL<70 mg/dL

(3) Moderate risk: score 1-5%

- Statin therapy +/- ezetimide if statin can not tolerate and LDL<100 mg/dL

(4) Low risk: score <1% and keep LDL< 126 mg/dL

Chronic kidney disease


Advanced CKD
↑ Oxidative stress
↑ Inflammation
↑ Oxidized LDL
↑ Scavenger receptors
Cholesterol and fatty acid
Cellular influx (foam-cell formation)
↓ Apo-AI, ↓ LCAT
HDL dysfunction
↑ ACAT
Impaired HDL-mediated RCT
Lipid accumulation and plaque formation
Atherosclerosis and CKD progression

FIRE AND FORGET

4. Dialysis patient: statin not be initiated

5. Dialysis patient: already used statin, be continued

KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, Kidney Int 2013;3(1)

ACUTE KIDNEY INJURY

1. Energy: 25–35 kcal/kg IBW/day
2. Protein: Non catabolic patient; 0.8–1 g/kg IBW/day

   Catabolic patient without dialysis; 1.2–1.4 g/kg IBW/day

   With dialysis; 1–1.5 g/kg IBW/day

   With CRRT; 1.5–2.5 g/kg IBW/day

SPENT 2018: Clinical Practice Recommendation for Nutritional Management in Adult Kidney Patients .

	Extent of catabolism		
	Mild	Moderate	Severe
Excess urea appearance (above N intake)	> 5 g	5-10 g	> 10 g
Clinical setting (examples)	Drug toxicity	Elective surgery ± infection	Severe injury or sepsis, ARDS, MODS
Mortality	20%	60%	> 80%
Dialysis/ hemofitration: frequency	Rare	As needed	Frequent
Route of nutrient administration	Oral	Enteral and/or parenteral	Enteral and/or parenteral
Energy recommendations (kcal/kg BW/day)	20-25	20-30	25-35
Energy substrates	Glucose	Glucose + fat	Glucose + fat
Glucose (g/kg BW/day)	3.0-5.0	3.0-5.0	3.0-5.0
Fat (g/kg/BW/day)	-	0.6-1.0	0.8-1.2
Amino acids/protein (g/kg/day)	0.6-1.0 EAA (+NEAA)	1.0-1.4 EAA + NEAA	1.2-1.5 (1.7) EAA + NEAA
Nutrients used; Oral/enteral parenteral	Food	Enteral formulas Glucose 50-70% Lipids10% or 20% Amino acids 6.5-10% Micronutrients	Enteral formulas Glucose 50-70% Lipids10% or 20% Amino acids 6.5-10% Micronutrients
Vitamins - Water soluble vitamin = 2 x RDA/day - Lipid-soluble vitamin = 1-2 x RDA/day (Higher for vitamin E)			
Trace element = 1 x RDA/day (Selenium 300 ug/day)			

ARDS; adult respiratory distress syndrome, MODS; multiple organs dysfunction syndrome, EAA; essential amino acids, NEAA; non-essential amino acids.

Adapted from Druml W. Acute renal failure in Nutrition in kidney disease

ACUTE KIDNEY INJURY

3. Water (maintenance):

- Normal urine; 1 ml/kcal/kg/day
- Oliguria/edema; 25 ml/kg/day or urine output plus 500 ml

Free water in blenderized diet
Concentration 1:1, free water 85%
1:2, free water 80%
1:5, free water 75%
2:1, free water 70%

BLENDERIZED DIET

- Calories = 25–30 kcal x BW/day
- Protein = 1 g x BW/day
- Fat = 30%
- Na < 2 g/day
- K < 1 – 2 g/day
- P = 800 –1200 g/day
- Vitamin A < 700 µg/day (5000 iu)
- Always add trace element
- Volume 1: 1 (85%), 1.5 (75%)

COMMERCIAL PRODUCT

1. Disease specific formula

- Kidney: Nepro (Low K, Low P)
- Diabetic formula: Gen DM, Glucerna SR

- 2. Polymeric diet; Pan enteral
- 3. Elemental diet; Peptamen

NEPHROTIC SYNDROME

1. Energy: 30–35 kcal/kg IBW/day
2. Protein: 1 g/kg/day
3. Water: Restricted according to insensible loss
4. Sodium: Na 2 g/day
5. Calcium: 1–1.2 g/day (in steroid treatment patient)

SPENT 2018: Clinical Practice Recommendation for Nutritional Management in Adult Kidney Patients .

KIDNEY STONE

Recurrent rate > 40% in 5-year in Thailand

Common kidney stone

- Calcium oxalate/ calcium phosphate stone
- Uric acid stone
- Infectious stone (struvite stone)

KIDNEY STONE

Stone promotors

- Calcium
- Phosphate
- Uric
- Oxalate

Stone inhibitors

- Water
- Citrate

ACP American College of Physicians℠
Leading Internal Medicine, Improving Lives

CLINICAL GUIDELINE

Dietary and Pharmacologic Management to Prevent Recurrent Nephrolithiasis in Adults: A Clinical Practice Guideline From the American College of Physicians

Amir Qaseem, MD, PhD; Paul Dallas, MD; Mary Ann Forciea, MD; Melissa Starkey, PhD; and Thomas D. Denberg, MD, PhD, for the Clinical Guidelines Committee of the American College of Physicians*

2014

American Urological Association (AUA) Guideline

MEDICAL MANAGEMENT OF KIDNEY STONES: AUA GUIDELINE

Margaret Sue Pearle, MD, PhD.; David S. Goldfarb, MD; Dean G. Assimos, MD; Gary Curhan, MD; Cynthia J Denu-Ciocca, MD; Brian R. Matlaga, MD; Manoj Monga, MD; Kristina Lea Penniston, PhD Glenn M. Preminger, MD; Thomas M.T. Turk, MD; James Robert White, PhD

2014

Guidelines on

Urolithiasis

C. Türk (chair), T. Knoll (vice-chair), A. Petrik, K. Sarica, A. Skolarikos, M. Straub, C. Seitz

Kidney stone

FLUID INTAKE

1. Water intake
    - Fluid amount 2.5–3 L/day
    - Diuresis 2–2.5 L/day
    - Sp.gr of urine < 1010
    - Circadian drinking
    - Neutral pH beverage

FLUID INTAKE

2. Beverage

- Mineral water (Avoid)
- Fruit juice (Avoid grape fruit)
- Soda with phosphoric acid (No COLA)
- Caffeine (more water)

DIET

2. Balanced diet
    - Rich in vegetable and fiber
    - Normal calcium 1–1.2 g/day
    - Limit salt intake 4–5 g/day
    - Limit animal protein 0.8–1 g/day, no more than 2 meals/day (170–230 g/day)

AVOID OXALATE-RICH FOODS

ผักโขม

ชอคโกแลต

ถั่วเหลือง

ชาดำ

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กระเจี๊ยบ

บีทรู้ท

ใบชะพลู

Kidney stone

THANK YOU