Diabetes management and renal replacement therapies

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Declaration of interests

- TAC
  - No conflicts of interest
- JK
  - Speaker fees and advisory boards from:
    - Boehringer Ingelheim, Astra Zeneca, Daichi Sankyo

Learning objectives for this session

1. To be aware of the importance of diabetes in the epidemiology and pathogenesis of Chronic Kidney Disease (CKD) in the UK.
2. To be able to describe methods for screening, diagnosis, management and prevention of Diabetic Kidney Disease (DKD).
3. To be aware of the complexities in managing glycaemia in people with diabetes and CKD.
4. To be aware of guidelines in the management of diabetes in people on haemodialysis or peritoneal dialysis.
5. To be aware of guidelines in the management of diabetes in people undergoing renal transplantation.
6. To be familiar with the reasons for considering simultaneous pancreas and kidney transplantation.

Plan for this session

- 15 mins Abstract presentation
- 60 mins Interactive cases to highlight:
  - *How should be undertaken initial assessment of DKD?*
  - *When should we to consider non-diabetic CKD?*
  - *When should we refer to nephrology?*
  - *How should we manage DKD?*
  - *How should we manage glycaemia in people on haemo- or peritoneal dialysis*
  - *How should we manage glycaemia in the context of transplantation?*
  - *When should we consider Simultaneous Pancreas and Kidney transplant?*
- 15 mins If time allows, 1-2 interesting cases

Abstract presentation

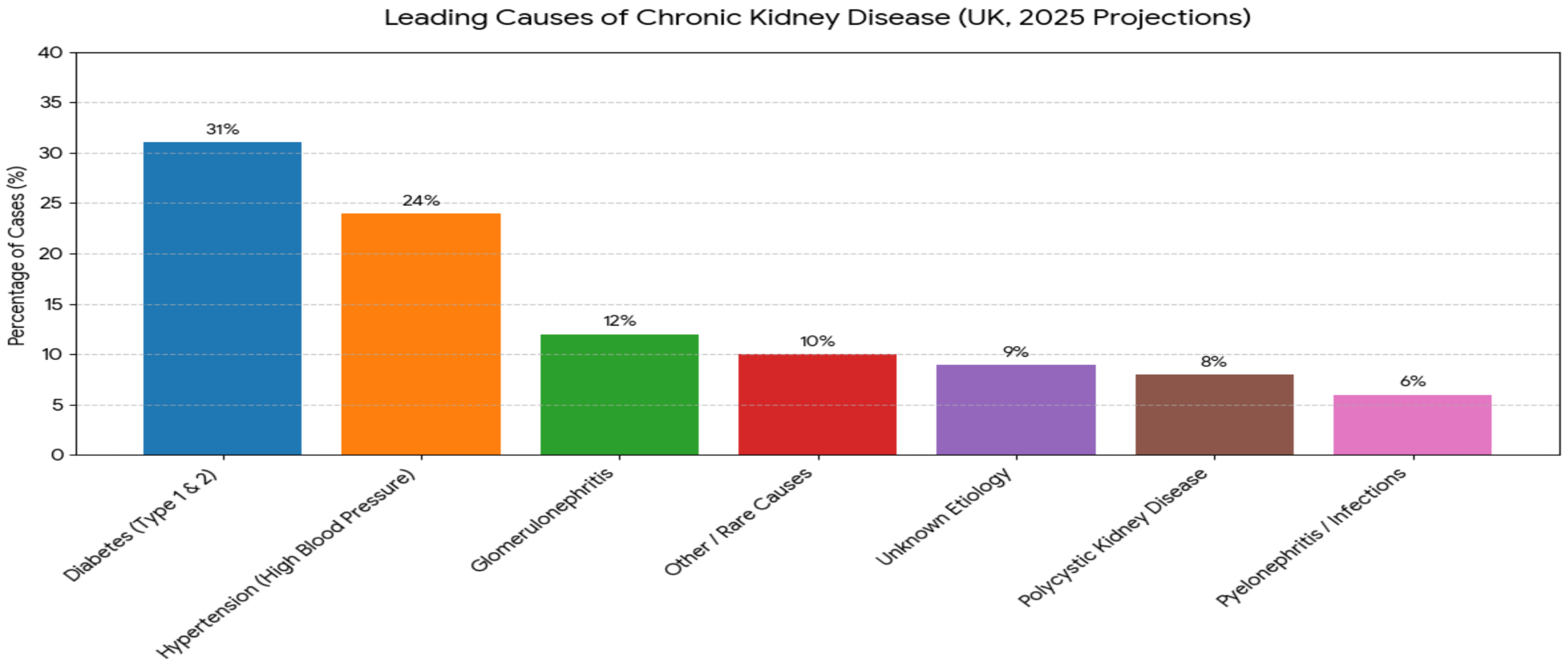
Diabetic Kidney Disease

TAC

The worlds most populated countries?

1. INDIA
2. CHINA
3. DIABETES
4. USA
5. BRAZIL

The most common cause of renal failure in most Western Countries



Adapted from: The Renal Association. UK Renal Registry. 2024

CKD in the UK

- Total estimated cases of CKD:
  - ~7.2 to 7.6 million people (~ 9% of the UK population).
  - ~ 4.1 million stages 1-2; ~ 3.25 million stages 3-5
- Main causes:
  - 2/3 – diabetes and hypertension
- Other important causes:
  - Glomerulonephritis
  - Adult Polycystic Kidney Disease (APKD): 70,000 adults in the UK
  - Obstructive Uropathy
  - Medication: NSAIDS, lithium
- Risk Factors & Health Inequalities
  - Age
  - Ethnicity: South Asian & Black 5x more likely to progress to ESKD
  - Social Deprivation: Higher incidence rates are consistently found in the most deprived UK postcodes.

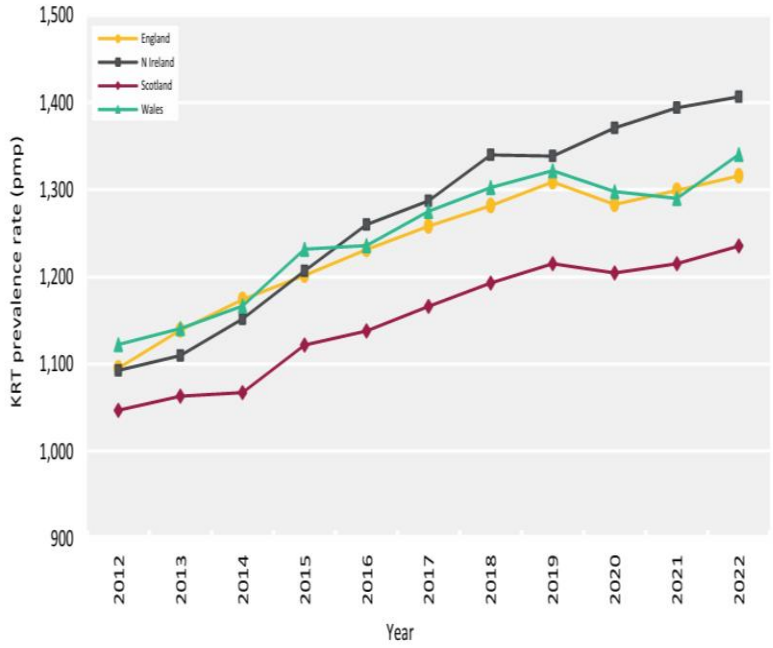


Figure 3.2 Adult KRT prevalence rates by country between 2012 and 2022
pmp – per million population

Diagnosis and screening for DKD

Case 1

- A 46-year-old South Asian man attends for diabetes review.
  - Diabetes, Hypertension 4 years
  - BMI is 27 kg/m^2 – trying with diet, sedentary job (taxi driver)
  - Results:
    - HbA1c 68 mmol/mol
    - Creatinine 89 (eGFR 82)
    - ACR 10.4 ug/mmol/l (<3.0)
    - BP 127/64 mmHg, Cholesterol 3.2
  - Metformin, Statin, ACEI

Case 1

- Questions
  - Does he have diabetic kidney disease?
  - What is DKD?
  - What are the diagnostic tests for DKD?
  - In what circumstances should you consider non-diabetic renal disease?
  - Should you consider other investigations at this stage?

How do you screen for DKD?

- Screen yearly for ACR and eGFR
  - If ACR elevated what should you do?

Parameters influencing urinary albumin excretion rate (AER)

Parameter influencing AER	Effect on AER
Acute Exercise	Increase
Increased diuresis	Increased
Protein meal	Increased
Body mass index	Uncertain may increase with increasing BMI
Drugs- ACE inhibitors, NSAID	Reduced
Congestive cardiac failure	Increased
Fever	Increased
Urinary tract infection	May be increased
Acute poor metabolic control	Increased
Daytime vs. Night	30% lower at night

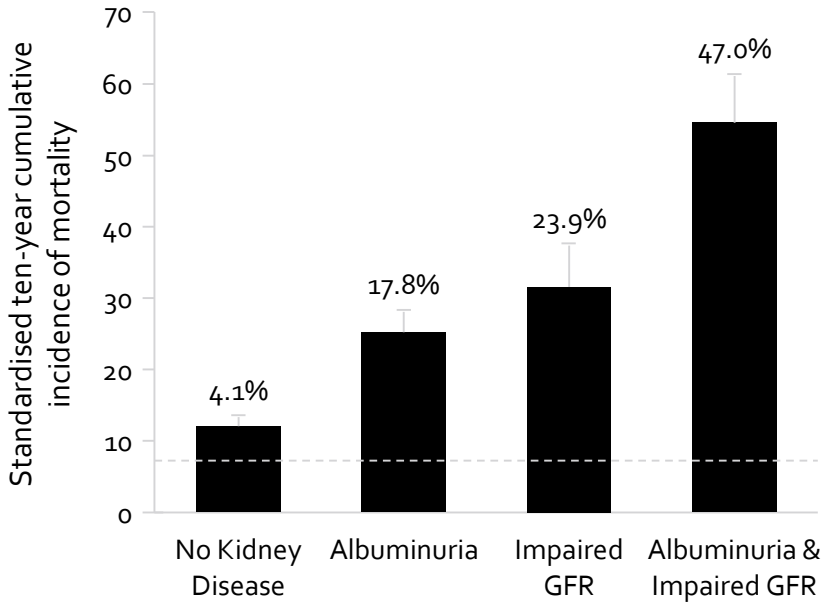
Karalliedde J & Viberti GC Oxford Textbook of Endocrinology and Diabetes 2011

What is diabetic kidney disease?

Diabetic kidney disease (or diabetic nephropathy) is a clinical syndrome defined by:

- Persistent albuminuria
- High blood pressure
- Progressive decline in eGFR
- Increased risk of cardiovascular mortality and morbidity

Ten-year mortality in type 2 diabetes by kidney disease manifestation



Diagnosis of DKD

- DKD is a clinical diagnosis defined as:
  - Among patients with diabetes, the presence of (*in the absence of other causes*):
    - Microalbuminuria:
      - albumin creatinine ratio [ACR] 3-30 mg/mmol
    - Macroalbuminuria:
      - ACR > 30 mg/mmol

How do you screen for DKD?

- Person with diabetes, raised ACR x2, no haematuria / UTI
- Any other investigations?
  - USS + myeloma screen
  - Unlikely to need biopsy
- Are there any clinical circumstances where non-diabetic CKD should be considered?

Non-DKD should be considered in the presence of the following

- Rapidly decreasing GFR (>10 ml/min/year) or rapidly increasing proteinuria / nephrotic syndrome
- Refractory hypertension (±significant fluid retention)
- Presence of active urinary sediment / haematuria
- Absence of significant diabetic retinopathy (perhaps more relevant in T1D)
- Signs or symptoms of other systemic disease
- >30% reduction in GFR within 2-3 months after initiation of an ACE inhibitor or ARB
- Development of overt proteinuria without previous microalbuminuria
- Short duration of known DM - <5 years

Classification of DKD

CLASSIFICATION OF CKD USING eGFR AND ACR CATEGORIES

(eGFR = estimated glomerular filtration rate; ACR = albumin creatinine ratio)

eGFR and ACR categories and risk of adverse outcomes

Based on KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease (Kidney International Supplements (2013) 3, 136-150

eGFR categories (mls/min/1.73m²)				ACR categories (mg/mmol)		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				< 3	3 - 30	> 30
	G1	Normal or high	> 90	No CKD in the absence of markers of kidney damage		
	G2	Mild reduction related to normal range for a young adult	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			

increasing risk

increasing risk

Management of DKD

Case 1

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  - BMI is 27 kg/m^2 – trying with diet, sedentary job (taxi driver)
  - Results:
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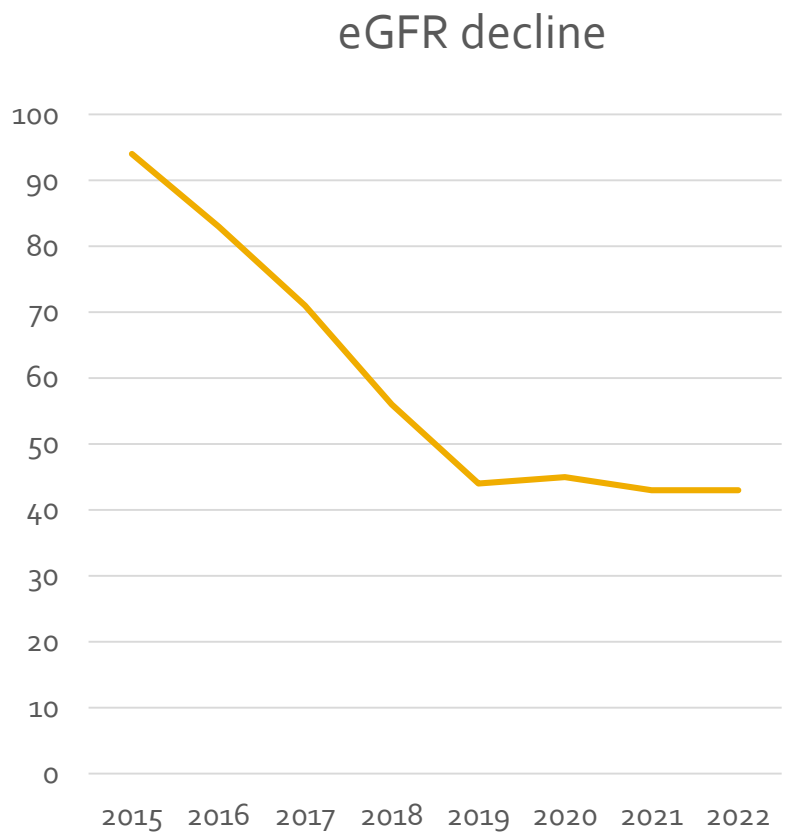
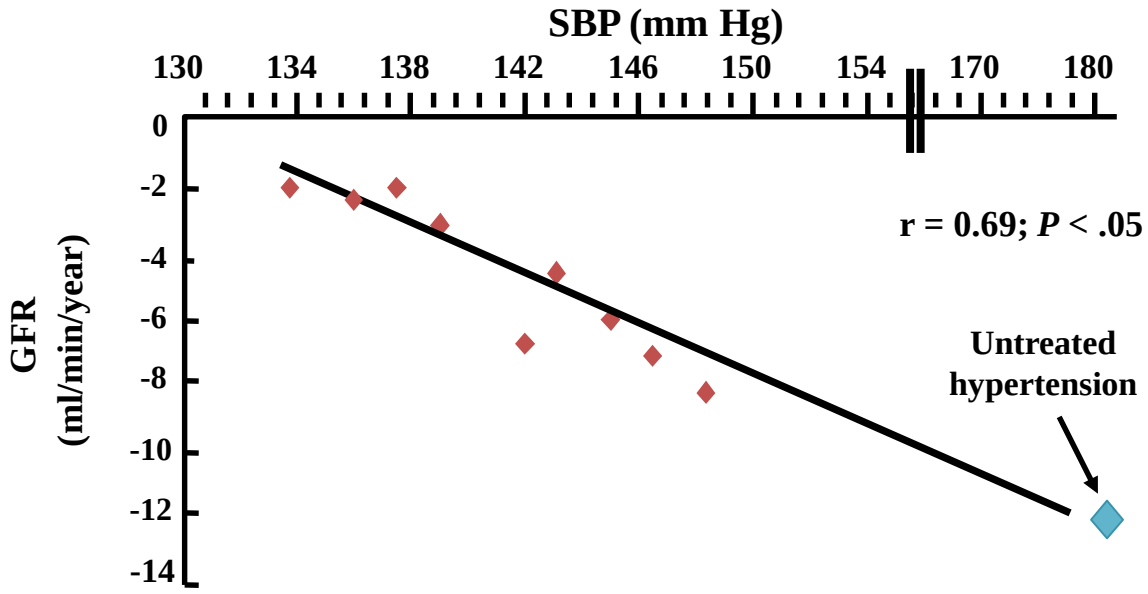
    - ACR 10.4 mg/mmol (<3.0)
    - BP 127/64 mmHg, Cholesterol 3.2
  - Metformin, Statin, ACEI
  - How should we manage?

Aims of management of DKD

- Preventing development of microalbuminuria
- Preventing progression to overt macroalbuminuria
- Slowing rate of loss of GFR
- Prevent or delay onset of ESRF
- Reduce CV risk



Meta-analysis: lower SBP results in lower GFR decline in patients with and without diabetes



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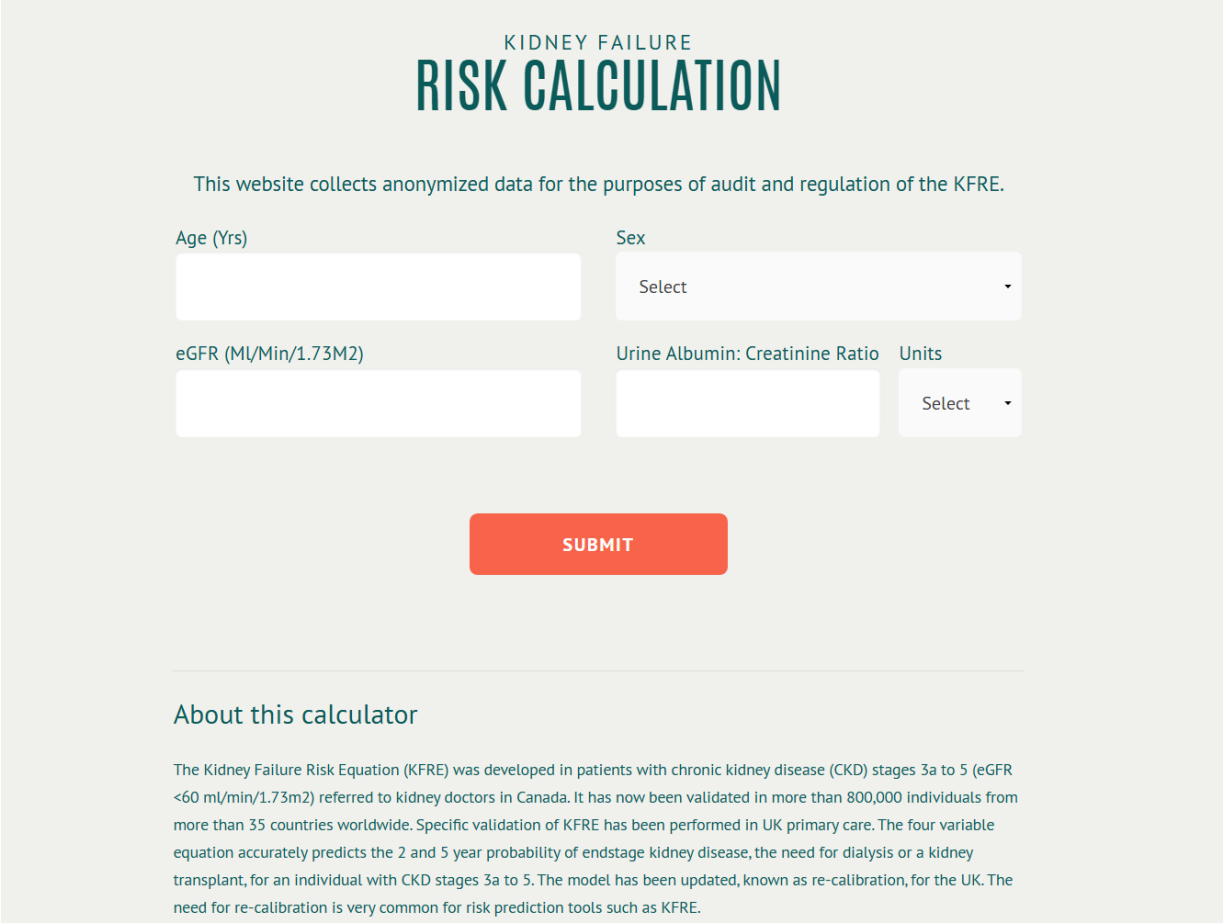
How do you currently manage DKD?

- In established DKD:
  - Prescribe ACEi / ARB (not both) titrated to full dose
  - Control blood pressure < 130/80 mmHg (KDIGO 120/80 mmHg)
  - Reduce CV risk – high intensity statins (+/- aspirin?)
- Renal issues
  - Acidosis - sodium bicarbonate
  - Anaemia - iron / erythropoeitin
  - Bone disease – vit D / phosphate binders
- Who should be referred to nephrology?

Who should be referred to nephrology?

NICE 2021

- Haematuria
- Concern about non-diabetic CKD (haematuria, other factors)
- Possible genetic cause
- Suspected RAS
- BP above target on 4 agents
- eGFR decrease by 25% in 1 year
- Rapid deterioration >15 mls/min/year
- KFRE > 5% in 5 years
  - (Only valid for eGFR <60)



KFRE -Age, gender, ACR & eGFR
Risk of ending up on dialysis at 2 and 5 yrs

HOW CAN I REDUCE MY RISK OF KIDNEY FAILURE?

There are things you can do to reduce your risk of kidney failure over the next five years. Click below to see how the following will decrease your risk.

- (●) Your current 5 year risk based on the answers you provided is **2.47%**
- ( ) Achieving good blood pressure control can reduce your 5 year risk from **2.47%** to **1.95%.**
- ( ) An ACE inhibitor (pril) or ARB (sartan) can reduce your 5 year risk from **2.47%** to **1.73%.**
- ( ) An SGLT2 inhibitor (gliflozin) can reduce your 5 year risk from **2.47%** to **1.36%.**

The benefits of these changes can add up over time.

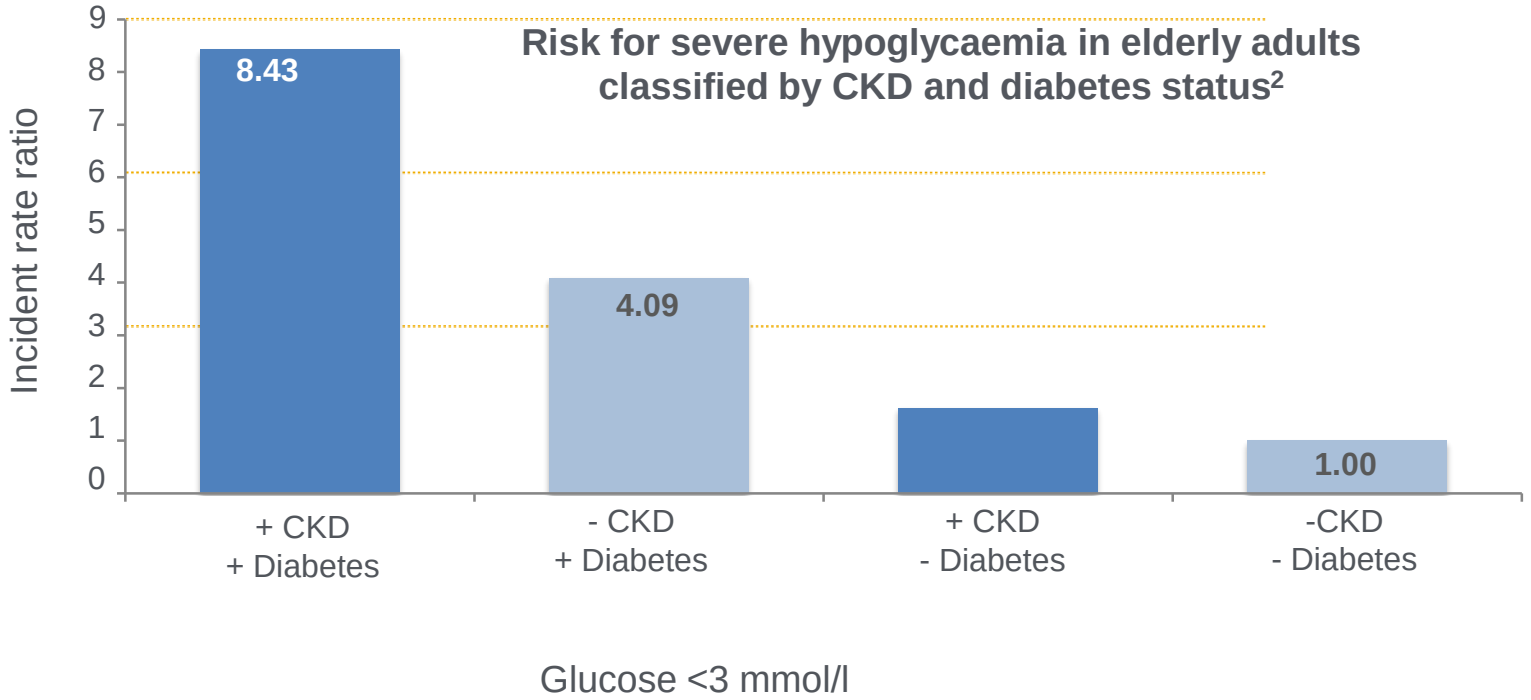
Only valid if eGFR <60

How do you currently manage DKD?

- In established DKD:
  - Prescribe ACEi / ARB (not both) titrated to full dose
  - Control blood pressure < 130/80 mmHg
  - Reduce CV risk – high intensity statins (+/- aspirin?)
- Renal issues
  - Acidosis - sodium bicarbonate
  - Anaemia - iron / erythropoeitin
  - Bone disease – vit D / phosphate binders
- Possibly joint management with nephrology especially if renal function declining
- What about glycaemic management?

CKD in DM and hypoglycaemia risk

- Chronic kidney disease increases hypoglycaemia risk in patients with diabetes
- In elderly subjects (>70 years) hypoglycaemia occurs more frequently in subjects with CKD stages 3–5



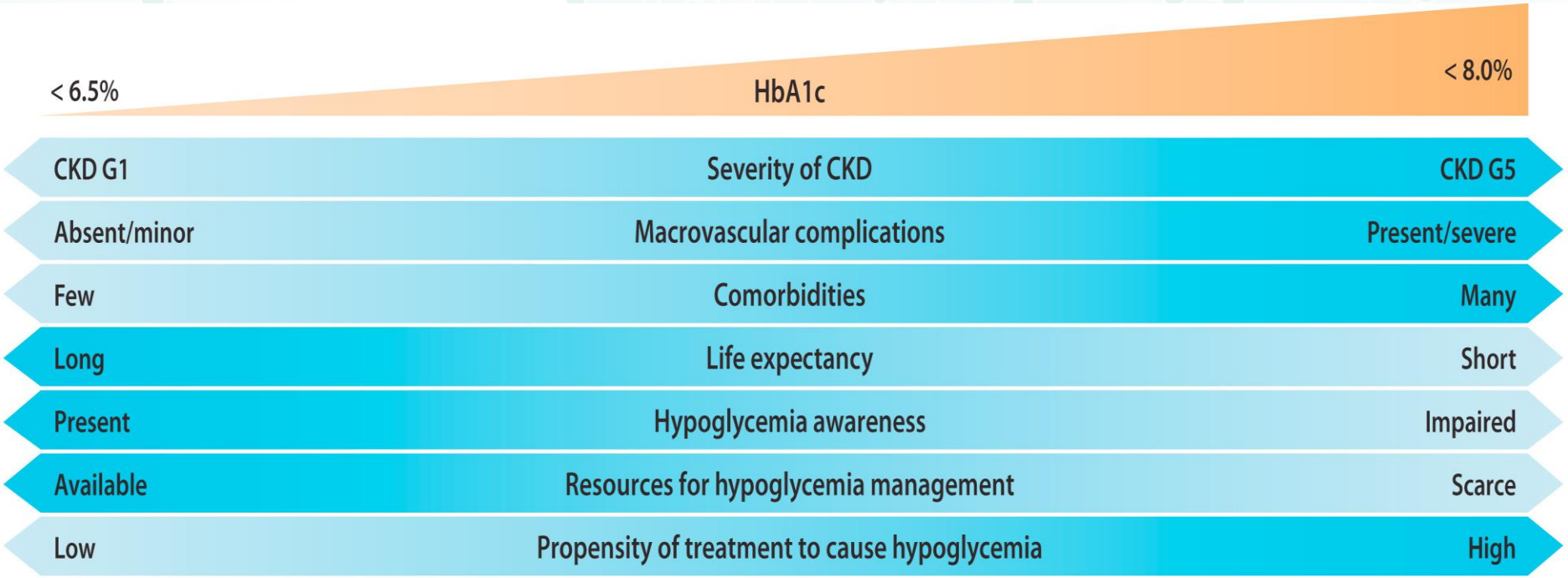
Glycaemic targets in Diabetes and CKD: ABCD/UKKA guidelines (2025) Kidney International Reports, 2025

	Glycaemic target	Note
Type 1 diabetes	48–58 mmol/mol (6.5–7.5%)	Younger patients within 10 years' duration of diabetes and variable microalbuminuria–CKD stage 2
	58–62 mmol/mol (7.5–7.8%)	The majority of patients with proteinuria and/or CKD stages 3–4
	58–68 mmol/mol (7.5–8.5%)	Patients with CKD stage 5-dialysis
Type 2 diabetes	48–58 mmol/mol (6.5–7.5%)	For the majority of patients who are aged <40 years, or have CKD stages 1–2 (no basis to aim for <52 mmol/mol (6.9%) unless the patient is aged <40 years and has CKD stages 1–2)
	52–58 mmol/mol (6.9–7.5%)	For those with CKD stages 3–4 this target may be appropriate with a GLP-1 and/ or SGLT-2 inhibitor-based treatment regime without insulin
	58–68 mmol/mol (7.5–8.5 %)	For those with CKD stages 3–4 especially with –albuminuria∇ who are on an insulin-based regime, and those with CKD stage 5 who are on dialysis

Kidney International Reports, 2025 Volume 10, Issue 10, 3318 - 3331

Glycemic Monitoring and Targets in Patients with Diabetes and CKD

KDIGO Recommendation 2.2.1. We recommend an individualized HbA1c target ranging from <6.5% to <8.0% in patients with diabetes and CKD not treated with dialysis (Figure 14) *(1C)*.

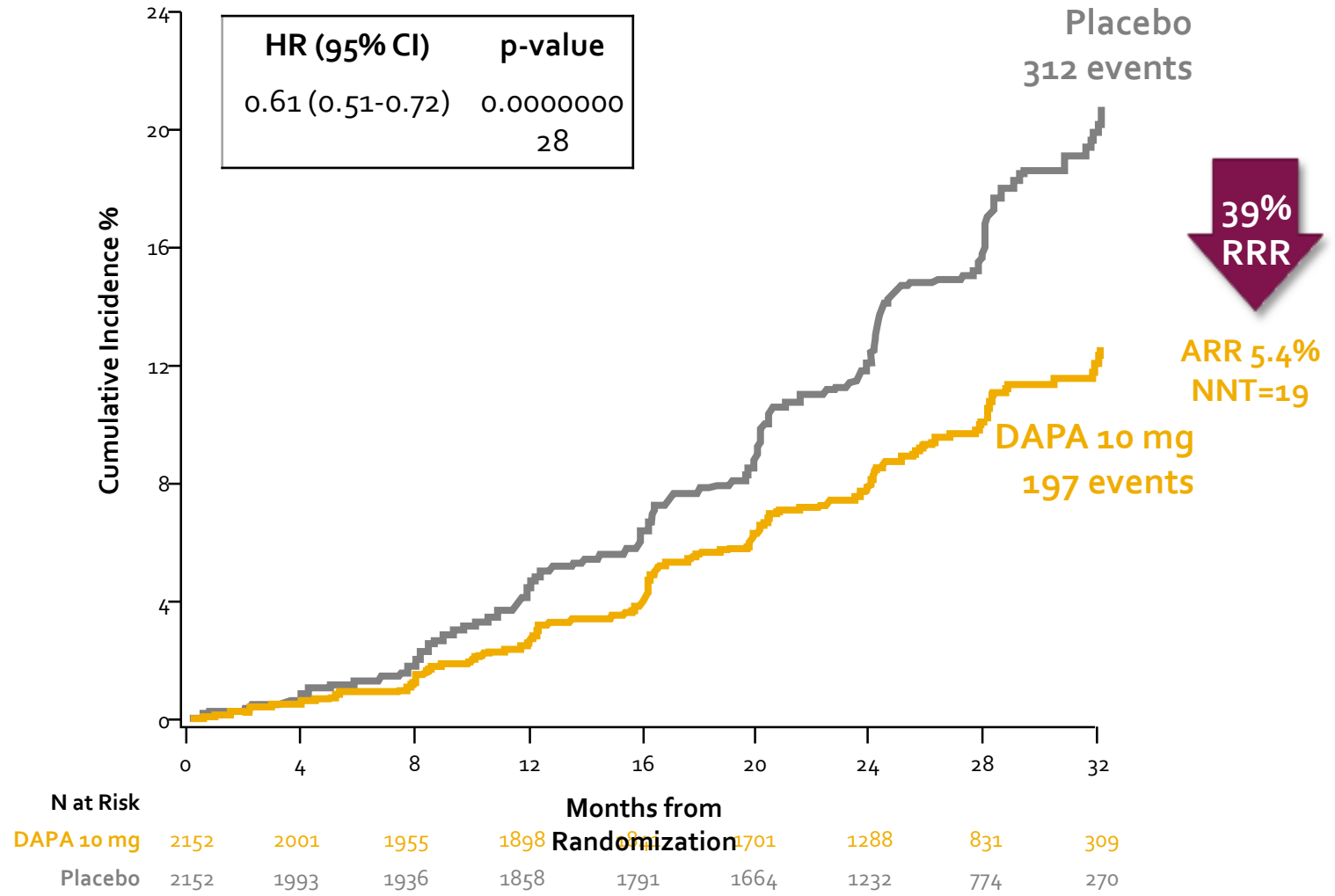


Drug therapy in DKD

Case 1

- A 46-year-old South Asian man attends for diabetes review.
  - Diabetes, Hypertension 4 years
  - BMI is 27 kg/m^2 – trying with diet, sedentary job (taxi driver)
  - Results:
    - HbA1c 68 mmol/mol
    - Creatinine 89 (eGFR 82)
    - ACR 10.4 ug/mmol/l (<3.0)
    - BP 127/64 mmHg, Cholesterol 3.2
  - Metformin, Statin, ACEI
  - How should we manage?

Dapa-CKD: ≥50% eGFR Decline, ESRD, Renal / CV Death



Adverse effects of SGLT-2i?

- No increase in amputations in CREDENCE (seen in CANVAS)
  - Meta-analysis confirms no increase in risk
- UTI / Candidiasis
  - T2D assoc with 60% increased risk of urosepsis
  - SGLT2 associated UTI - 2.15 versus 2.96 per 1000 persons (<1 in 1000 for pyelonephritis)
  - More common in women
- DKA-associated with SGLT2 inhibitors
  - 0.16 to 0.76 events per 1000 patient-years in patients with T2D
- Fourniers gangrene
  - Extremely rare
- Bone fractures
  - Meta-analysis of 25 RCTs (19,500) – *Osteoporosis international* August 2020
  - SGLT2 did not appear to increase risk (OR = 0.97, 95% CI 0.71–1.32).

Case 1

- A 46-year-old South Asian man attends for diabetes review.
  - Diabetes, Hypertension 4 years
  - BMI is 27 kg/m^2 – trying with diet, sedentary job (taxi driver)
  - Results:
    - HbA1c 68 mmol/mol
    - Creatinine 89 (eGFR 82)
    - ACR 10.4 ug/mmol/l (<3.0)
    - BP 127/64 mmHg, Cholesterol 3.2
  - Metformin, Statin, ACEI

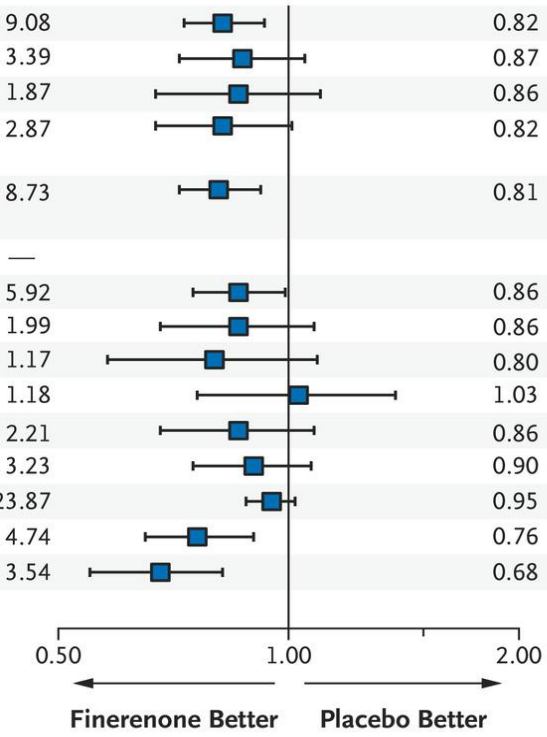
GLIFLOZIN

Case 1 – 3 years later

- A 49-year-old South Asian man attends for diabetes review.
  - Diabetes, Hypertension 7 years
  - BMI is 27.5 kg/m^2
  - Results:
    - HbA1c 59 mmol/mol
    - Creatinine 118 (eGFR62)
    - ACR 40.2 ug/mmol/l (<3.0)
    - BP 132/72 mmHg, Cholesterol 2.8
  - Metformin, Gliflozin, Statin, ACEI, Calcium channel blocker
  - What would you do?

FIDELIO trial

Outcome	Finerenone (N=2833)	Placebo (N=2841)	Finerenone (N=2833)	Placebo (N=2841)	Hazard Ratio (95% CI)	P Value
	no. of patients with event (%)		*no. of patients with event per 100 patient-yr*			
Primary composite outcome	504 (17.8)	600 (21.1)	7.59	9.08	0.82 (0.73–0.93)	0.001
Kidney failure	208 (7.3)	235 (8.3)	2.99	3.39	0.87 (0.72–1.05)	—
End-stage kidney disease	119 (4.2)	139 (4.9)	1.60	1.87	0.86 (0.67–1.10)	—
Sustained decrease in eGFR to <15 ml/min/1.73 m^2	167 (5.9)	199 (7.0)	2.40	2.87	0.82 (0.67–1.01)	—
Sustained decrease of ≥40% in eGFR from baseline	479 (16.9)	577 (20.3)	7.21	8.73	0.81 (0.72–0.92)	—
Death from renal causes	2 (<0.1)	2 (<0.1)	—	—	—	—
Key secondary composite outcome	367 (13.0)	420 (14.8)	5.11	5.92	0.86 (0.75–0.99)	0.03
Death from cardiovascular causes	128 (4.5)	150 (5.3)	1.69	1.99	0.86 (0.68–1.08)	—
Nonfatal myocardial infarction	70 (2.5)	87 (3.1)	0.94	1.17	0.80 (0.58–1.09)	—
Nonfatal stroke	90 (3.2)	87 (3.1)	1.21	1.18	1.03 (0.76–1.38)	—
Hospitalization for heart failure	139 (4.9)	162 (5.7)	1.89	2.21	0.86 (0.68–1.08)	—
Death from any cause	219 (7.7)	244 (8.6)	2.90	3.23	0.90 (0.75–1.07)	—
Hospitalization for any cause	1263 (44.6)	1321 (46.5)	22.56	23.87	0.95 (0.88–1.02)	—
Secondary composite kidney outcome	252 (8.9)	326 (11.5)	3.64	4.74	0.76 (0.65–0.90)	—
Sustained decrease of ≥57% in eGFR from baseline	167 (5.9)	245 (8.6)	2.41	3.54	0.68 (0.55–0.82)	—



What is the place of finerenone?

ABCD-UKKA position statement:

- T2D and DKD with ACR>30 mg/mmol despite maximum RAASi and SGLT2i, consider addition of Finerenone to reduce risk of adverse kidney/CV outcomes.
- Fineronone can be used if eGFR > 25 ml/min/1.73m^2 and K^+ < 5 mmol/L.
- Finerenone can be used 2nd line in addition to ACEi/ARB (if SGLT2i not tolerated or contraindicated) or 3rd line therapy in addition to ACEi/ARB + SGLT2i.
- Initiate Finerenone 20mg once daily if eGFR ≥60 mL/min/1.73 m^2.
- Initiate Finerenone 10 mg once daily if eGFR between 25 to 59 mL/min/1.73 m^2.

Comprehensive Care in Patients with Diabetes and CKD

KDIGO Recommendation 1.4.1: We suggest a nonsteroidal mineralocorticoid receptor antagonist with proven kidney or cardiovascular benefit for patients with T2D, an eGFR ≥25 ml/min per 1.73 m², normal serum potassium concentration, and albuminuria (≥30 mg/g [≥ 3mg/mmol]) despite maximum tolerated dose of RAS inhibitor (RASi) *(2A)*.

K^+ ≤4.8 mmol/l

- Initiate finerenone
  - 10 mg daily if eGFR 25–59 ml/min per 1.73 m²
  - 20 mg daily if eGFR ≥60 ml/min per 1.73 m²
- Monitor K^+ at 1 month after initiation and then every 4 months
- Increase dose to 20 mg daily, if on 10 mg daily
- Restart 10 mg daily if previously held for hyperkalemia and K^+ now ≤5.0 mmol/l

K^+ 4.9–5.5 mmol/l

- Continue finerenone 10 mg or 20 mg
- Monitor K^+ every 4 months

K^+ >5.5 mmol/l

- Hold finerenone
- Consider adjustments to diet or concomitant medications to mitigate hyperkalemia
- Recheck K^+
- Consider reinitiation if/when K^+ ≤5.0 mmol/l

Case 1 – 3 more years later

- A 52-year-old South Asian man attends for diabetes review.
  - Diabetes, Hypertension 10 years
  - BMI is 27.5 kg/m^2
  - Results:
    - HbA1c 62 mmol/mol
    - Creatinine 128 (eGFR56)
    - ACR 59.2 ug/mmol/l (<3.0)
    - BP 122/69 mmHg, Cholesterol 2.9
  - Metformin, Gliflozin, Statin, ACEI, Calcium channel blocker, MRA
  - What would you do?

GLP-1 analogues

- Exenatide + Exenatide LAR
- Lixisenatide
- Liraglutide
- Dulaglutide
- Semaglutide
- Tirzepatide

FLOW study (NEJM May 2024)

Semaglutide for CKD in Patients with Type 2 Diabetes: "FLOW"ing with the Semaglu"TIDE"

#NephJC

METHODS

International, double-blind, placebo-controlled
28 countries

Type 2 DM and CKD:
GFR 50-75 ml/min + ACR 300-5000 mg/g
or
GFR 25-<50 ml/min + ACR 100-5000 mg/g

Median follow-up, 3.4 years

	Major kidney disease events	Death from any causes	Adverse event leading to discontinuation
Major kidney disease events- kidney failure, ≥50% reduction in GFR, death from CV or kidney-related causes			
Placebo n = 1766	7.5 events per 100 patient-years	279(15.8%)	211(11.9%)
	HR 0.76 (95% CI, 0.66-0.88)	HR 0.80 (95% CI, 0.67-0.95)	
Semaglutide n = 1767	5.8 events per 100 patient-years	227(12.8%)	233(13.2%)

HR= Hazard ratio

Reference: Perkovic,V et al. Effects of Semaglutide on Chronic Kidney Disease in Patients with Type 2 Diabetes. NEJM, May 2024.

Conclusion: Semaglutide reduced the risk of clinically important kidney outcomes and death from cardiovascular causes in patients with type 2 diabetes and chronic kidney disease.

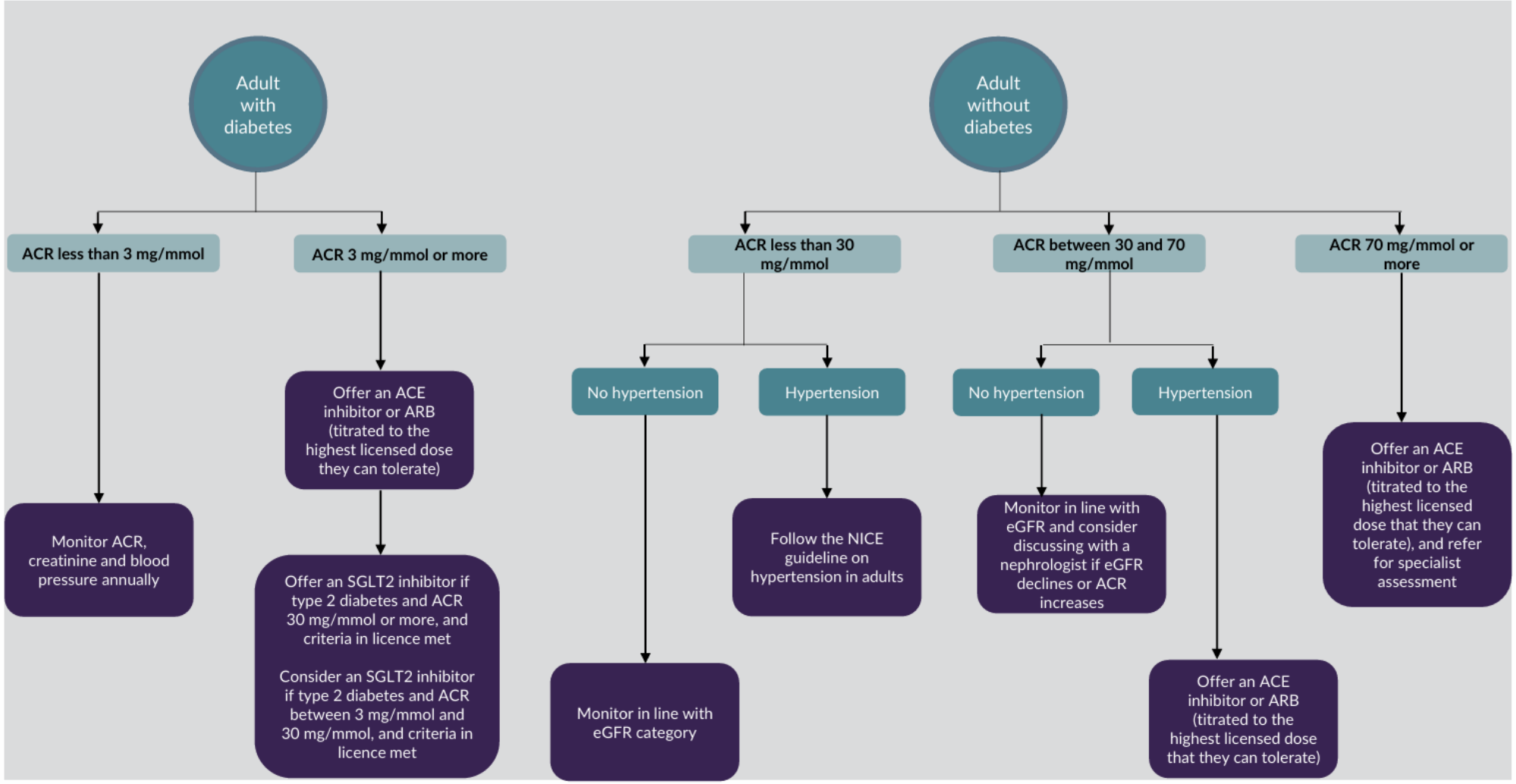
What do the guidelines suggest?

- NICE renal 2021
- NICE diabetes 2022 - (draft 2025)
- ADA/EASD consensus – updated 2022
- KDIGO – 2022
- ABCD-UKKA – update 2025

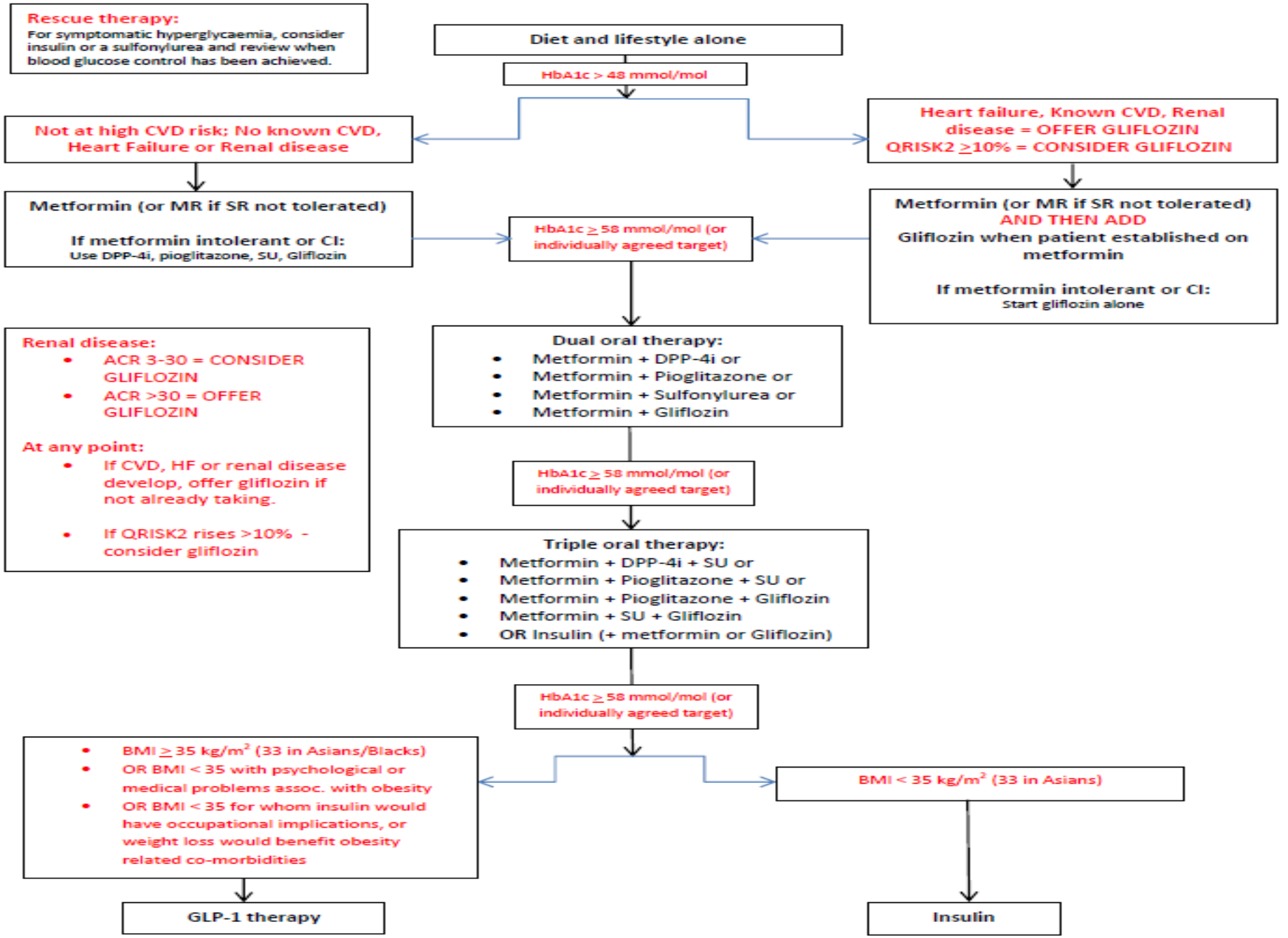
NICE 2021 renal - managing proteinuria

Chronic kidney disease (G1-5, A1-3): managing proteinuria

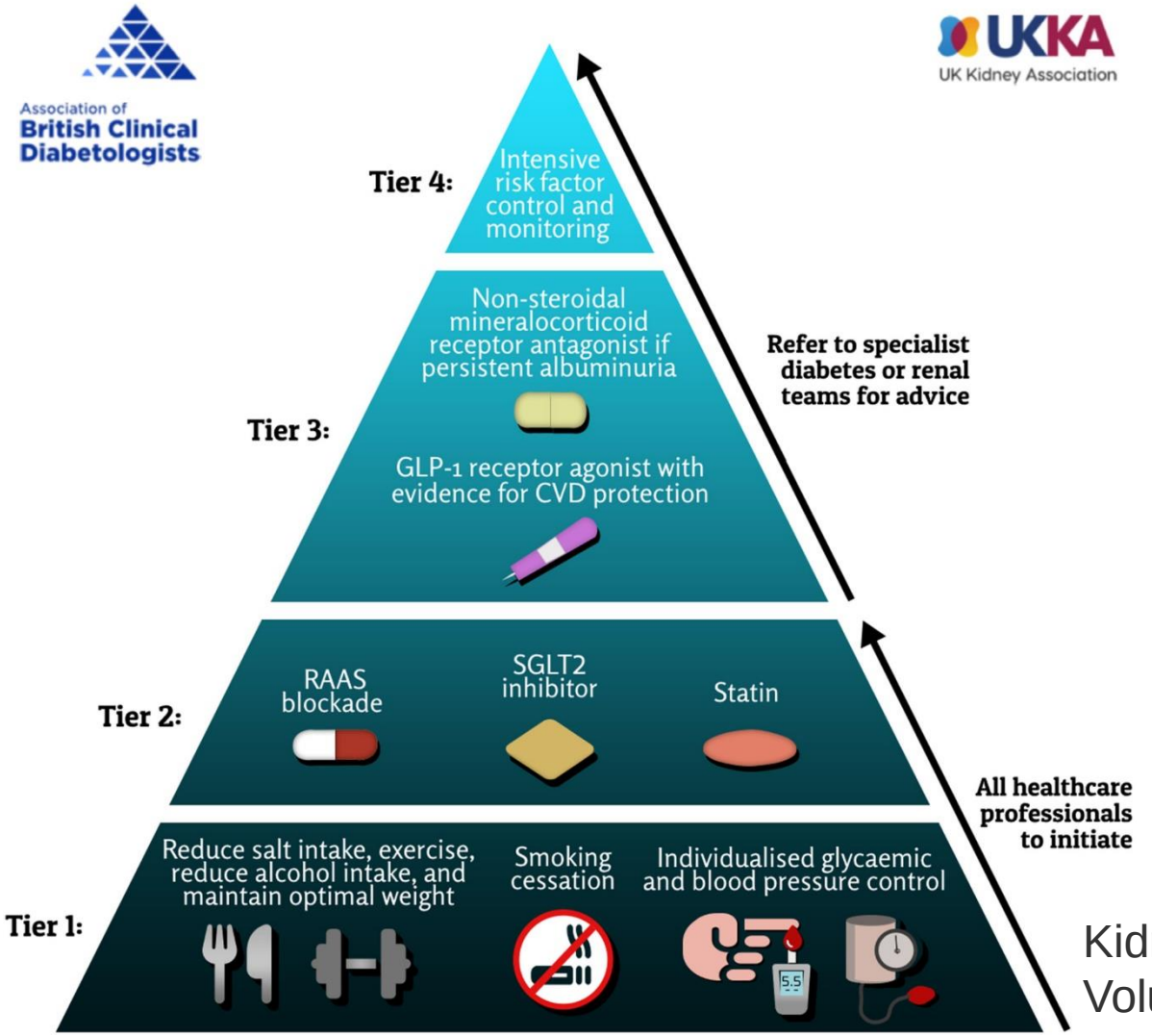
NICE National Institute for Health and Care Excellence



NICE 2022 THERAPEUTIC PATHWAY FOR GLYCAEMIC MANAGEMENT OF TYPE 2 DIABETES



A tiered approach to managing people with type 2 diabetes mellitus and CKD. An overview of the joint Association of British Clinical Diabetologists and UK Kidney Association (ABCD-UKKA) guidelines. Kidney International Reports, 2025 online open access



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Case 1

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  - What would you do?

GLP-1

Association of British Clinical Diabetologists and UK Kidney Association Joint Clinical Practice Guidelines for the Pharmacological Management of Hyperglycemia in Adults With Type 2 Diabetes Mellitus and CKD

Drug	Class of drug	Kidney impairment – CKD stage and eGFR (ml/min/1.73 m2)					
		1 eGFR ≥90	2 eGFR 60–89	3a eGFR 45–59	3b eGFR 30–44	4 eGFR 15–29	5 eGFR <15
Metformin**	Biguanide				Reduce dose to 500 mg twice daily	eGFR may underestimate in obesity, potential role for 500 mg daily**	Do not initiate Not recommended in ESKD
Gliclazide, Glimepiride, Glipizide, Glyburide Other Sulfonylureas	Sulfonylurea	Monitor glucose	Monitor glucose	Monitor glucose	Dose reduction advised Monitor glucose	Not recommended if eGFR<30 Off licence – high risk of hypoglycaemia; monitor glucose.	
Dapagliflozin†	SGLT-2 inhibitor			May initiate at 10mg od and /or continue for diabetes, kidney protection , cardiovascular protection and treatment of heart failure	May initiate at 10mg od and /or continue for kidney protection , cardiovascular protection and treatment of heart failure	May initiate at 10mg od and /or continue for kidney protection and treatment of heart failure Limited experience for treatment of heart failure and kidney protection.	Can be continued at 10mg od until kidney replacement therapy started. Do not initiate.
Canagliflozin‡	SGLT-2 inhibitor			May initiate at 100 mg od and/or continue for diabetes ,cardiovascular and kidney protection	May initiate at 100 mg od and/or continue for cardiovascular and kidney protection	Continue at 100 mg od for kidney protection until kidney replacement therapy. Do no initiate	Can be continued at 10mg od until kidney replacement therapy started. Do not initiate.
Empagliflozin†	SGLT-2 inhibitor			May initiate at 10mg od for treatment of diabetes, kidney protection , cardiovascular protection and heart failure	May initiate at 10mg od for kidney protection , cardiovascular protection and treatment of heart failure	May initiate at 10mg od in eGFR >20ml/min for kidney protection or treatment of heart failure. Limited experience for treatment of heart failure.	Can be continued at 10mg od until kidney replacement therapy started. Do not initiate.
Ertugliflozin	SGLT-2 inhibitor				Do not initiate	Do not initiate. Discontinue if eGFR persistently <30 ml/min.	Do not initiate

Figure 1. Glucose-lowering therapies—current licensing indications based on eGFR and cardio-kidney protection. Note that sick day guidance applies to metformin, all SGLT-2 inhibitors, and GLP-1 agonists. *Monitor for fluid retention; contraindicated in heart failure and macular edema. **CrCl and cystatin C may be used as an estimate of glomerular filtration rate to help clinical decision making (CrCl calculated using Cockcroft–Gault equation). †Dapagliflozin and Empagliflozin† can be initiated and continued for treatment of heart failure without reference to kidney function but no current evidence for initiation if eGFR < 20. ‡Canagliflozin can be initiated for kidney protection down to an eGFR of 30 ml/min per 1.73 m2 and be continued thereafter until the onset of dialysis or transplantation. Dapagliflozin† and Empagliflozin† can be initiated for kidney protection down to an eGFR of 15 ml/min per 1.73 m2 and be continued thereafter until the onset of dialysis or transplantation. CrCl, creatinine clearance; eGFR, estimated glomerular filtration rate; GLP-1, glucagon-like peptide 1; SGLT-2, sodium-glucose cotransporter 2.

Association of British Clinical Diabetologists and UK Kidney Association Joint Clinical Practice Guidelines for the Pharmacological Management of Hyperglycemia in Adults With Type 2 Diabetes Mellitus and CKD

Dulaglutide	**GLP-1 agonist**						**Not recommended in ESKD**
Semaglutide (injectable)	**GLP-1 agonist**			May initiate at 0.25mg weekly for diabetes and up-titrate to 1mg weekly / continue for kidney and cardiovascular protection	May initiate at 0.25mg weekly and up-titrate to 1mg weekly /continue for kidney and cardiovascular protection	May initiate at 0.25mg weekly and up-titrate to 1mg weekly / continue for kidney protection if eGFR >20	**Not recommended in ESKD**
Tirzepatide	**GLP-1/GIP agonist**						Caution in ESKD due to limited experience
Semaglutide (oral)	**GLP-1 agonist**			continue for cardiovascular protection	continue for cardiovascular protection		**Not recommended in ESKD**
Liraglutide	**GLP-1 agonist**			continue for cardiovascular protection	continue for cardiovascular protection		**Not recommended in ESKD**
Sitagliptin	**DPP-4 inhibitor**				Reduce dose to 50 mg	Reduce dose to 25 mg	Reduce dose to 25 mg
Saxagliptin	**DPP-4 inhibitor**				Reduce dose to 2.5 mg	Reduce dose to 2.5 mg	**Not recommended in ESKD requiring haemodialysis**
Linagliptin	**DPP-4 inhibitor**						
Pioglitazone*	**Thiazolinedione**						Not recommended in dialysis
Insulin		Monitor glucose	Monitor glucose	Monitor glucose	Dose reduction may be needed. Monitor glucose	Dose reduction should be needed. Monitor glucose	Dose reduction should be needed. Monitor glucose.

Kidney International Reports, Volume 10, Issue 10, 3318 – 3331 October 2025

Type 1 Diabetes and CKD

JK

Case from S London

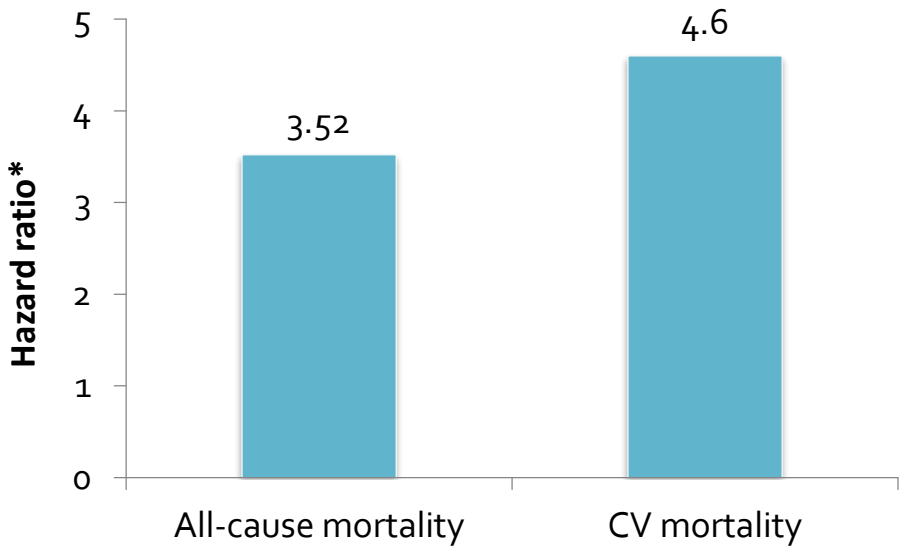
- 21 year old female T1DM for 12 years, Pre-proliferative retinopathy (parents from Brazil) Clinic Review
- HbA1c 10% (86 mmol/mol) BP 138/74 mmHg eGFR 88 ml/min BMI 26 kg/m2 and central obesity
- FH of hypertension and type 2 diabetes (Uncles)
- Urine ACR 28 mg/mmol (~250 mg/g), rechecked and raised at 36 mg/mmol (320 mg/g)

What would you do?

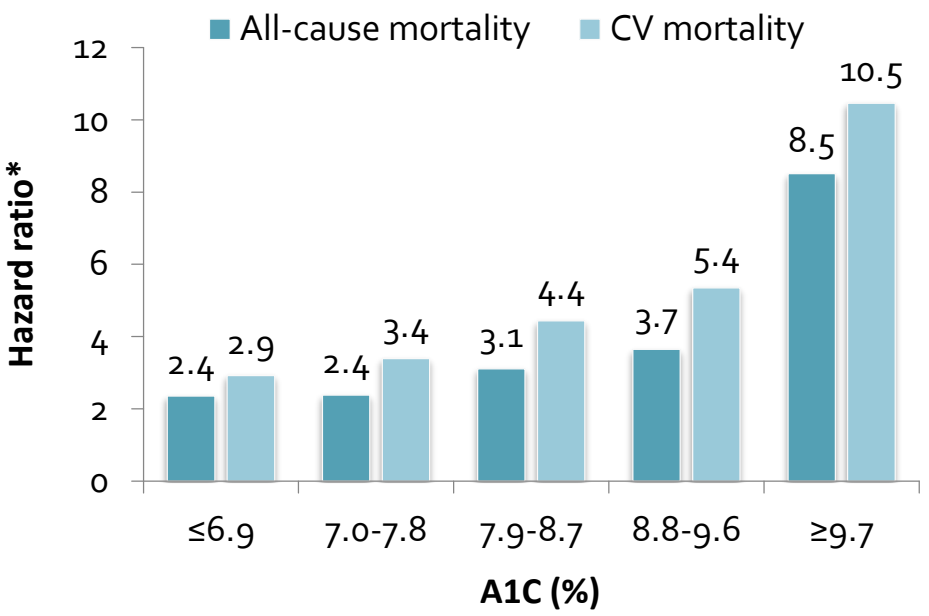
Mortality in People With Type 1 Diabetes

Swedish National Diabetes Register
(n=33,915 with T1D; n=169,249 without diabetes)

Mortality Risk vs Patients Without Diabetes



Mortality Risk by A1C Level

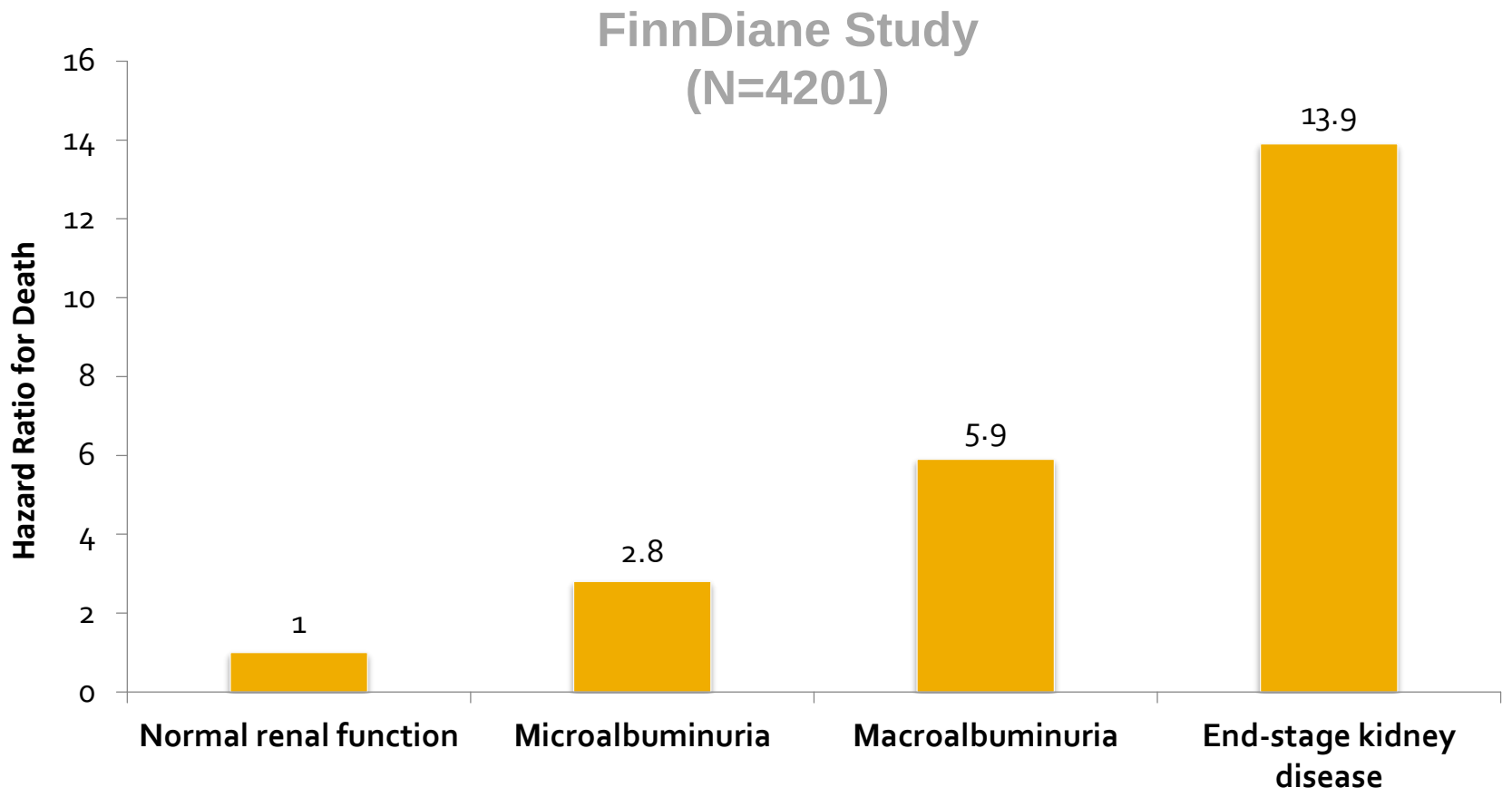


*Adjusted for age, diabetes duration, sex, birthplace, education, CVD status, and cancer status.

CVD, cardiovascular disease; T1D, type 1 diabetes.

Lind M, et al. *N Engl J Med*. 2014;371:1972-1982.

In type 1 diabetes Mortality Correlates With Renal Function



Risk of mortality in individuals with T1D associated each level of albuminuria and end-stage kidney disease.

Groop P, et al. *Diabetes.* 2009;58:1651-1658.

The uncomfortable truth about kidney disease in type 1 diabetes

B Perkins Lancet Diabetes Endo 2023

Type 1 diabetes and risk of heart failure: A systematic review and meta-analysis

ji et al Diabe Res Clin Prac 2023

The double burden: type 1 diabetes and heart failure—a comprehensive review

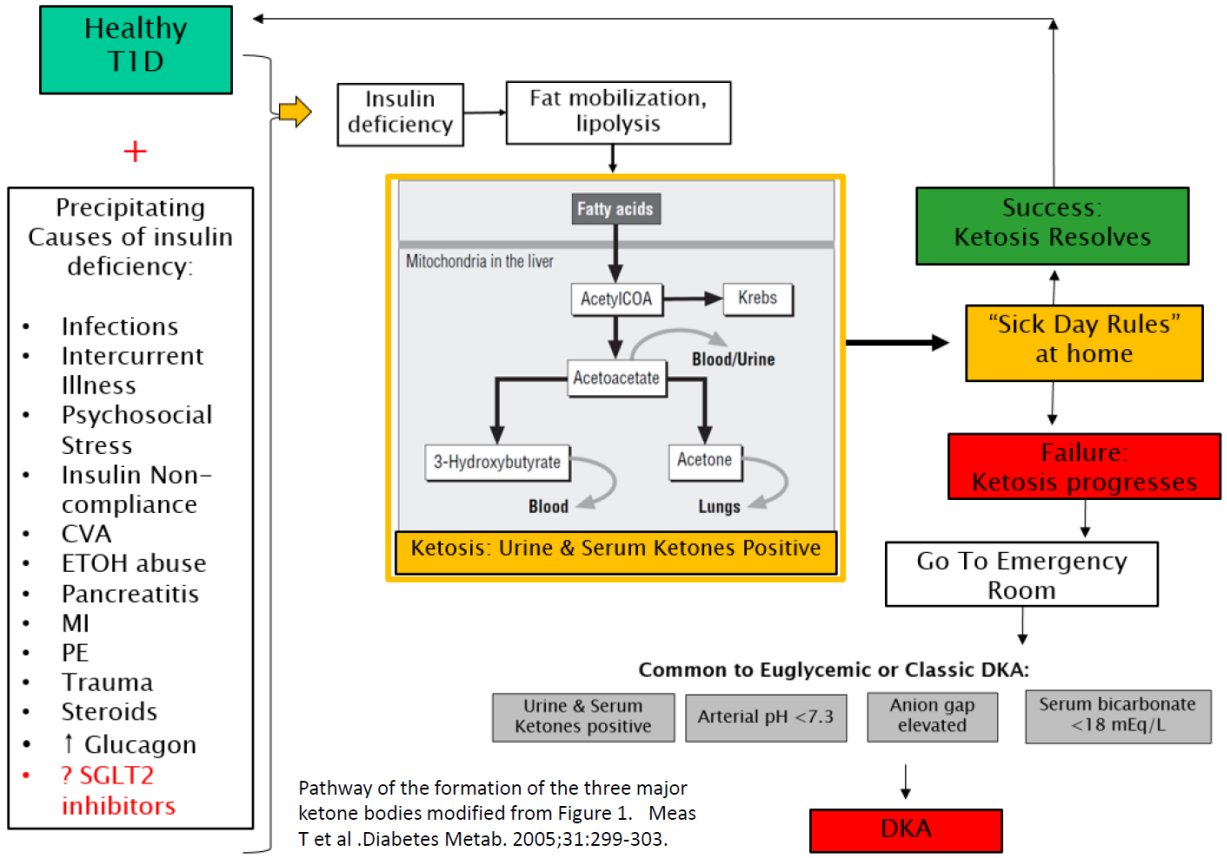
Julián et al. Cardiovascular Diabetology (2024)

- Treatment strategies for type 1 diabetes and CKD have remained largely unchanged over the last 30 years, with RAS inhibitors introduced in 1993.
- Risk of CKD was 1.4- to 3.0-fold higher in individuals with type 1 diabetes at all ages than in those with type 2 diabetes
- RAS inhibition trials, 20–40% of participants randomised to ACE inhibitors still experienced the primary kidney endpoint
- More recently, in the PERL trial of adults with type 1 diabetes and CKD, GFR declined by ~3 ml/min per 1.73 m^2 per year, despite 90% of participants using RAS inhibitors
- Risk of heart failure (HF) 3-5 higher in type 1 DM compared to non diabetes
- Event rates of HF, stroke, incident CKD and 'cardio-renal'-related death were higher in type 1 diabetes than in type 2 diabetes

Haji et al Diabe Res Clin Prac 2023 , Sridhar, V.S et al *Diabetologia* 2024

Euglycaemic DKA - its not a new problem

Initiation of Ketosis, and Progression to DKA



Pathway of the formation of the three major ketone bodies modified from Figure 1. Meas T et al .Diabetes Metab. 2005;31:299-303.

Euglycaemic Diabetic Ketoacidosis

J. F. MUNRO, I. W. CAMPBELL, A. C. McCUISH, L. J. P. DUNCAN

British Medical Journal, 1973, 2, 578-580

Summary

Of a series of 211 episodes of diabetic metabolic decompensation 37 had severe euglycaemic ketoacidosis (a blood sugar level of less than 300 mg/100 ml and a plasma bicarbonate of 10 mEq/l. or less). All were young insulin-dependent diabetics, only one being previously undiagnosed. Vomiting was a common factor, and in all carbo-

blood glucose exceeded 650 mg/100 ml or the plasma bicarbonate was less than 15 mEq/l. In 11 there was gross hyperglycaemia and hyperosmolarity but no ketoacidosis (Campbell *et al.*, 1973). This paper considers the other extreme of the broad spectrum of diabetic metabolic decompensation—namely, severe ketoacidosis with a plasma bicarbonate of 10 mEq/l. or less without pronounced hyperglycaemia, the blood glucose being less than 300 mg/100 ml. We have called this syndrome "euglycaemic diabetic ketoacidosis" for lack of a better term.

BRITISH MEDICAL JOURNAL 14 JULY 1973

Euglycaemic Diabetic Ketoacidosis

SIR,—In identifying a group of young diabetics presenting in ketoacidosis without significant hyperglycaemia, Dr. J. F. Munro and his colleagues (9 June, p. 578) have enhanced the panorama of diabetic metabolic upsets. With the exception of vomiting, however, there was difficulty in explaining the features.

In our experience such patients are characteristically youngsters with good renal function and in some we have identified a massive urinary loss of sugar and a greater tendency to a low renal threshold to glucose than in others. Since ketoacidosis is generally regarded as the metabolic outcome of excessive gluconeogenesis coupled with increased fatty acid release, it seems difficult to postulate that the relative euglycaemia is due to a lesser glucose formation in such cases. A greater urinary loss of glucose seems to us more likely. Whether this is a consequence of increased growth hormone secretion affecting renal function, related to the enhanced clearance reported in early diabetic renal involvement,[1] or simply represents one end of the spectrum in terms of the renal threshold to glucose, remains to be determined. Whatever the explanation, perhaps the clue lies in the suggestion by Dr. Munro and his colleagues that there is an ability to grow out of the tendency.—We are, etc.,

J. T. IRELAND
Medical Unit,
W. S. T. THOMSON
Biochemistry Department,
Southern General Hospital,
Glasgow

1 Ditzel, J., and Schwartz, M., *Lancet*, 1967, 1, 276.

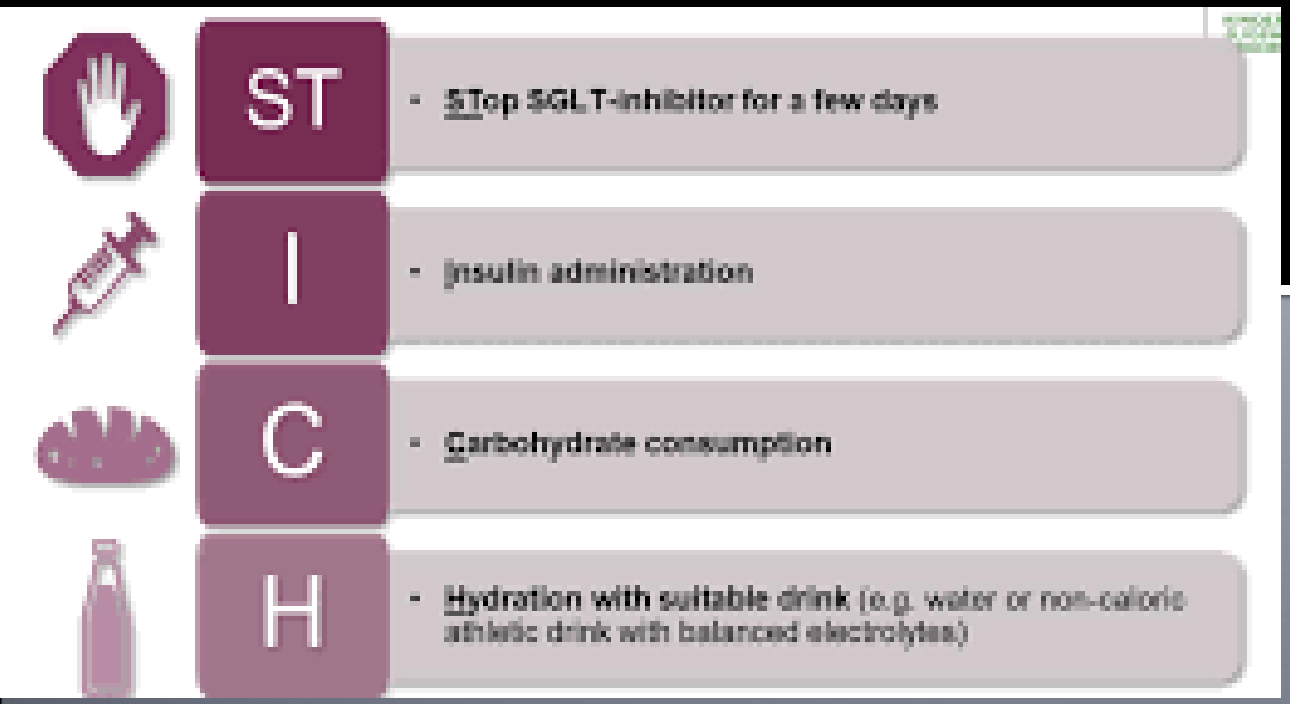


Table 1 'STICH' protocol-based practicalities of management once ketosis has been confirmed in the setting of SGLT inhibitor use in combination with insulin for the treatment of type 1 diabetes

Step	Strategy	Action
1	Confirm diagnosis	Verify ketosis by early symptoms Identify conditions that might be causing ketosis;* test for ketones
2	Invoke the '**STICH**' protocol	**ST**op the SGLT inhibitor† + **I**nject bolus insulin + **C**onsume 30 g carbohydrates + **H**ydrate
3	Monitor response	Recheck ketones every 3–4 hours
4	Escalate care	Seek emergency medical care if (a) ketosis does not resolve or (b) if symptoms of DKA appear, including abdominal pain, nausea, vomiting, fatigue, and/or dyspnoea.

* Symptoms may start hours after last SGLT inhibitor dose.
† Patients should not take the SGLT inhibitor after ketosis is detected and not take another dose until ketones have resolved and patient has received appropriate care.

Acute illness dehydration, vomiting, reduced intake (starvation or eating disorder) excessive alcohol consumption, chronic liver disease and glycogen storage disorders, pregnancy and substance abuse with cocaine.

Diabetes care in End Stage Kidney Disease

- Dialysis – HD and PD
- Failing SPK – what to look for
- AHCL in failing SPK case
- AHCL in type 1 on dialysis

Diabetes management in people on Haemodialysis

Managing glucose control in people with diabetes on HD is challenging

1.High risk of Hypoglycaemia

2.HbA1c less reliable

3.Variability of glucose is common amongst due to several factors:

- Clearance of glucoregulatory hormones (insulin, glucagon) on HD
- HD causes periodic improvement in uraemia, acidosis and inflammatory mediators which can lead to subsequent improved insulin secretion
- Glucose concentration in the dialysate may influence glucose control, and, in particular, low glucose dialysates may predispose to hypoglycaemia
- Blood glucose often falls during a HD session, and often glucose levels may be low for 24-hour post dialysis
- HD may clear diabetes therapies such as insulin

Personal experience Janaka Karalliedde

Haemodialysis (HD) and glucose control

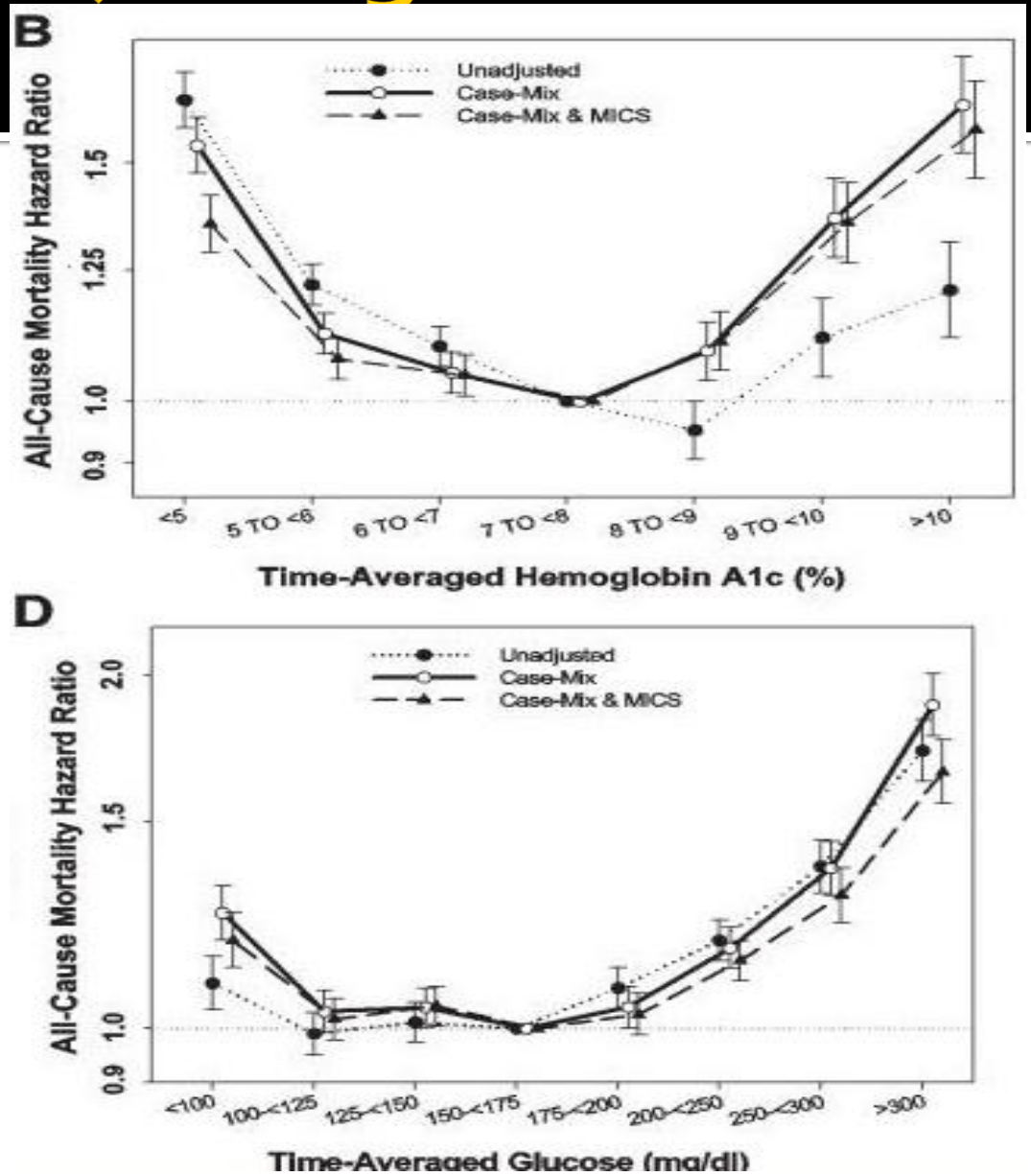
- Major risk is hypoglycaemia

2-3 higher risk on dialysis days versus non dialysis days

- "U" shaped curve of HbA1c and dialysis

Higher mortality with A1Cs <6.5% or >9%

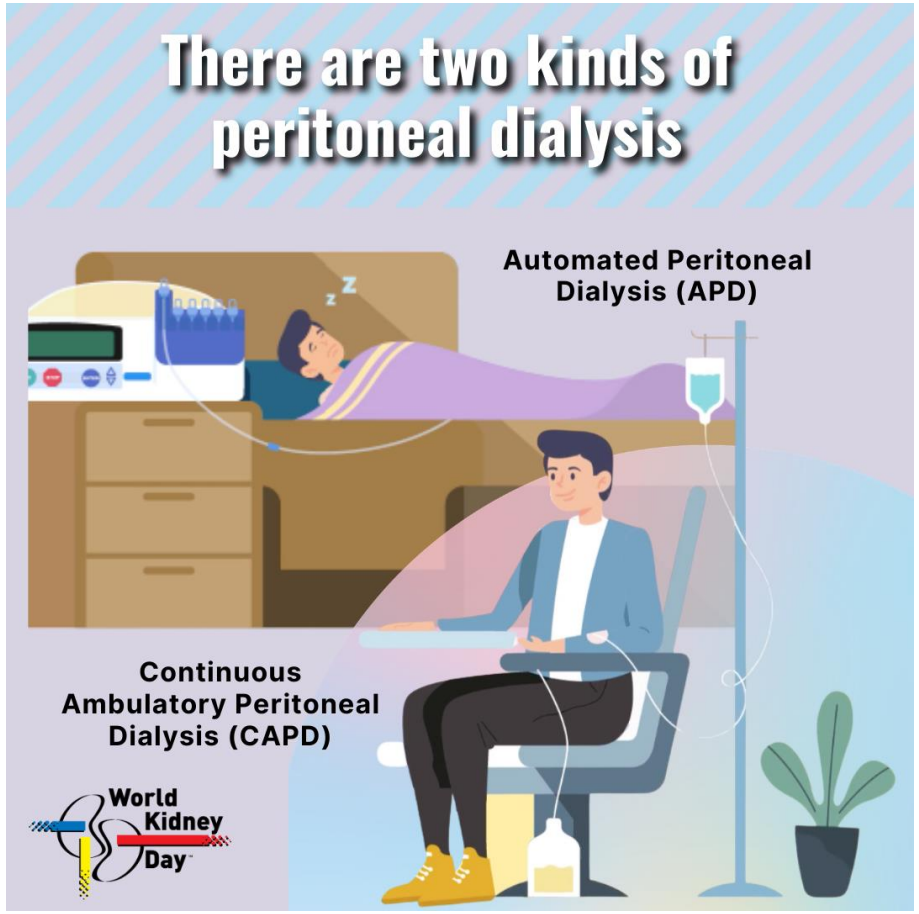
- Consider reducing insulin on dialysis days
- Feet – a high risk for severe foot problems
- Eye checks -high risk

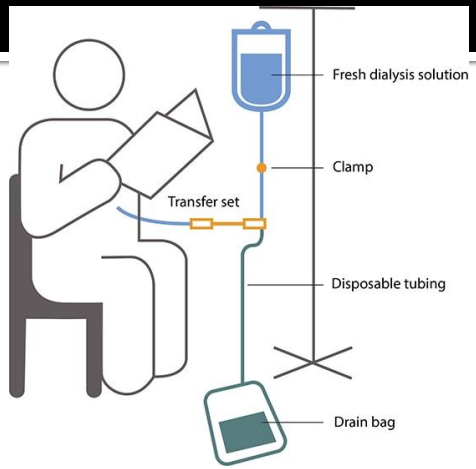


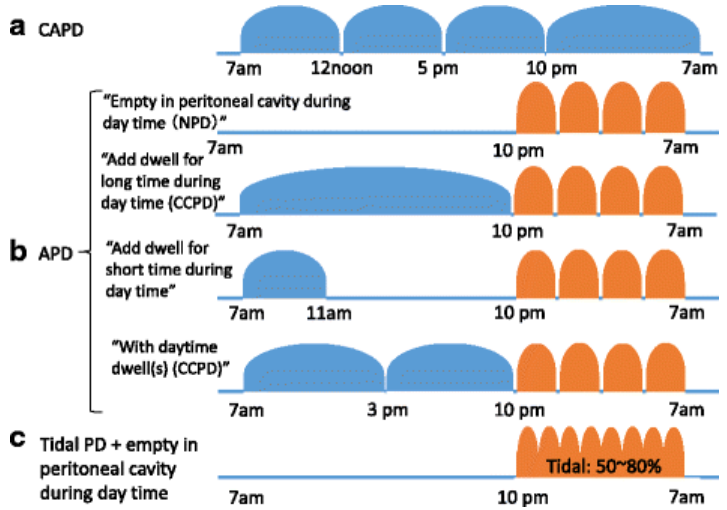
Personal experience Janaka Karalliedde

Rhee et al Semin Dial. 2014 doi: 10.1111/sdi.12198

Peritoneal dialysis diabetes management







Managing glucose control in people with diabetes on PD is challenging

1. Can have fragmented clinical care and follow up
2. High risk of Hypoglycaemia and Variability of glucose is common

Glucose remains the most commonly used osmotic agent in peritoneal dialysate.

Standard solutions available have concentrations ranging from 1.5% to 4.25% dextrose (1,360, to 3,860 mg/dL of glucose respectively)

As a result of its small molecular size glucose is freely absorbed from the peritoneal cavity and net absorption of glucose estimated at **100-300g per 24 hours** depending on the PD regime.

Besides the tonicity of dialysate, the amount of glucose absorbed depends on peritoneal membrane transport characteristics, dwell time, dialysate volume, and the patient's blood glucose level

	1.5 L		2.0 L		2.5 L		3 L		5 L	
	g	kcal	g	kcal	g	kcal	g	kcal	g	kcal
1.5%	22.5	83	30	111	37.5	139	35	130	75	278
2.5%	37.5	139	50	185	62.5	232	75	278	125	463
4.25%	63.75	236	85	315	106.25	393	127.5	472	212.5	786

Caloric load has been rounded up to the nearest kcal.

Personal experience Janaka Karalliedde,

Glucometers and PD - Why it matters

- In general, there are 2 key components of a glucometer: an enzyme reaction and a detector. Three types of enzymatic reactions are currently being utilized: glucose oxidase, glucose dehydrogenase (GDH), and hexokinase.
- GDH based glucometers use 3 types of co-enzymes, one of which is co-enzyme pyrroloquinoline-quinone (GDH-PQQ),
- Icodextrin is metabolized to maltose which cross reacts as glucose, giving falsely high glucometer values when using GDH-PQQ based glucometers. This overestimation of BG can lead to significant hypoglycaemia and delay in recognizing hypoglycaemia.

Diabet Med. 2022 Dec 16:e15027. doi: 10.1111/dme.15027. Online ahead of print

Case Reports > J Emerg Med. 2013 Feb;44(2):e191-3. doi: 10.1016/j.jemermed.2012.02.037. Epub 2012 May 11.

Masked hypoglycemia in the presence of icodextrin for peritoneal dialysis

Michael M Khouli [1]

Affiliations + expand

PMID: 22579020 DOI: 10.1016/j.jemermed.2012.02.037

> Korean J Anesthesiol. 2009 Feb;56(2):221-224. doi: 10.4097/kjae.2009.56.2.221.

Severe hypoglycemia due to falsely elevated capillary blood glucose levels in a peritoneal dialysis patient using icodextrin: A case report

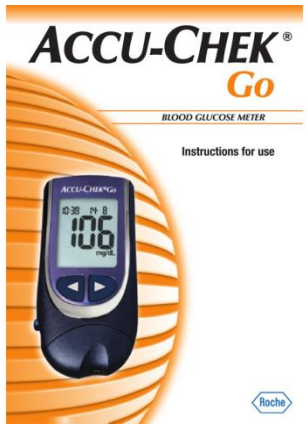
Eun Jung Cho [1], Seung Hwan Lee [1]

Affiliations + expand

PMID: 30625727 DOI: 10.4097/kjae.2009.56.2.221

Free article

Therefore, in order to avoid over estimation of blood glucose levels and subsequent over treatment with insulin, **GDH-PQQ based glucometer systems should not be used in people undergoing PD**



Case Reports > Saudi J Kidney Dis Transpl. 2011 Jul;22(4):764-8.

Severe hypoglycemia in peritoneal dialysis patients due to overestimation of blood glucose by the point-of-care glucometer

Hasan M Al-Dorzi [1], Hythem Al-Sum, Salem Alqurashi, Saleh J Aljaser, Yaseen M Arabi

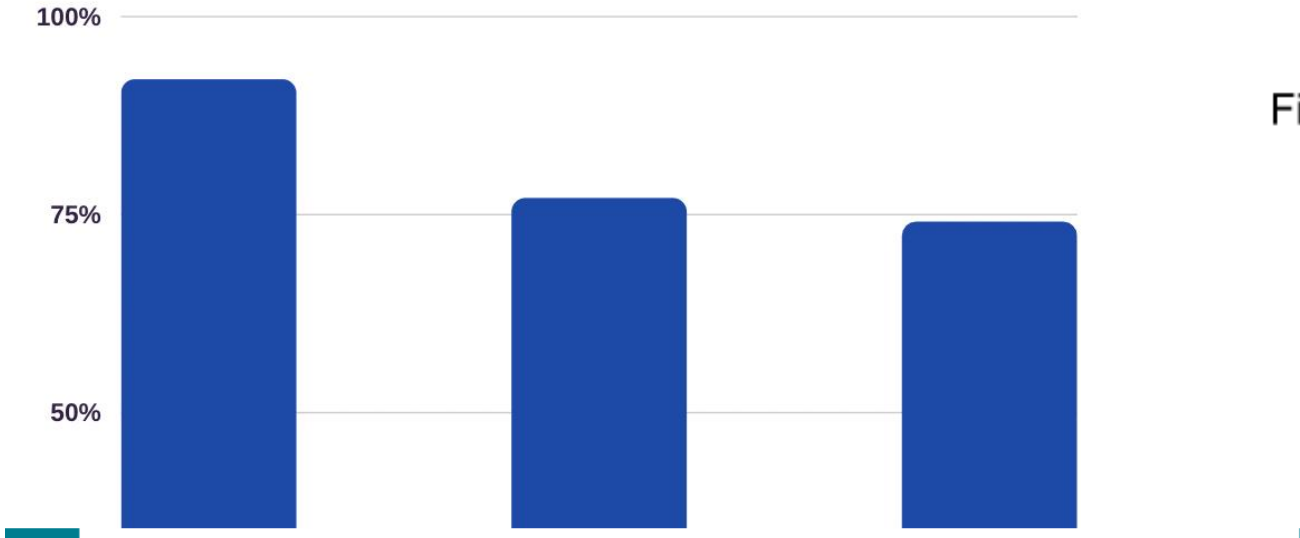
Affiliations + expand

PMID: 21743225

Results Standard of diabetes care of 64 people with diabetes on PD

The percentage of people with diabetes on peritoneal dialysis seen at least annually varied between 63% and 94%

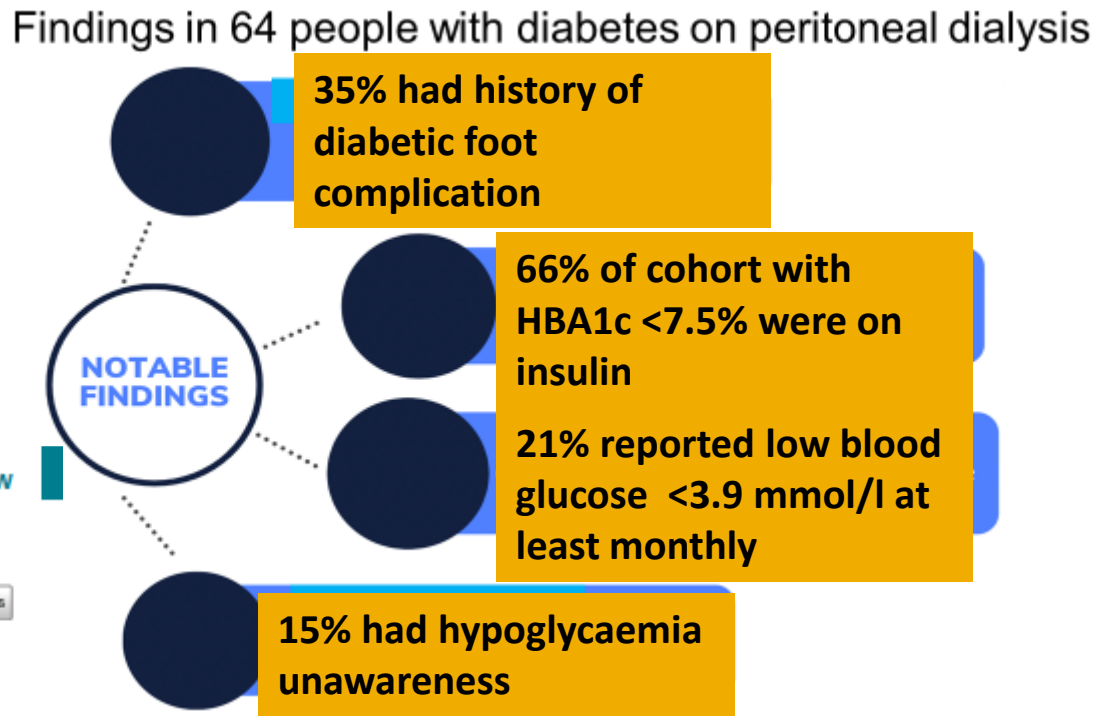
Of the cohort 92% had at least annual retinal screening and 77% had at least an annual foot review



KI REPORTS
KIReports.org
REVIEW

Narrative Review of Glycemic Management in People With Diabetes on Peritoneal Dialysis

Piyumi Wijewickrama[1], Jennifer Williams[2], Steve Bain[3], Indranil Dasgupta[4], Tahseen A. Chowdhury[5], Mona Wahba[6], Andrew H. Frankel[7], Mark Lambie[8], Janaka Karalliedde[9] and on behalf of The Association of British Clinical Diabetologists (ABCD) and UK Kidney Association (UKKA) Diabetic Kidney Disease Clinical Speciality Group[10]



Wijewickrema P et al Peritoneal dialysis international 2023 and Kidney International Reports 2023

Insulin pumps and CGM used in our diabetes renal clinic at Guy's Hospital London

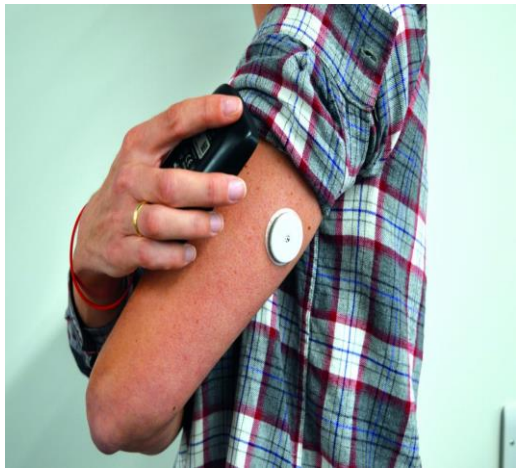
A. Medtronic 780G with Guardian sensor/transmitter.
B. Omnipod 5
C. Tandem t:slim pump
D. Freestyle Libre 2
E. Dexcom G6
F. YpsoMed CamAPX

A.

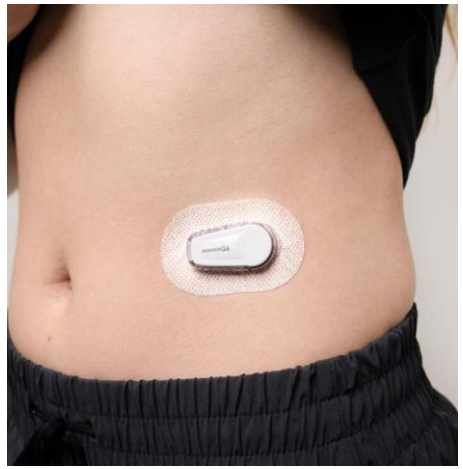
B

C.

D.



E.



F.

Personal experience Janaka Karalliedde, Cases from Guy's Hospital

Continuous Glucose Monitoring (CGM) in person with diabetes on HD

AGP Report

26 June 2023 - 9 July 2023 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

26 June 2023 - 9 July 2023	**14 Days**
Time sensor active:	**95%**

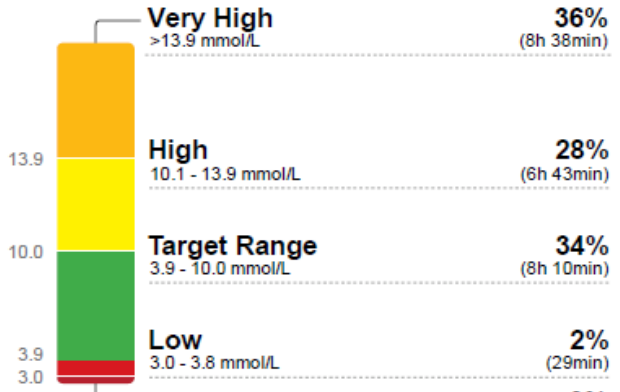
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	**Targets** % of Readings (Time/Day)
Target Range 3.9-10.0 mmol/L	Greater than 70% (16h 48min)
Below 3.9 mmol/L	Less than 4% (58min)
Below 3.0 mmol/L	Less than 1% (14min)
Above 10.0 mmol/L	Less than 25% (6h)
Above 13.9 mmol/L	Less than 5% (1h 12min)

Each 5% increase in time in range (3.9-10.0 mmol/L) is clinically beneficial.

Average Glucose	**12.2** mmol/L
Glucose Management Indicator (GMI)	**8.6% or 70 mmol/mol**
Glucose Variability	**37.9%**

Defined as percent coefficient of variation (%CV)

TIME IN RANGES

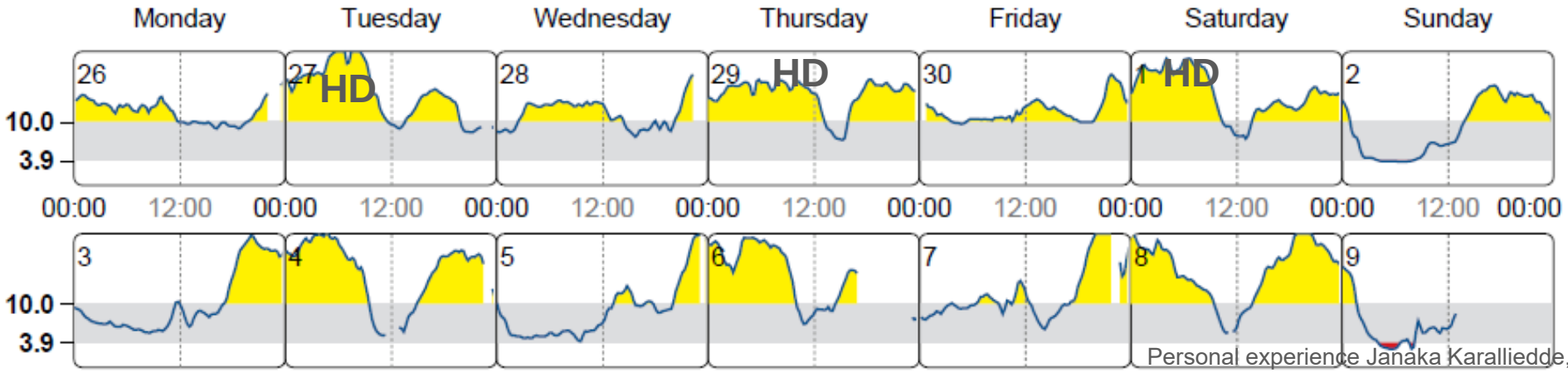


Aged 78 on HD
Lives alone
Aim for Time in target range 50-60%
And <3.9 mmol/l
<1% of time

Glycemic variability (%CV) target ≤36%

DAILY GLUCOSE PROFILES

Each daily profile represents a midnight to midnight period with the date displayed in the top-left corner.



Personal experience Janaka Karalliedde, Case from Guy's Hospital

Hyperglycaemia post SPK transplant

- Differential diagnosis include

a. failing pancreas graft (acute post op-surgical complications or later onset),

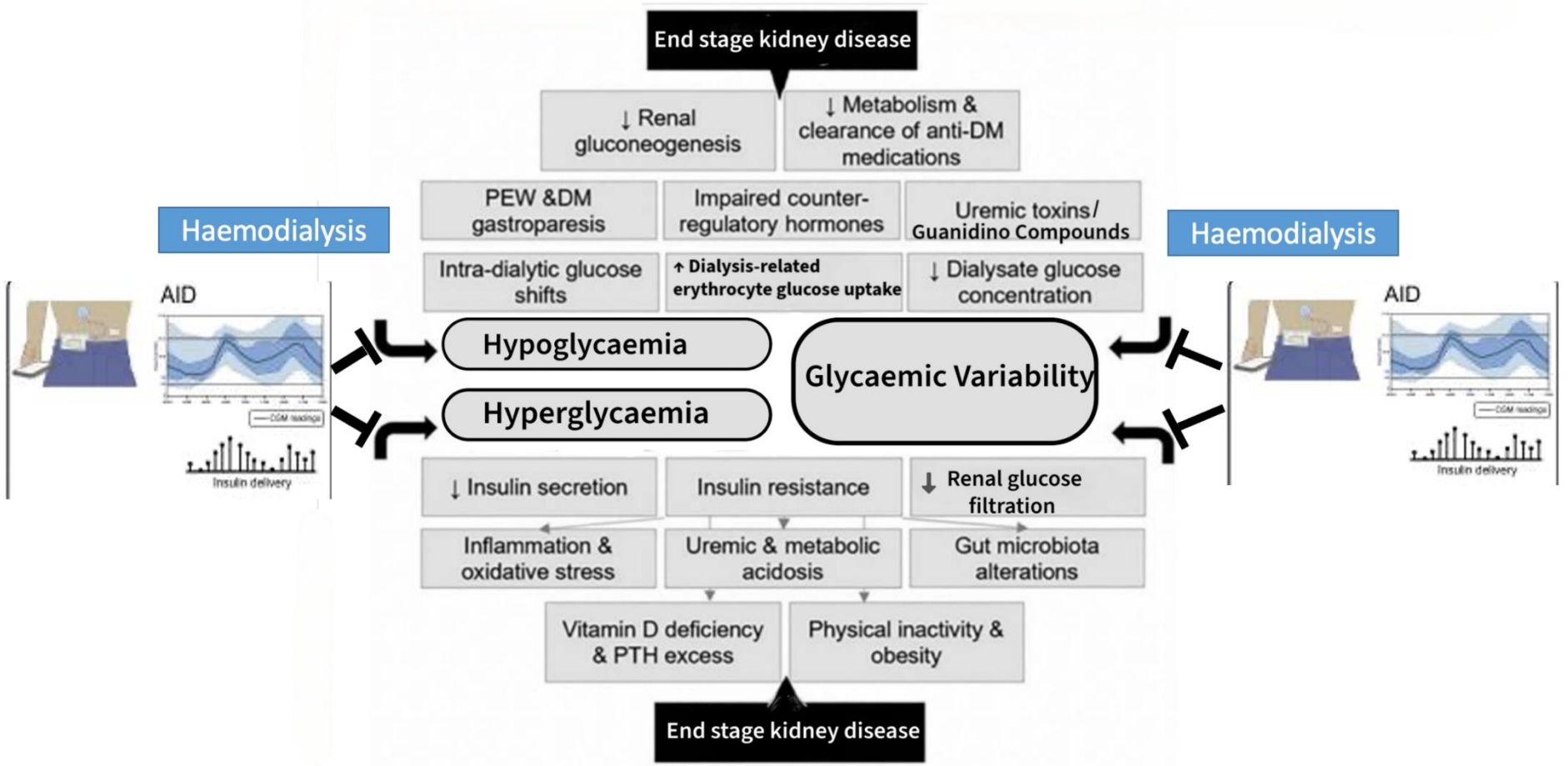
b. recurrence of T1DM,

c. diabetes post-transplant (related to immunosuppression/weight gain post transplant)

- Clinical assessments- if clinically significant new onset symptoms - restart insulin
- Investigations –, glucose data (CGMS or home CBG), HbA1c (trend may be useful), diabetes auto-antibodies, C-peptide (trend - pre/post transplant), amylase, imaging (CT Abdomen/MRI for thrombosis), biopsy
- Management/treatment- depends on cause

Personal experience Janaka Karalliedde, Cases from Guy's Hospital Hua J et al Diabetic Med 2023

Using automated insulin delivery ('artificial pancreas') in people with type 1 diabetes on haemodialysis



Diabetes Research Clinical Practice 2024, J Diabetes Investigation 2023 and 2025

Dialysis meets devices: The use of automated insulin delivery in end stage kidney disease and haemodialysis

Journal: *Expert Review of Endocrinology & Metabolism*

Expert Review of Endocrinology & Metabolism
Pavlou P et al 2026 online open access

Pathophysiological challenges in ESKD	AID mitigating feature
• ***Increased risk of hypoglycaemia***	• *Automatic suspension of insulin delivery upon detection of impending hypoglycaemia* • *Low glucose alarms helpful in nocturnal hypoglycaemia or cases of impaired hypoglycaemia awareness* • *Algorithms can be adjusted to prevent hypoglycaemia on dialysis days by altering glucose target or by using "activity/exercise mode"*
• ***Impaired insulin clearance***	• *Most systems allow adjustment of active insulin time*
• ***Increased insulin resistance*** • ***High glucose variability***	• *Automatic adjustment of basal insulin and correction bolus delivery factor at every few minutes based on CGM and pump data.* • *Healthcare professionals can access AID data illuminating discernible patterns in insulin requirements glucose variability, allowing for meaningful intervention thereby reducing the risk of clinical inertia due to the complexity of glycaemic profile*

Assess suitability:

-Before starting dialysis, individuals using AID systems should be assessed to confirm whether AID therapy can be continued safely and to determine if any setting adjustments are needed. Ability to self-manage AID also needs to be assessed. Ensure recent ophthalmology (eye clinic) review and no immediate risk of progression/worsening of existing diabetes complications (e.g. retinopathy, neuropathy) if rapid reduction of glucose occurs

Coordinated Care Plan:

-If the patient is considered appropriate to remain on AID therapy, a multidisciplinary diabetes care plan should be created and recorded within the shared electronic medical record.

-When beginning AID treatment, structured follow-up is essential, typically involving 2–3 contacts per week (face-to-face or virtual) for about the first two weeks. After this initiation phase, appointments can be reduced to weekly as needed. Once therapy has been established for two months, the review schedule may be tailored to individual requirements

- Consider the presence of diabetes complications such as advanced retinopathy and neuropathy (peripheral and autonomic) which can be exacerbated by rapid fluxes in glycaemic control. Prior to AID initiation ensure the patient is up to date with retinopathy screening and there is no active eye disease which requires treatment. In the context of such complications, initiation of AID may be postponed, or conservative glycaemic treatment goals may need to be adopted. Using an insulin pump in manual mode for the initial period may be a viable strategy, with activation of AID at a later stage to ensure gradual and cautious glycaemic improvement.

Recommendations for AID Use During Dialysis:

-Modify blood glucose target, active insulin time and basal profile to more conservative settings when starting dialysis or initiating AID in the context of end-stage kidney disease. SmartGuard™ and SmartAdjust™ provide glucose target options as high as 8.3 mmol/L, Control IQ 7.8- 8.9 mmol/L and CamAPS™ even higher (up to 11 mmol/L). Glucose target of 8.3 mmol/l at initiation would be suitable in most cases in the context of ESKD.

-Advise patients to refrain from administering bolus doses during dialysis to due to risk of hypoglycemia.

-Avoid paracetamol when using Medtronic CGM sensors, as it can interfere with sensor accuracy.

-Keep the control device (e.g., smartphone) within six meters of the person at all times.

-If low blood glucose is a concern during dialysis sessions, consider activating temporary modes (activity/exercise/sleep) to increase target glucose levels for a designated time period. Activation 2-4 hours prior to dialysis continuing for 2-4 hours after dialysis (or longer depending on individual susceptibility to hypoglycaemia) could be a viable strategy. In addition, SmartGuard™ offers the option to manually turn off autocorrections during dialysis.

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Case series of using automated insulin delivery to improve glycaemic control in people with type 1 diabetes and end stage kidney disease on haemodialysis

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Tme in range (TIR) increased from 43.5% pre-AID to 64.8% post-AID (p=0.015), with a reduction in mean time above range from 55.5% pre-AID to 34.8% post-AID (p=0.03).

TIR (3.9-10 mmol/l)

JDI Journal of Diabetes Investigation Open access
Official Journal of the Asian Association for the Study of Diabetes

SHORT REPORT

Using automated insulin delivery to address the clinical challenges of glycemic management in people with type 1 diabetes and kidney failure on maintenance hemodialysis

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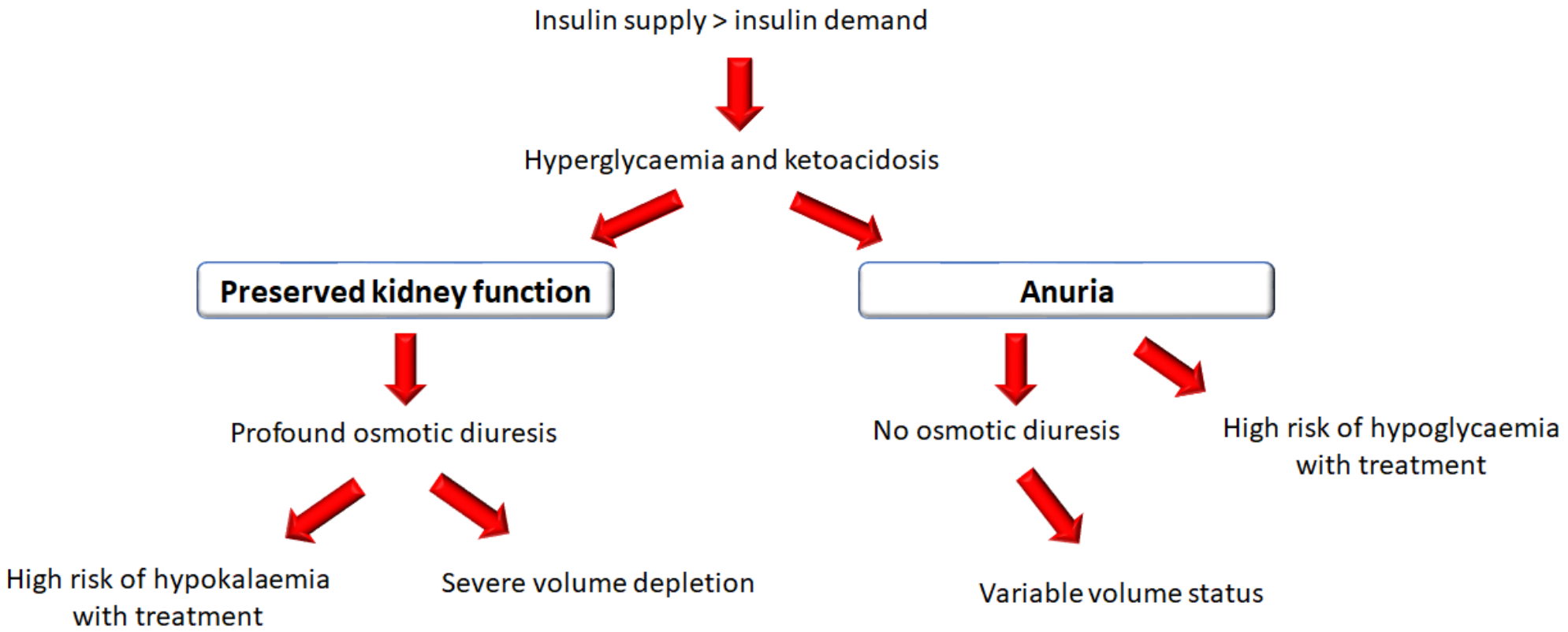
With AID- TIR Increased from ~40% to ~60% ($p<0.05$)
Glucose variability fell 40% to 34% ($p<0.05$)
HbA1c (lab) 78.6- 56.1 mmol/mol ($p<0.05$)
Time below range 4% to 1.4% (NS)

DKA on Dialysis

JK

Pathophysiological Differences



Volume Phenotype	Labs	Fluid Management
Hypovolaemic 	High Na+ High Tonicity	Small isotonic fluid boluses with reassessment 
Euvolaemic 	Low Na+ High Tonicity	Fluids not indicated 
Hypervolaemic 	Low Na+ Normal/Low Tonicity	Insulin alone can improve pulmonary oedema 

Ongoing management

Insulin infusion

Consider slower rate of 0.05units/kg/hour due to higher risk of hypoglycaemia

Dextrose infusions

Consider higher concentration and lower volume of dextrose (E.g. 20% dextrose)

Dialysis

Consider isolated ultrafiltration for refractory pulmonary oedema

You may recognise these guys from Joel Topf and Sarah Faubel's *The Fluid, Electrolyte and Acid-Base Companion*. 1999.

Insulin 0.02–0.05 units/kg/hour
(lower than the 0.1 units/kg/hour used in preserved renal function)

DKA in Anuric Patients on Dialysis - Summary

@jamiekwillows
@simonjsmiths

Pathophysiology

Anuria

Insulin deficiency

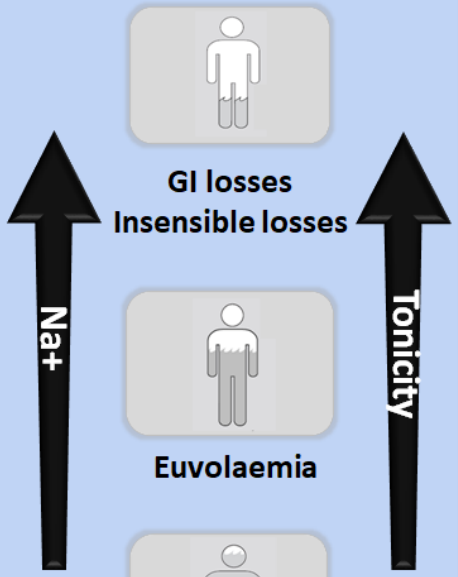
Hyperglycaemia and Ketoacidosis

No osmotic diuresis

Increased risk of Hypoglycaemia with treatment

Variable volume status

Volume Phenotypes



GI losses
Insensible losses

Euvolaemia

EC fluid shift
Thirst

Management

Intravenous insulin
(Can improve pulmonary oedema. Consider a slower rate of infusion)

Fluids as per volume status
(Consider 250-500ml boluses if hypovolaemic)

Do not routinely replace potassium
(Increased total body potassium + no diuresis)

Isolated Ultrafiltration
(For treatment resistant pulmonary oedema)

Take Home Points

There is lacking evidence for the management of DKA in this cohort

The "usual" DKA protocols can be dangerous

Insulin is the mainstay of treatment. The role of dialysis is unclear

Ask for help early! Closer monitoring is needed

Post Transplant Diabetes Mellitus

TAC

Case 4

- A 57 y/o man develops immediate post-operative hyperglycaemia (glucoses 18-27 evening) after renal transplantation

- How should this be managed?

Transplantation and DM

- PTDM is common in patients undergoing transplantation
  - Reasons are multifactorial –
    - Calcineurin inhibitors / steroids
    - Weight gain
  - Post-prandial hyperglycaemia – glucose high post evening meal

Time	07.00	12.00	18.00	22.00
Glucose (mmol.l)	5.6	8.7	15.6	27.0

- Strong epidemiological evidence that diagnosis of PTDM increases risk of mortality by 2 fold and graft loss by 1.5x

Risk factors for PTDM

Non-modifiable	Modifiable

• Age
• Ethnicity
  – Black
  – Hispanic
  – South-Asian
• Family history of diabetes mellitus
• Cause of end-stage renal failure
  – Polycystic kidney disease
• Gender
• HLA mismatch
• Deceased-donor kidney
• Genetics
• Innate immunity
	• Previous stress related hyperglycaemia
	• Obesity
	• Metabolic syndrome
	• Pre-transplant triglycerides
	• Cytomegalovirus
	• Hepatitis C
	• Immunosuppression
	  – Tacrolimus
	  – Ciclosporin
	  – Sirolimus
	  – Corticosteroids
	  – Basiliximab
	• Rejection episodes
	• Hypomagnesaemia
	• Anti-hypertensive medications
	  – Beta blockers
	  – Thiazide diuretics

Calcineurin Inhibitors

Sirolimus plus calcineurin inhibitors

Tacrolimus plus steroids

Sirolimus plus MMF and steroids

Ciclosporin plus MMF and steroids

Calcineurin Inhibitors

- Cochrane review –
  - Tacrolimus based immunosuppression instead of ciclosporin may have avoided 12 episodes of acute rejection but resulted in 5 extra cases of insulin treated diabetes

Transplantation and DM

- Currently no RCT evidence that tight glucose control improves outcomes
- Nevertheless active prevention, detection and management is needed

Transplantation and DM

PRE-OPERATIVE

- Establish risk factors for diabetes (obesity, family history, previous GDM, high risk ethnic group, glucocorticoid therapy).
- Monitor FPG and HbA_{1c} ideally six monthly (High risk if FPG 6.1-6.9 mmol/L or HbA_{1c} 42-47 mmol/mol (6.1-6.4%).
- If high risk for diabetes, advise weight loss, increased exercise and improved diet, smoking cessation.
- If $HbA_{1c} \geq 48$ mmol.mol or FPG $\geq$ 7.0 mmol/L on two occasions diagnose diabetes and put on to standard diabetes pathway.

Transplantation and DM

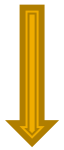
IMMEDIATELY POST-OPERATIVE

- Monitor afternoon CBG readings.
- If CBG persistently (x2) >11.0 mmol/L consider therapy.
- If CBG 11-13.9 mmol/L, patient is eating and clinically well, consider oral hypoglycaemic therapy (metformin [if eGFR > 30 mls/min], DPP-4i or sulfonylurea singly or in combination may be used).
- If CBG > 14.0 mmol/L on two occasions, commence insulin.
    - If clinically unstable and/or not eating, give VRIII with iv 5% glucose.
    - If clinically stable and eating, commence s/c NPH insulin 10 units and rapidly titrate.
    - Consider adding metformin if no contra-indications.
    - CBG target 4-12 mmol/L.
    - Refer for dietetic advice to reduce glycaemic excursions.
    - Refer for education regarding insulin therapy and CBG monitoring, and undergo regular follow by a health professional with expertise in diabetes management.
    - Ensure primary care are aware of diagnosis of post-transplant hyperglycaemia.

Transplantation and DM

UPTO SIX WEEKS POST OPERATIVE

- Regular review with aim to reduce glucocorticoid dose, stabilise immunosuppression, *consider* conversion to less diabetogenic CNI therapy (eg ciclosporin) if no signs of rejection and stable graft function.
- Reduce oral hypoglycaemic therapy or insulin if possible.
- Ensure diet and lifestyle changes are optimised.
- At six weeks, consider OGTT if practical.
- During OGTT, if FPG ≥7.0 mmol/L or 2 hour PG ≥11.1 mmol/L diagnosis PTDM and treat as below.



Transplantation and DM

THREE MONTHS POST OPERATIVE

If CBG well controlled and HbA1c at target, consider reduction in anti-hyperglycaemic therapy with careful self-monitoring of CBG.

If hyperglycaemia resolved (CBG < 11 mmol/L) off anti-hyperglycaemic therapy, screen for PTDM with OGTT if possible, but if not, request HbA_{1c} and FPG.

- If $HbA_{1c} \geq$ 48 mmol.mol or FPG $\geq$ 7.0 mmol/L on two occasions **diagnose PTDM**
  - Ensure patient and their primary health care team are informed of the diagnosis and the diagnosis is coded on the patients electronic care record.
  - Refer patient for structured education and regular screening of eyes, feet, kidneys, blood pressure, weight, smoking status and lipids.
  - Improve CV risk factors.
  - Individualise glycaemic target according to patients preference and co-morbidities.
  - Drugs such as metformin (if eGFR > 30 ml/min/1.73m^2), gliptins, GLP-1 analogues, and insulin can all be used safely post transplantation.
  - Avoid pioglitazone and saxagliptin in heart failure.
  - Seek specialist advice when considering SGLT2 inhibitors.
-
- If HbA_{1c} < 42 mmol.mol (6.0%) and FPG < 6.0 mmol/mol, PTDM is not diagnosed and hyperglycaemia has resolved.
  - Continue to monitor HbA_{1c} and FPG at 12 months and then annually.
- If HbA_{1c} 42-47 mmol.mol (6.0-6.4%) or FPG 6.1-6.9 mmol/L, patient is at risk of developing PTDM
  - Continue to monitor HbA_{1c} and FPG at 6 monthly intervals.
  - Offer lifestyle advice to reduce risk of developing PTDM.

Newer drugs in PTDM?

- Database study of 1970 SGLT-2i users in diabetic KTR propensity matched to 1970 non-users
- Median follow-up of 3.4 years, SGLT-2i users showed lower:
  - all-cause mortality (HR 0.32)
  - MACE (HR 0.48)
  - MAKE (HR 0.52)
  - No increase in UTI

Sheu JY, Chang LY, Chen JY, Pan HC, Tseng CS, Chueh JS, Wu VC. The outcomes of SGLT-2 inhibitor utilization in diabetic kidney transplant recipients. Nat Commun. 2024 Nov 20;15(1):10043. doi: 10.1038/s41467-024-54171-8. PMID: 39567483; PMCID: PMC11579355.

GLP-1s in PTDM?

- Data from RLH clinic published in 2023 for GLP-1s in PTDM

	Mean difference ± SD at 1 year (n=19)	Mean difference ± SD at 2 years (n=12)
Weight (kg)	-2.66 ± 5.82 (p = 0.08)	-4.73 ± 5.29 (p = 0.02)
BMI (kg/m²)	-0.9 ± 2.07 (p = 0.09)	-1.03 ± 2.57 (p = 0.24)
SBP (mmHg)	2.5 ± 24.93 (p = 0.69)	-1.25 ± 21.61 (p =0.88)
DBP (mmHg)	-0.25 ± 12.47(p = 0.94)	-6.63 ± 12.72 (p = 0.18)
Creatinine (µmol/L)	2.16 ± 31.95(p = 0.77)	-0.41± 28.7 (p = 0.96)
eGFR (ml/min/1.73m²)	-0.42 ± 9.78 (p = 0.85)	0.33 ± 8.37 (p = 0.89)
HbA_{1C} (mmol/mol) (%)	-14.95 (1.3) ± 18.97 (1.5) (p = 0.003)	-12.58 (1.1) ± 23.88 (1.7) (p =0.95)

Lots of questions remain

1. Despite PTDM appearing to impact on graft and patient survival, does treatment lead to better outcomes?
2. Should we be screening pre transplant?
    1. Glucose tests?
    2. Risk scores?
3. Could weight reduction on haemodialysis have an impact
    1. Dialysis on exercise bikes?
    2. GLP-1s?
4. Metformin / other drugs for prevention
    1. pre-transplant or immediately peri-transplant
    2. GLP-1s?

Summary of PTDM guidance

- Guidelines available on management of PTDM
- https://abcd.care/sites/abcd.care/files/site_uploads/Resources/Position-Papers/ABCD-RA-PTDM-Diab-Med.pdf
- Large evidence gap and need for more studies

Pancreas Transplantation

Tahseen

Learning objectives for this session

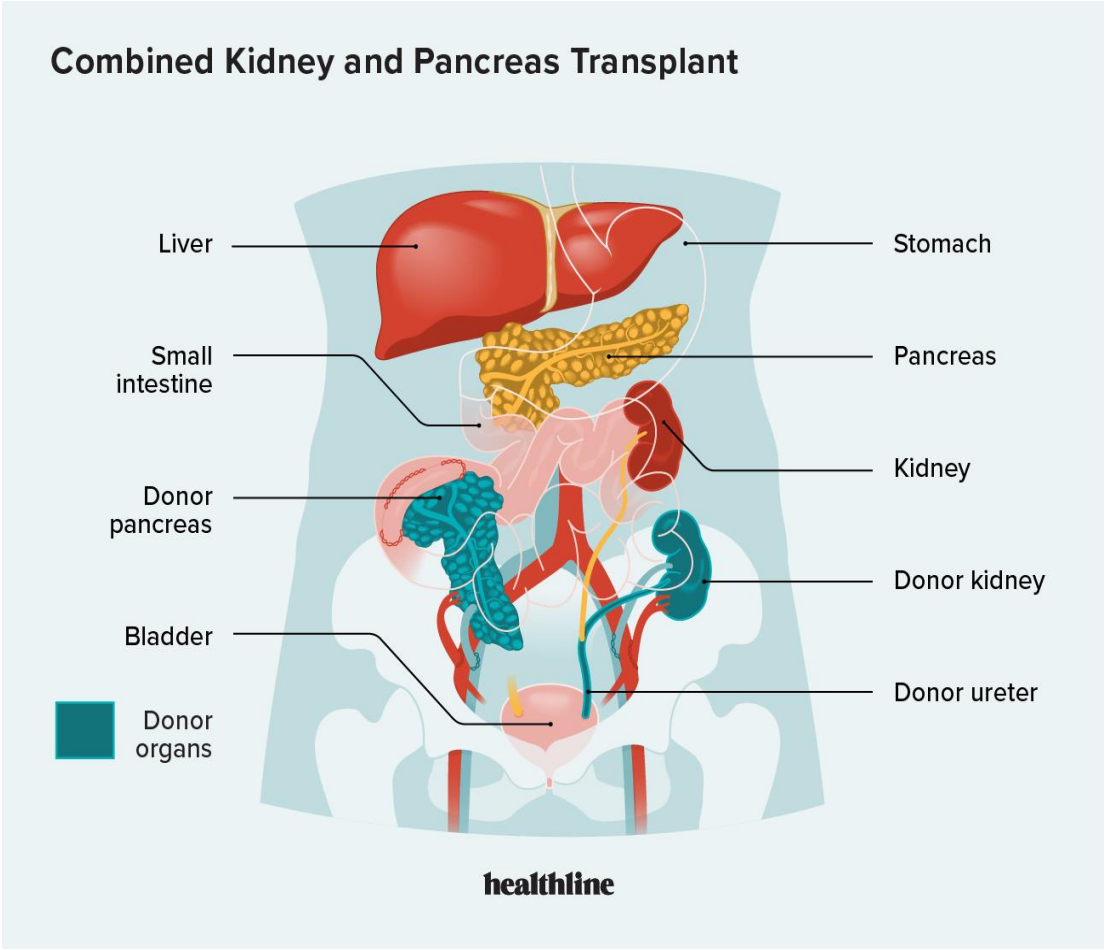
6. To be familiar with the reasons for considering simultaneous pancreas and kidney transplantation.

Options for transplantation in people with T1D

- Beta cell replacement therapy has been available for treatment of T1D for > 5 decades.
  - Simultaneous pancreas and kidney (SPK)
  - Pancreas after kidney (PAK)
  - Islets after kidney (IAK)
  - Simultaneous islet and kidney (SIK)
  - (Stem cells)
  - Currently SPK is considered for people with insulin deficient diabetes and ESKD

Criteria for SPK referral

- T1D (some slim T2D on insulin) and are already on dialysis or will be on dialysis within 6 months (eGFR < 20 mL/min/1.73 m^2)
- < 65 years old (most < 55)
- BMI < 32 (most < 30)
- Adequate CV reserve (assessed by echocardiogram + ETT or nuclear medicine myocardial perfusion scan or dobutamine stress echocardiogram)
- Adequate respiratory reserve as assessed by lung function tests



https://www.guysandstthomas.nhs.uk/referral-guide/pancreas-transplant

TTAs

- DKD
  - Is defined by presence of (micro-)albuminuria in a person with diabetes, with progressive reduction in renal function
  - Defines a population of people with diabetes who have a significantly increased CV risk
  - Intervention to improve BP with ACEI/ARBs reduces risk of progression
  - No good evidence that improved glucose control reduces risk of progression in T2D
- New agents
  - SGLT2s show definitive evidence of benefit in DKD
  - MRAs and GLP-1s should be considered in people who continue to progress despite maximal RAAS blockade and SGLT-2i

TTAs

- Diabetes and dialysis
  - Glycaemic management is challenging
  - HbA1c may not be helpful
  - CGM is helpful
- PTDM
  - Guidance available on screening, diagnosis and management
  - Much more evidence required
- SPK
  - Consider SPK in some patients with T1D and ESRD

Thanks for your attention

Any questions?

Further reading

Association of British Clinical Diabetologists and UK Kidney Association Joint Clinical Practice Guidelines for the Pharmacological Management of Hyperglycemia in Adults With Type 2 Diabetes Mellitus and CKD Kidney International Reports, Volume 10, Issue 10, 3318 – 3331 October 2025

Management of adults with diabetes on dialysis: Summary of recommendations of the Joint British Diabetes Societies guidelines 2022. Diabet Med. 2023

Narrative Review of Glycemic Management in People With Diabetes on Peritoneal Dialysis. Kidney Int Rep. 2023 Feb 9;8(4):700-714.

Case series of using automated insulin delivery to improve glycaemic control in people with type 1 diabetes and end stage kidney disease on haemodialysis
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Dialysis meets devices: the use of automated insulin delivery in end stage kidney disease and haemodialysis Accepted 15 Jan 2026, https://doi.org/10.1080/17446651.2026.2619097
Expert Review of Endocrinology & Metabolism

Association of British Clinical Diabetologists and Renal Association guidelines on the detection and management of diabetes post solid organ transplantation. Diabet Med 2021: e14523. https://doi.org/10.1111/dme.14523