



Impact of COVID 19 on The Kidney

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Many Aspects of COVID-19 and The Kidney



COVID-19 Infection Increases Incidence of AKI

Paper	Study N and Centre	Period	Population	Risk of AKI	Need for KRT	Comorbid conditions
China - Wuhan						
Chen et al Lancet	N = 99 Jinyintan Hospital, Wuhan	Jan 1 to 20, 2020	Hospitalized	3 (3 %)	9 % 9/23 in ICU (39%) 0/76 outside ICU	CV disease: 40 %; DM: 12 %
Yang et al Lancet Respir Med	N = 52 Jinyintan Hospital, Wuhan	Dec 2019 to Jan 26, 2020	Critically ill	15 (29 %)*	5 %	Cardiac disease: 10 %; DM: 17 %
Zhou et al Lancet	N = 191 Jinyintan Hospital and Wuhan Pulmonary Hospital, Wuhan	Discharged or died by Jan 31 2020	Hospitalized	28 (15 %)*	5%	HTN: 30% ; DM: 19%; CKD: 1%
Wang et al JAMA	N = 138 Zhongnan Hospital, Wuhan	Jan 21 to 30, 2020	Hospitalized	5 (3.6 %)* 3/36 in ICU (8 %) 2/102 outside ICU (2 %)	1.5 %	HTN 31 %; DM 10 %; CKD 3 %
Zhang et al medRxiv	N = 221 Zhongnan Hospital, Wuhan	Feb 1 to Feb 10, 2020	Hospitalized	10 (4.5 %)*	2.3 %	HTN: 24 %; DM: 10 %; CKD: 3 %
Diao et al medRxiv	N = 85 General Hospital of Theatre Command, Wuhan	Jan 17 to March 3, 2020	Hospitalized with dynamic renal function data	27 (23 %)	Not reported	HTN: 20 %; DM: 8%; CKD: 6%
Cheng et al Kidney Int	N = 701 Tongji Hospital, Wuhan	Jan 28 to Feb 11, 2020	Hospitalized	36 (5 %)* Stage 1: 2% Stage 2: 1% Stage 3: 2%	Not reported	With ≥ 1 comorbidity: 43% HTN: 33 %; DM: 14 %; CKD: 2 %;
Wang et al Am J Nephrol	N = 116 Renmin Hospital, Wuhan	Jan 14 to Feb 13, 2020	Hospitalized	0*	0	HTN: 37 %; DM: 16 % ; CKD: 4 %
Xiao et al medRxiv	N = 287 Hankou Hospital, Wuhan	Jan 5 to March 8, 2020	Hospitalized	55 (19 %)* Stage 1: 14 % Stage 2/3: 5 %	Not reported	HTN: 30 %; DM: 16 %; CKD: 2 %
China – outside of Wuhan/Hubei Province						
Guan et al NEJM	N = 1099 552 Hospitals, 30 Regions in China	Dec 11, 2019 to Jan 29, 2020	Hospitalized	6 (0.5 %)*	0.8 %*	HTN: 15 %; DM: 7 %; CKD: 0.7 %
Cao et al medRxiv	N = 198 Shanghai Public Health Clinical Centre, Shanghai	Jan 20 to Feb 15, 2020	Hospitalized	10 (5 %)	Not reported	HTN: 21 %; DM: 8 %
Liu et al Sci China Life Sci	N = 12 Shenzhen Third People's Hospital, Shenzhen	Jan 11 to Jan 20, 2020	Hospitalized	2 (17 %)	Not reported	HTN: 25 %; DM: 17 %; CKD: 17 %
Wu et al Clin Infect Dis	N = 80 3 Hospitals in Jiangsu Province	Jan 22 to Feb 14, 2020	Hospitalized	2 (2.5 %)	1 % (hemodialysis)	CV disease: 31 %; CKD: 1%
Yang et al J Infect	N = 149 3 Hospitals in Wenzhou	Jan 17 to Feb 10, 2020	Hospitalized	0	Not reported	CV disease: 19%

China: 0.5 - 29%

Etiology: mostly ATN

COVID-19 AKI: Higher Incidence in U.S.

Paper	Study N and Centre	Period	Population	AKI Definition	Risk of AKI	Need for KRT	Comorbid conditions
Outside China							
Arentz et al JAMA	N = 21 Evergreen Hospital, Seattle	Feb 20 to March 5, 2020	Critically ill	Need for KRT	4 (19 %)	Not reported	CKD: 48% ESKD: 10% With ≥ 1 comorbidity: 86%
ICNARC	N = 8250 All ICUs in England, Wales, Northern Ireland	Until May 8, 2020	Critically ill	Need for KRT	1442 (17.4%)	1442 (17.4%)	CKD: 1.4 % CV disease: 0.4%
Chan et al MedRxiv	N = 3235, 21% AA Mt Sinai, NY	Feb 27 to April 15, 2020	Hospitalized	KDIGO	1406 (43%) 25% AA 553/815 (68%) in the critically ill	280 (20%)	HTN: 37 %; DM: 25 %; CKD: 10 %
Hirsch et al Kidney Int	N = 5449 21% AA Northwell Health, New York	Mar 1 to Apr 5, 2020	Hospitalized	KDIGO	1993 (37%) 21% AA Stage 1 927 Stage 2 447 Stage 3 619	285 (5.2%) overall	HTN: 79 %; DM: 48 % Mean BMI ~ 29
Mohamed et al Kidney360	N = 575 70% AA Ochsner Health, New Orleans	March 2020	Hospitalized	KDIGO	161 (28 %) 75% AA 61% among critically ill 14% among non critically ill	89 (15.4%)	HTN: 72%; DM: 48%; CKD: 29 %






NephJC.com

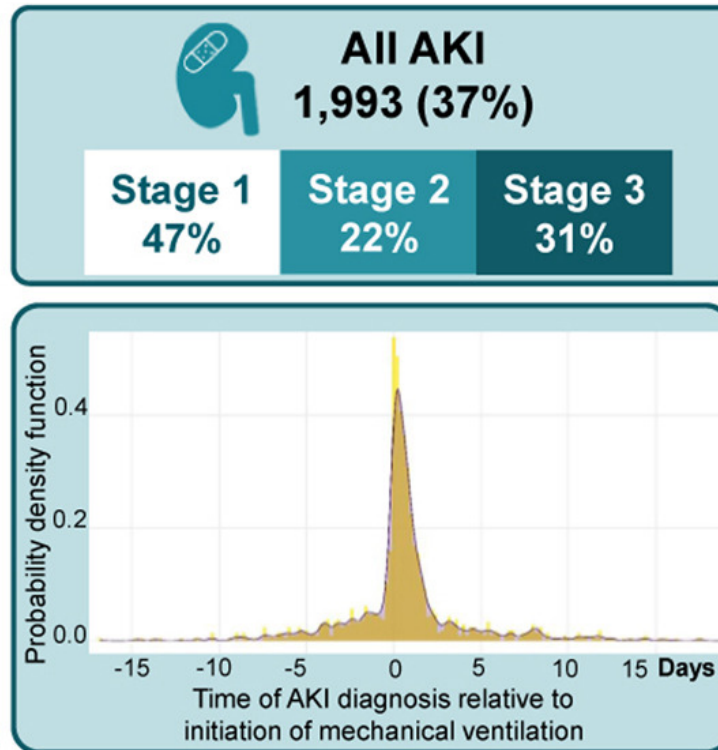
United States: 19 - 43%

COVID-19 AKI Is NOT Equal Opportunity Offender

Acute kidney injury (AKI) in patients hospitalized with COVID-19

Methods & Cohort

-  Retrospective cohort
-  13 hospitals in New York
-  SARS-CoV-2 positive
-  N = 5449
Age = 64 (52, 75)
-  March 1 – April 5, 2020




Results


Independent risk factors for AKI


Older age
Black race 20.6%
Hypertension
Diabetes mellitus
Cardiovascular disease
Vasopressor use
Need for ventilation*

*OR=10.7
(95%CI 6.8 -16.7)

Disposition of patients with AKI

 Still admitted
780 (39%)

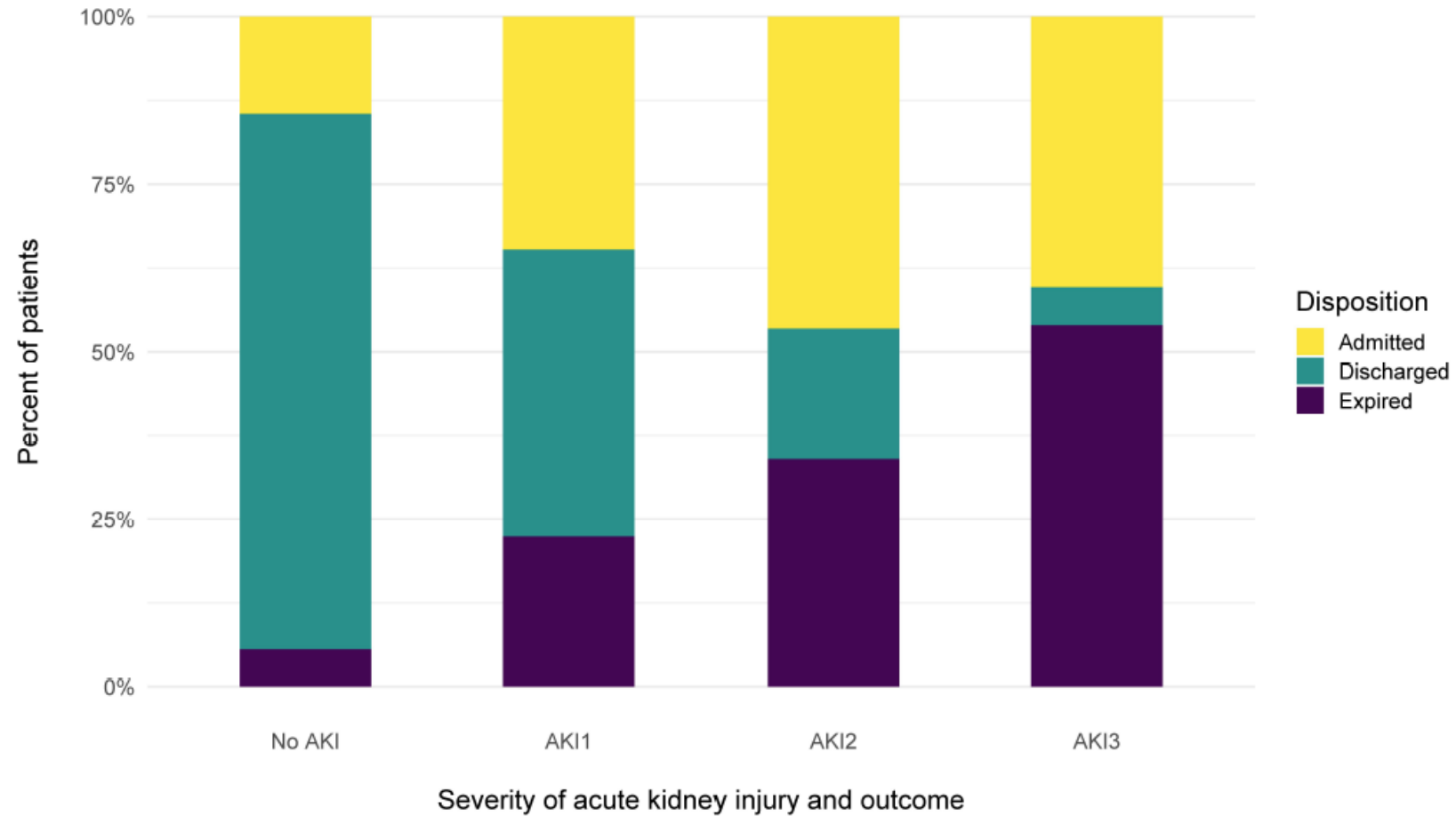
 Discharged
519 (26%)

 Died
694 (35%)

CONCLUSION:

AKI occurs frequently among patients with COVID-19. It occurs early and in temporal association with respiratory failure. AKI in COVID-19 is associated with a poor prognosis.

COVID-19 Associated AKI is Associated with High Mortality Rate



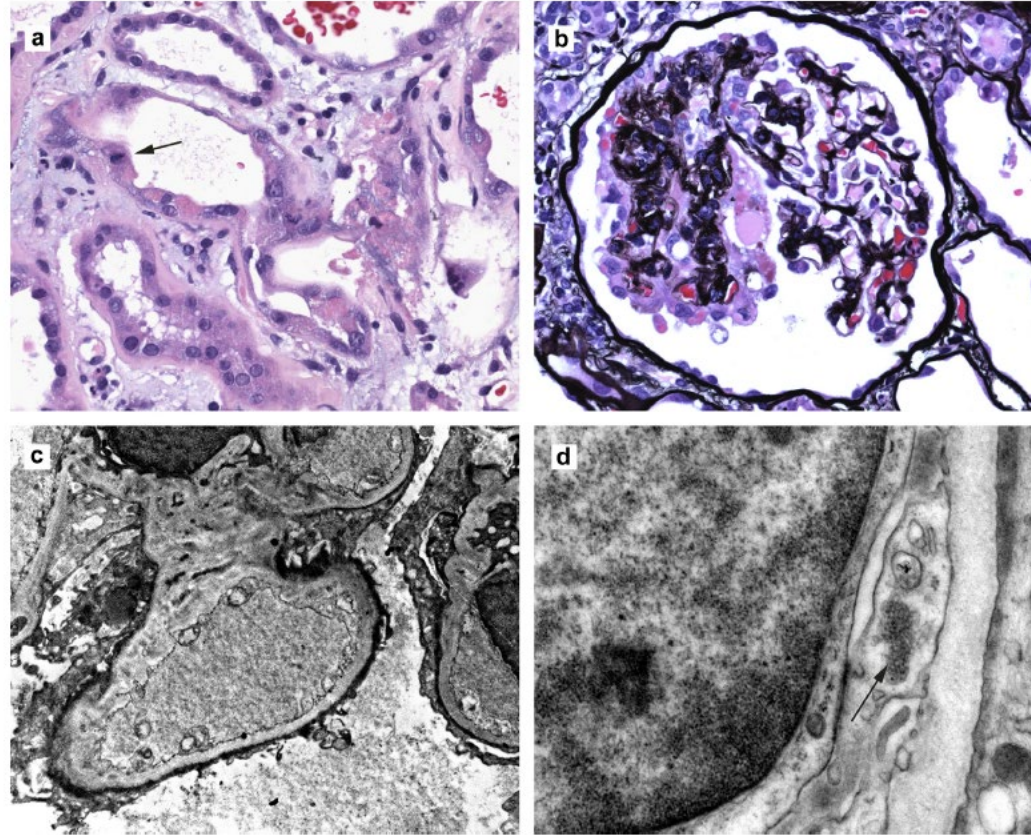
Possible Mechanisms of COVID-19 Induced AKI

Table 4. Etiology of CoV-AKI (n = 161)	
Ischemic ATI	
Hemodynamic instability	106 (66%)
Hypotension / shock	86 (53%)
Large reduction in SBP	4 (2.5%)
Rapid atrial fibrillation	2 (1.2%)
Prolonged volume depletion	14 (9%)
Toxic ATI	11 (7%)
Rhabdomyolysis (isolated)	7 (4%)
Another toxic agent [∞]	4 (2.5%)
Ischemic/Toxic	
Hemodynamic instability and rhabdomyolysis	4 (2.5%)
AKI otherwise not specified	20 (13%)
Urine sediment microscopy suggestive of ATI	11 (7%)
Overt proteinuria suggestive of glomerular lesion	3 (1.9%)
Acute interstitial nephritis	1 (0.6%)
De novo glomerular disease	4 (2.5%)
Collapsing glomerulopathy	3 (1.9%)
Proliferative glomerulonephritis	1 (0.6%)
Prerenal azotemia	15 (9%)
[∞] toxic agents that were identified as only potential culprit for AKI included: vancomycin (n = 3), iodinated radiocontrast (n = 1). Under Toxic ATI, 5 patients were diagnosed with rhabdomyolysis based on CPK > 5000 U/L and 2 based on CPK > 2000 U/L + 2+heme dipstick and no urine RBCs. Under Ischemic/Toxic ATI, among 4 patients with ischemic ATI, 3 patients were diagnosed with concomitant rhabdomyolysis based on CPK > 5000 U/L and 1 based on CPK > 2000 U/L + 2+heme dipstick and no urine RBCs. AKI, acute kidney injury; CoV-AKI, AKI associated with COVID-19; ATI, acute tubular injury	

Why does COVID-19 Cause more AKI in African Americans (AAs)?

COVID-19 AKI: Associated with Collapsing Glomerulopathy (cGN) in AAs

44 year old African American
Woman p/w COVID 19 and AKI.
Renal biopsy: →
APOL1 Genotype: **G1G1**



COVID-19 AKI: Associated with Collapsing Glomerulopathy (cGN) in AAs

Collapsing Glomerulopathy in a Patient With Coronavirus Disease 2019 (COVID-19)

Christopher P. Larsen¹, Thomas D. Bourne¹, Jon D. Wilson¹, Osaid Saqqa² and Moh'd A. Sharshir²

¹Arkana Laboratories, Little Rock, Arkansas, USA; and ²Tulane University, New Orleans, Louisiana, USA

Acute Kidney Injury Due to Collapsing Glomerulopathy Following COVID-19 Infection

Yonatan Peleg¹, Satoru Kudose², Vivette D'Agati², Eric Siddall¹, Syeda Ahmad¹, Sergey Kisselev¹, Ali Gharavi¹ and Pietro Canetta¹

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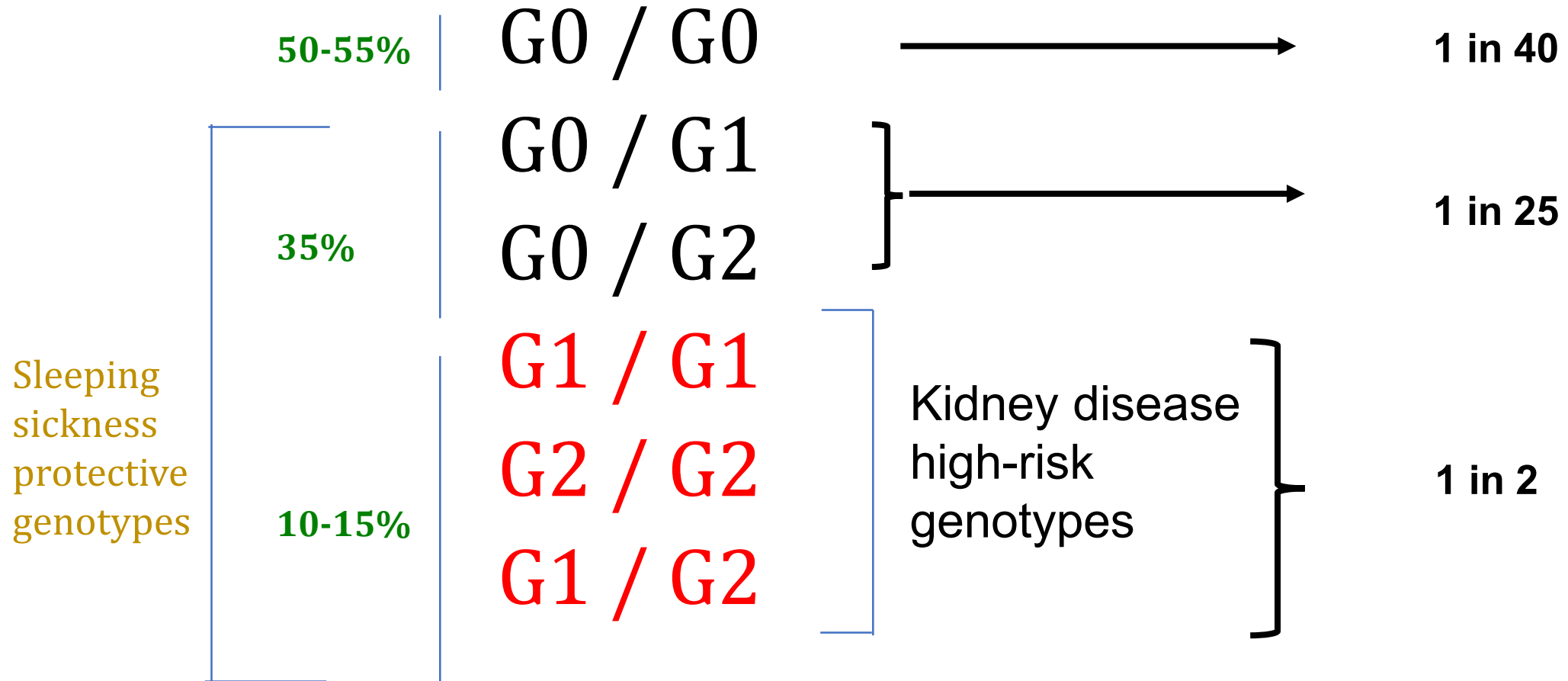
Other Causes of Collapsing Glomerulopathy:

- 1) High Interferon level
- 2) Viruses: **HIV**, CMV, parvovirus
- 3) Lupus

* High-risk APOL1 genotypes

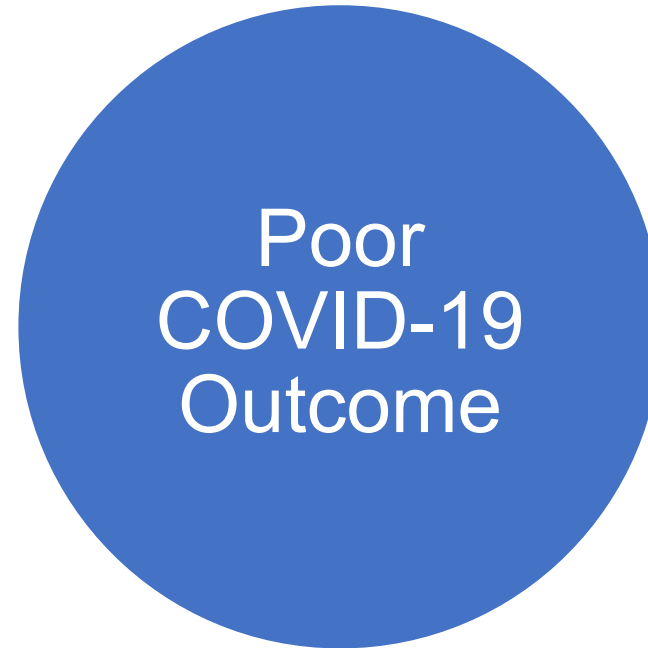
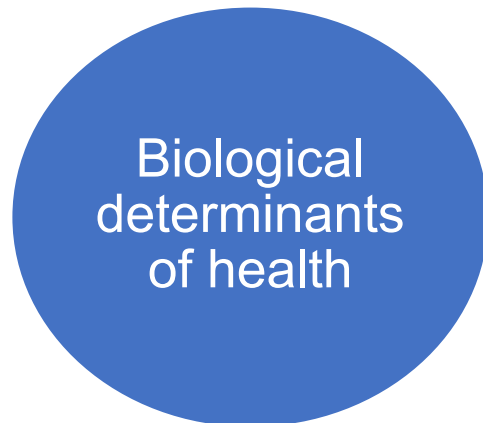
High-risk APOL1 genotypes Increase Risk of cGN

Incidence of HIV Associated Nephropathy



Beware of The Danger of A Single Story

**Call to action:
more studies
are needed**



Thanks

Beware of Hasty Generalization : You Could Miss Population-specific Attributes

Table 3 | The pathologic abnormalities of kidney in 26 cases of deceased patients with COVID-19

ID	LM											
	Tubule interstitium				Glomeruli		EM			IF		
	ATI	Multiple foci of bacteria	Pigmented casts	Arteriosclerosis	Segmental fibrin thrombus	FSGS	Coronavirus-like particles	Dense deposits	Subendothelial lucent expansion	IgG	IgA	SARS-CoV NP
1	Severe	N	N	Mild to moderate	N	N	N/A	N/A	N/A	N/A	N/A	N/A
2	Moderate	N	N	Mild	N	N	Y	N	N	N/A	N/A	N/A
3	Mild to moderate	N	Y	Mild	N	N	Y	N	Y	N/A	N/A	N/A
4	Severe	N	N	Severe	N	Y	Y	N	Y	N/A	N/A	N/A
5	Mild	N	N	Mild	N	N	N/A	N/A	N/A	N/A	N/A	N/A
6	Mild to moderate	N	Y	Mild	N	N	N/A	N/A	N/A	N/A	N/A	N/A
7	Severe	N	N	Mild to moderate	N	N	N/A	N/A	N/A	N/A	N/A	N/A
8	Moderate	N	N	Severe	Focal	Y	N/A	N/A	N/A	N/A	N/A	N/A
9	Moderate	N	Y	Moderate	N	N	N/A	N/A	N/A	N/A	N/A	N/A
10	Moderate	N	N	Moderate to severe	N	N	N/A	N/A	N/A	N/A	N/A	N/A
11	Moderate to severe	N	N	Moderate to severe	Focal	N	N/A	N/A	N/A	N/A	N/A	N/A
12	Moderate to severe	N	N	Moderate	N	N	Y	N	Y	N/A	N/A	N/A
13	Mild to moderate	N	N	Mild	N	N	N/A	N/A	N/A	N/A	N/A	N/A
14	Severe	Multiple foci	N	Moderate	Diffuse	N	N/A	N/A	N/A	N/A	N/A	N/A
15	Mild to moderate	N	N	Moderate to severe	N	N	N/A	N/A	N/A	N/A	N/A	N/A
16	Severe	Multiple foci	N	Moderate to severe	N	N	N/A	N/A	N/A	N/A	N/A	N/A
17	Moderate	N	N	Moderate	N	N	N/A	N/A	N/A	N/A	N/A	N/A
18	Moderate	N	N	Mild	N	N	N/A	N/A	N/A	N/A	N/A	N/A
19	Mild	N	N	Moderate to severe	N	N	N/A	N/A	N/A	N/A	N/A	N/A
20	Moderate to severe	N	N	Moderate	N	N	Y	N	N	N	N	N
21	Mild	N	N	Moderate to severe	N	N	N	Y	Y	Y	N	N
22	Moderate	N	N	Mild to moderate	N	N	Y	N	N	N	N	Y
23	Moderate	N	N	Moderate	N	N	N	N	N	N	N	Y
24	Mild	N	N	Mild	N	N	N/A	N/A	N/A	N	N	N
25	Moderate to severe	N	N	Moderate to severe	N	N	Y	Y	Y	N	Y	Y
26	Mild to moderate	N	N	Mild	N	N	N/A	N/A	N/A	N/A	N/A	N/A

ATI, acute tubular injury; COVID-19, coronavirus disease 2019; EM, electron microscopy; FSGS, focal segmental glomerulosclerosis; ID, identification number; IF, immunofluorescent (stain); LM, light microscopy; N, not detected; N/A, not available; NP, nucleoprotein; SARS-CoV, severe acute respiratory syndrome coronavirus; Y, detected.

Features of COVID-19 Associated AKI

- **Proteinuria (42.1%)**
- **Hematuria (41%)**
- **Leucocyturia (36.5%)**
- **Low urine sodium (65.6%)**