

# Prevalence and progression of chronic kidney disease among adults undergoing creatinine testing in South African public healthcare facilities: a study leveraging data from South Africa's National Health Laboratory Service (NHLS)

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*Disclosures: none*



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# Motivation

- Chronic kidney disease (CKD) is a growing public health concern
- Wide variation in CKD prevalence estimates in existing literature
  - Prevalence in South African adults is estimated to be between 5.9% - 28.9%
- CKD often goes undetected until critical advanced stages
- Knowledge of CKD burden could increase awareness and improve early detection, slowing progression to end-stage kidney disease

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# Objective

We sought to **estimate CKD prevalence** and **assess disease progression** among adult patients receiving serum creatinine tests at a government sector hospital or clinic in South Africa using data from South Africa's National Health Laboratory Service (NHLS) database.

# Methods

# NHLS cohort description

- South Africa's NHLS serves as the sole provider of laboratory services for the public health system, catering to over 80% of the population across all provinces
- Using a novel data linkage method, NHLS data was expanded to encompass all HIV, TB, and non-communicable disease laboratory tests, creating the 'NHLS Multi-morbidity Cohort'
- The NHLS Multi-morbidity Cohort encompasses over 68 million laboratory tests from >30 million individuals between 1 April 2004 and 31 March 2017

# Study population

- Patients aged 18-85 years with a first serum creatinine laboratory test performed at a government sector hospital or clinic between 1 January 2012 and 1 January 2016
- People living with **HIV** (PLWH) were those with an HIV-associated test (CD4 count, viral load, ELISA, etc.)
- People with acute **TB** infection were those with a positive TB-associated test (i.e., culture, smear, GeneXpert, etc)
- People living with lab-diagnosed **diabetes** were those with a fasting glucose, random glucose, or HbA1c above the diagnostic cut-off

# CKD definitions

- CKD: two eGFR (estimated glomerular filtrate rate) measurements  $< 60$  mL/min/1.73m<sup>2</sup> at least 90 days but no more than 12 months apart
  - eGFR was calculated using the 2009 CKD epi equation without adjusting for race
- Stages of kidney disease were classified as:
  - Stage 3a: eGFR 45-59 mL/min/1.73m<sup>2</sup>
  - Stage 3b: eGFR 30-44 mL/min/1.73m<sup>2</sup>
  - Stage 4: eGFR 15-29 mL/min/1.73m<sup>2</sup>
  - Stage 5 (end stage):  $< 15$  mL/min/1.73m<sup>2</sup>
- CKD progression: a drop in disease stage accompanied by at least a 25% reduction in eGFR from baseline

# Statistical analyses

- We calculated person-time (in years) by measuring the average time between patients' first and last creatinine measurements
- Crude rates of CKD progression were calculated by biological sex, age, diabetes status, HIV, and TB status
- Cox proportional hazard regression was used to calculate crude and adjusted hazard ratios (HRs) and corresponding survival curves



# Results

# CKD prevalence

CKD status	N (Total=6,106,521) <sup>a</sup>	%
Normal <sup>b</sup>	5,607,287	91.8
CKD <sup>c</sup>	88,273	1.5
RI event with no follow-up lab within 3-12 months <sup>d</sup>	142,104	2.3
RI event with follow-up lab < 60 L/min/1.73m <sup>2</sup> within 0-3 months <sup>d</sup>	152,320	2.5
RI event with follow-up lab ≥ 60 L/min/1.73m <sup>2d</sup>	116,537	1.9

<sup>a</sup>Total N represents all individuals aged 18-85 years with a serum creatinine laboratory test performed at a government sector hospital or clinic between January 1, 2012, and January 1, 2016.

<sup>b</sup>Patients were classified as having 'Normal' CKD status if their first eGFR measure was ≥ 60 mL/min/1.73m<sup>2</sup>.

<sup>c</sup>CKD defined as two eGFR measurements <60 mL/min/1.73m<sup>2</sup> at least 90 days but no more than 12 months apart.

<sup>d</sup>Renal Insufficiency (RI) event defined as having an eGFR measure < 60 L/min/1.73m<sup>2</sup>.

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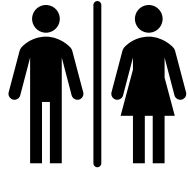
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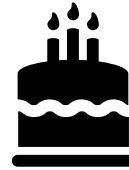
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# Cohort characteristics



63% female



71%  $\geq$  50 years



45% diagnosed  
at PHC



13% living with  
diabetes



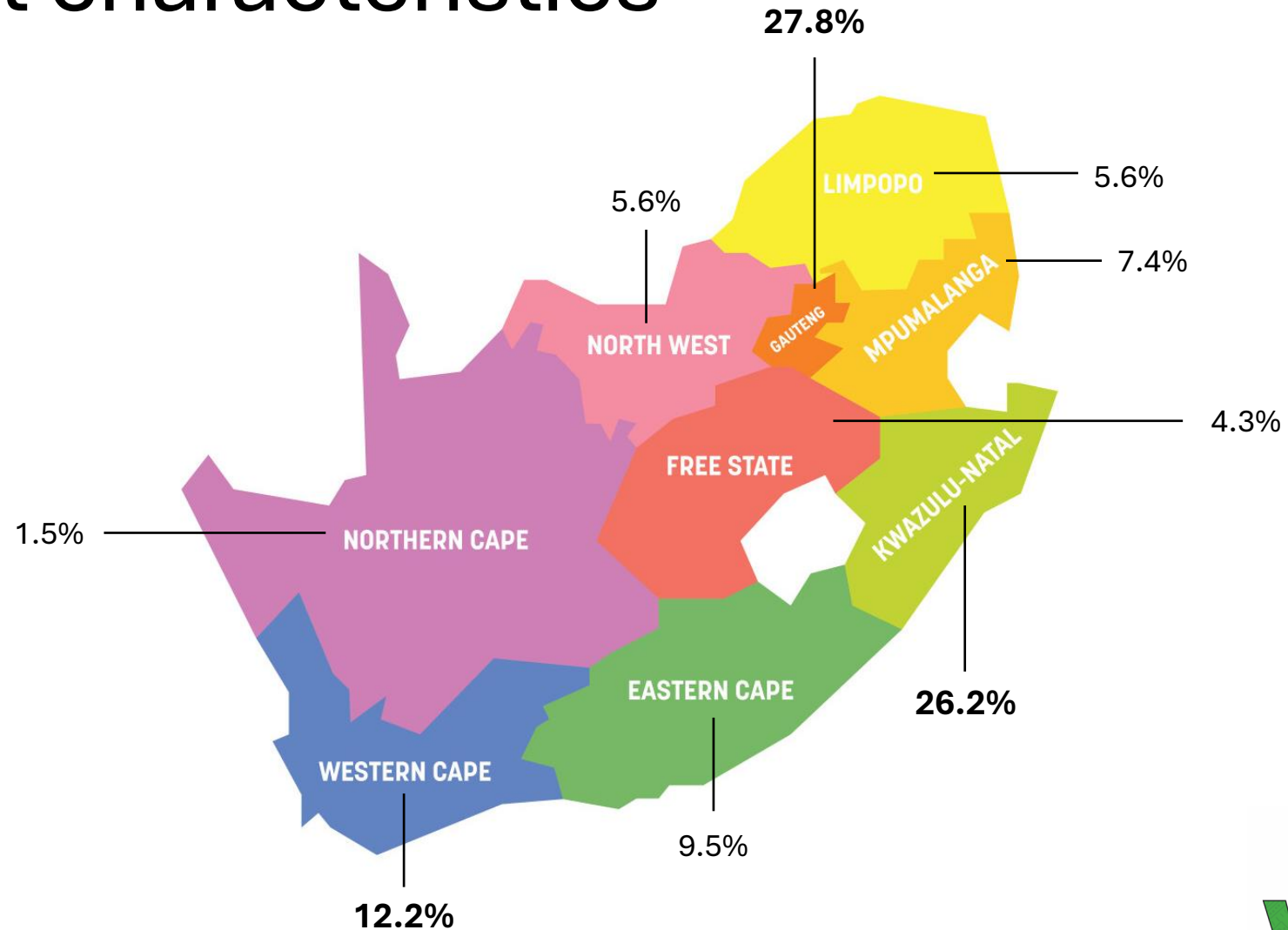
17% living with  
HIV

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# Cohort characteristics



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# CKD stages

**Stage 3a**  
(eGFR 45-59  
mL/min/1.73m<sup>2</sup>)  
**33,770 (44%)**

**Stage 3b**  
(eGFR 30-44  
mL/min/1.73m<sup>2</sup>)  
**25,462 (29%)**

**Stage 4**  
(eGFR 15-29  
mL/min/1.73m<sup>2</sup>)  
**14,055 (16%)**

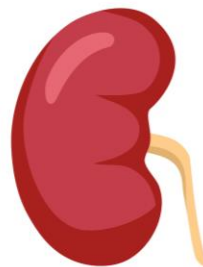
**Stage 5**  
(eGFR <15  
mL/min/1.73m<sup>2</sup>)  
**9986 (11%)**

## Stages of Chronic Kidney Disease



Stage 1

Normal function



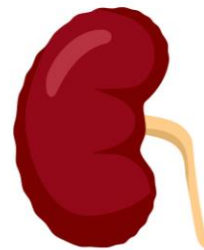
Stage 2

Mild loss  
of function



Stage 3

Moderate loss  
of function



Stage 4

Severe loss  
of function



Stage 5

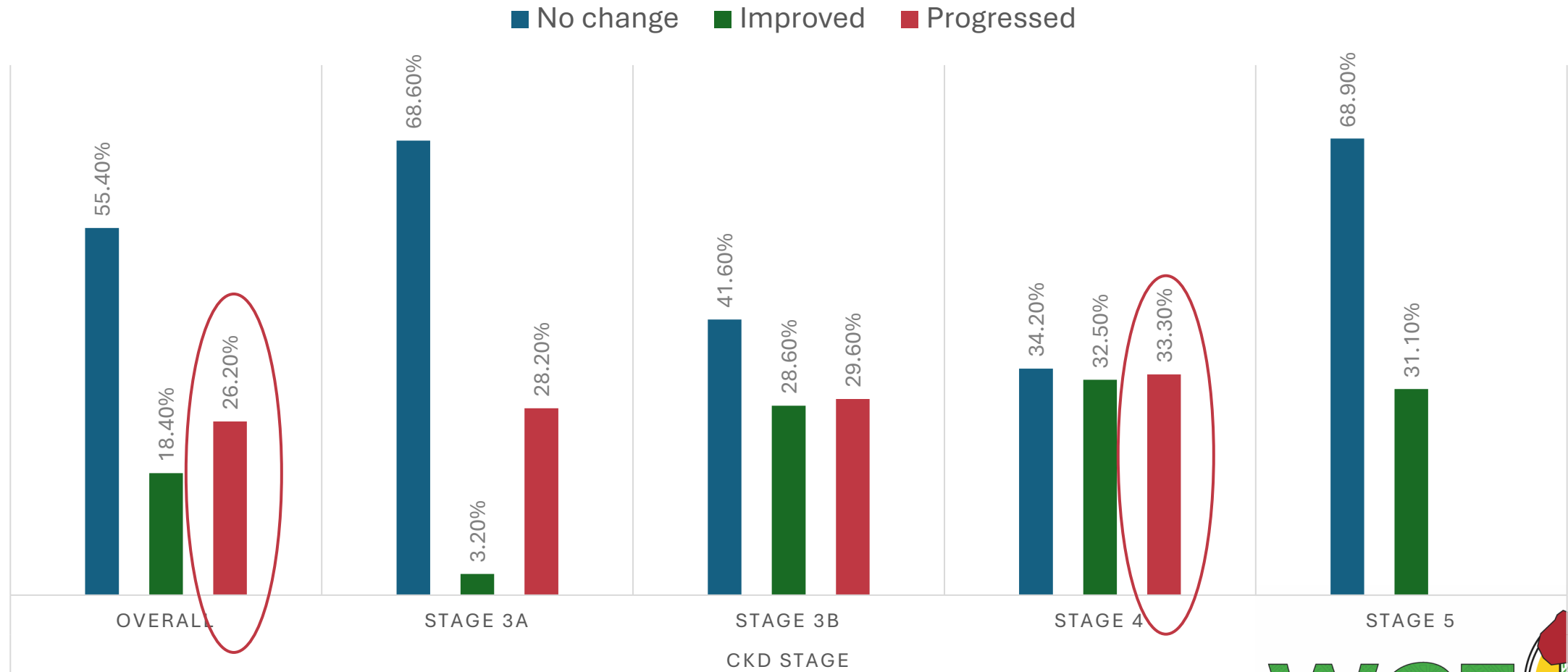
Kidney failure

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# CKD progression

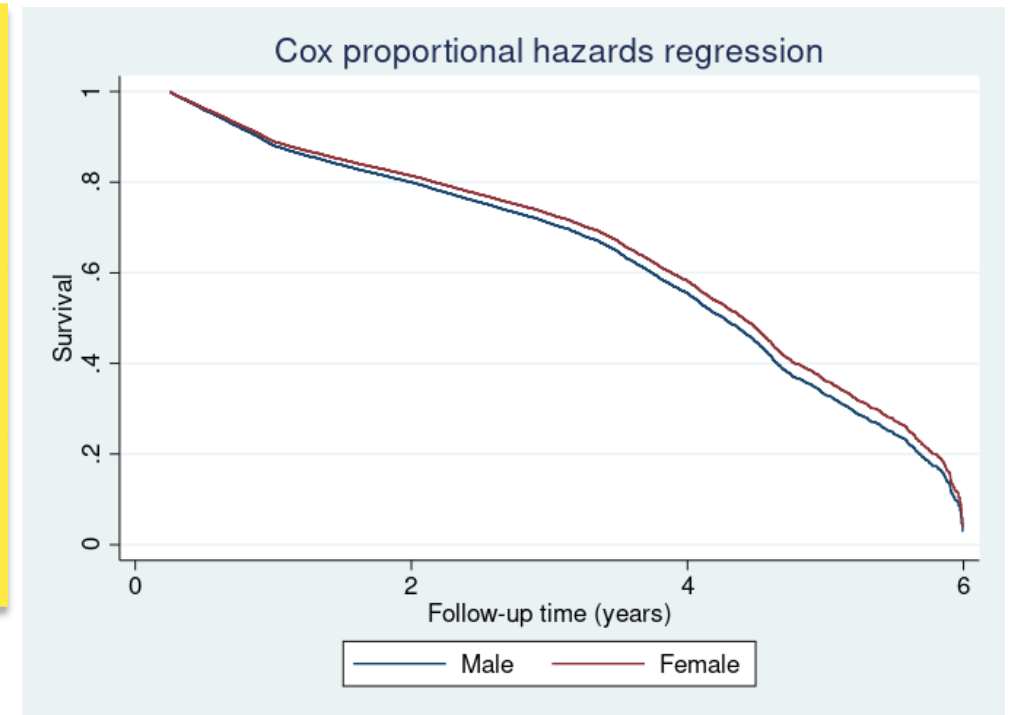


# CKD progression by biological sex

Biological sex	N (%) progressed	Total person time (years)	Rate per 100 person-years (95% CI)	Crude HR (95% CI)	Adjusted HR* (95% CI)
Male	9019 (32.1%)	67,725	13.3 (13.0-13.6)	ref.	ref.
Female	14,122 (28.2%)	127,145	11.1 (10.9-11.3)	0.88 (0.85-0.90)	<b>0.92 (0.87-0.97)</b>

Calculated among those with a diabetes lab (N=22,025).

\*Adjusted for age, diabetes status, and HIV/TB status.



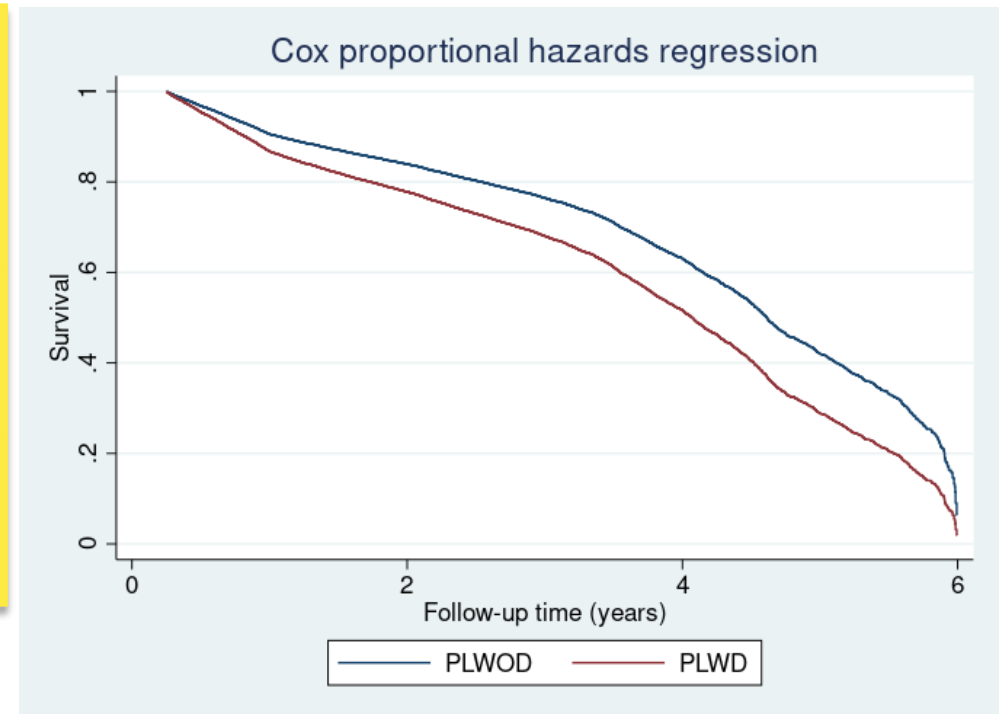


# CKD progression by diabetes status

Diabetes status	N (%) progressed	Total person time (years)	Rate per 100 person-years (95% CI)	Crude HR (95% CI)	Adjusted HR* (95% CI)
No diabetes	2523 (32.3%)	18,480	13.7 (13.1-14.2)	ref.	ref.
Diabetes	4152 (40.2%)	24,291	17.1 (16.6-17.6)	1.48 (1.41-1.57)	<b>1.43 (1.36-1.51)</b>

Calculated among those with a diabetes lab (N=22,025).

\*Adjusted for age, biological sex, and HIV/TB status.



PLWOD=people living without diabetes

PLWD=people living with diabetes

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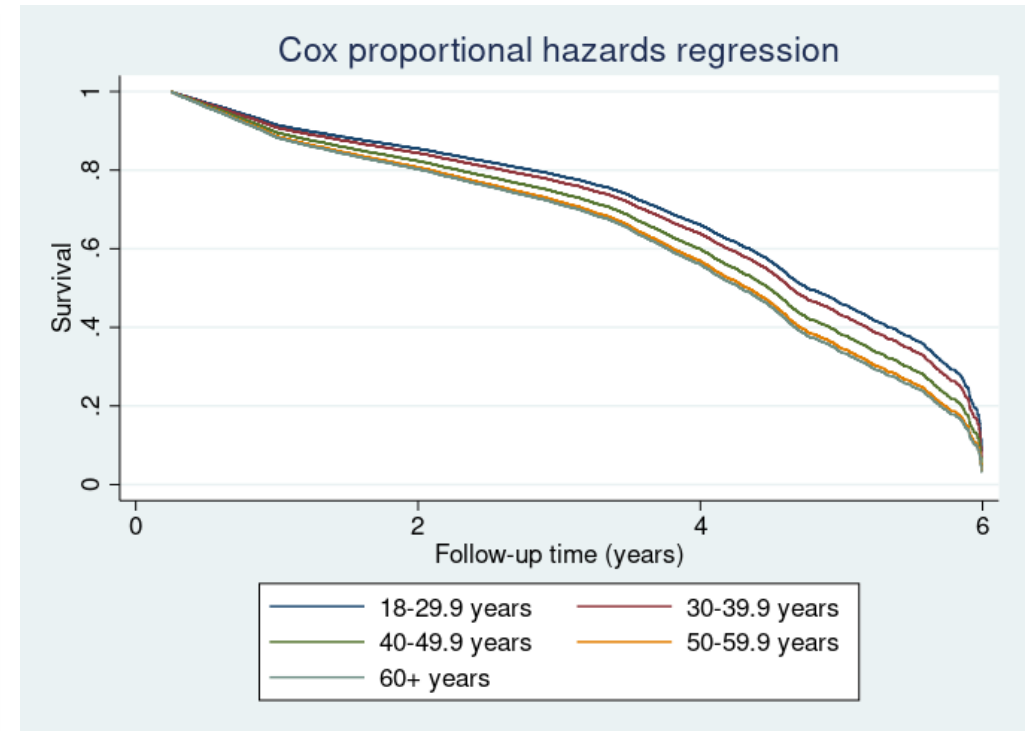


# CKD progression by age group

Age (years)	N (%) progressed	Total person time (years)	Rate per 100 person-years (95% CI)	Crude HR (95% CI)	Adjusted HR* (95% CI)
18-29.9	721 (27.8%)	6034	11.9 (11.1-12.9)	ref.	ref.
30-39.9	171 (24.8%)	18,037	9.8 (9.4-10.3)	0.91 (0.83-0.99)	<b>1.08 (0.87-1.35)</b>
40-49.9	2998 (26.1%)	30,225	9.9 (9.6-10.3)	0.98 (0.90-1.06)	<b>1.24 (1.01-1.51)</b>
50-59.9	4873 (23.1%)	42,898	11.4 (11.0-11.7)	1.17 (1.08-1.26)	<b>1.36 (1.13-1.65)</b>
60+	12,778 (31.4%)	97,705	13.1 (12.9-13.3)	1.44 (1.34-1.56)	<b>1.40 (1.16-1.69)</b>

Calculated among those with a diabetes lab (N=22,025).

\*Adjusted for biological sex, diabetes status, and HIV/TB status.

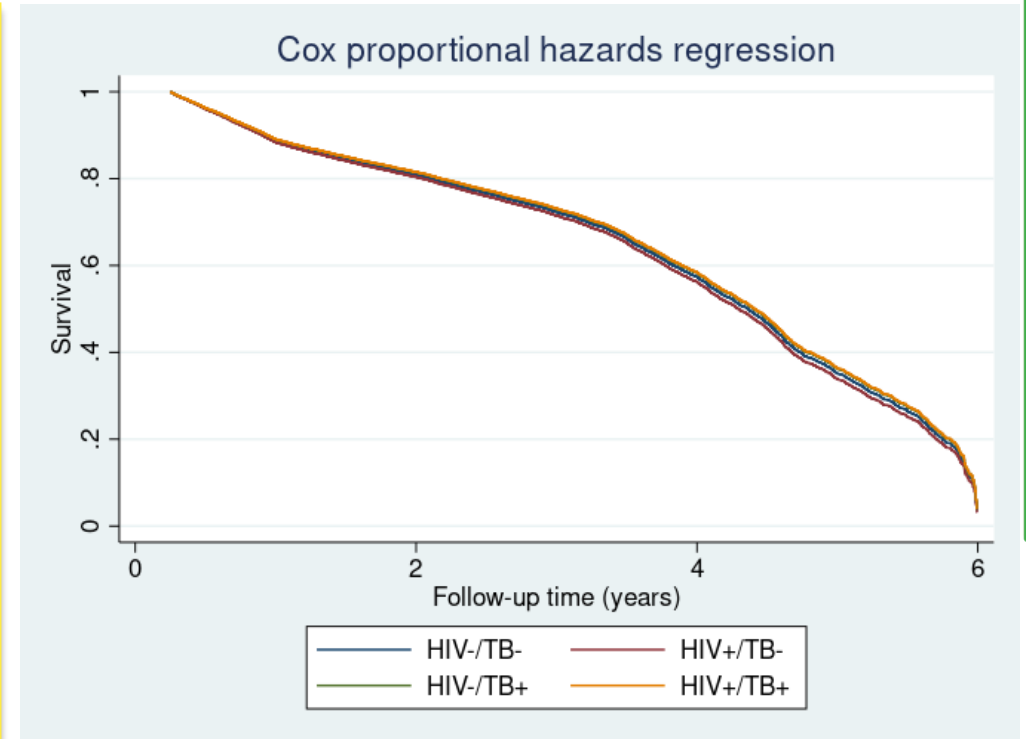


# CKD progression by HIV, and TB status

HIV/TB status	N (%) progressed	Total person time (years)	Rate per 100 person-years (95% CI)	Crude HR (95% CI)	Adjusted HR* (95% CI)
HIV-/TB-	17,897 (29.7%)	150,875	11.9 (11.7-12.0)	ref.	ref.
HIV+/TB-	3761 (29.2%)	31,007	12.1 (11.7-12.5)	1.03 (1.00-1.07)	<b>1.04 (0.97-1.11)</b>
HIV-/TB+	1179 (29.0%)	10,297	11.4 (10.8-12.1)	0.97 (0.91-1.03)	<b>0.97 (0.87-1.09)</b>
HIV+/TB+	304 (27.5%)	2719	11.2 (10.0-12.5)	0.99 (0.88-1.11)	<b>0.97 (0.78-1.19)</b>

Calculated among those with a diabetes lab (N=22,025).

\*Adjusted for age, biological sex, and diabetes status.



# Limitations

## Strengths

- National cohort
- Use of two eGFR measures to diagnose CKD minimizes misclassification of AKI (acute kidney injury)

## Limitations

- Limited time frame (2012-2017)
- Selection bias
- Uncontrolled confounding

# Conclusions

- Our study underlines the significance of CKD prevalence and risk of disease progression in South Africa, emphasising its association with diabetes
- Regular monitoring of kidney function, particularly for high-risk groups like those with type 2 diabetes and the elderly, is crucial to ensure early detection of CKD and prevent CKD progression

# Thank you!



**Co-authors:** Alana Brennan, Siyabonga Khoza, Nigel Crowther, Jacob Bor, Matthew Fox, Sydney Rosen, Patricia Hibberd, Frederick Raal, Kamy Chetty, Koleka Mlisana, Jaya George