
ANAH
ASEAN NETWORK of
ADRENAL HYPERTENSION
Breaking Boundaries in Adrenal Disorders
ANAH - AFES Joint Symposium 2025
14 - 16 Nov 2025 | Ariyana Convention Center, Da Nang city, Vietnam

ASEAN NETWORK of ADRENAL HYPERTENSION

Breaking Boundaries in Adrenal Disorders

ANAH-AFES Joint Symposium 2025

14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

Lecture

Primary Aldosteronism Diagnosis in a Global Perspective

Gregory A. Kline MD FRCPC
Medical Director, UC Adrenal Research Group
Clinical Professor of Medicine
University of Calgary

Breaking Boundaries in Adrenal Disorders

ANAH-AFES Joint Symposium 2025

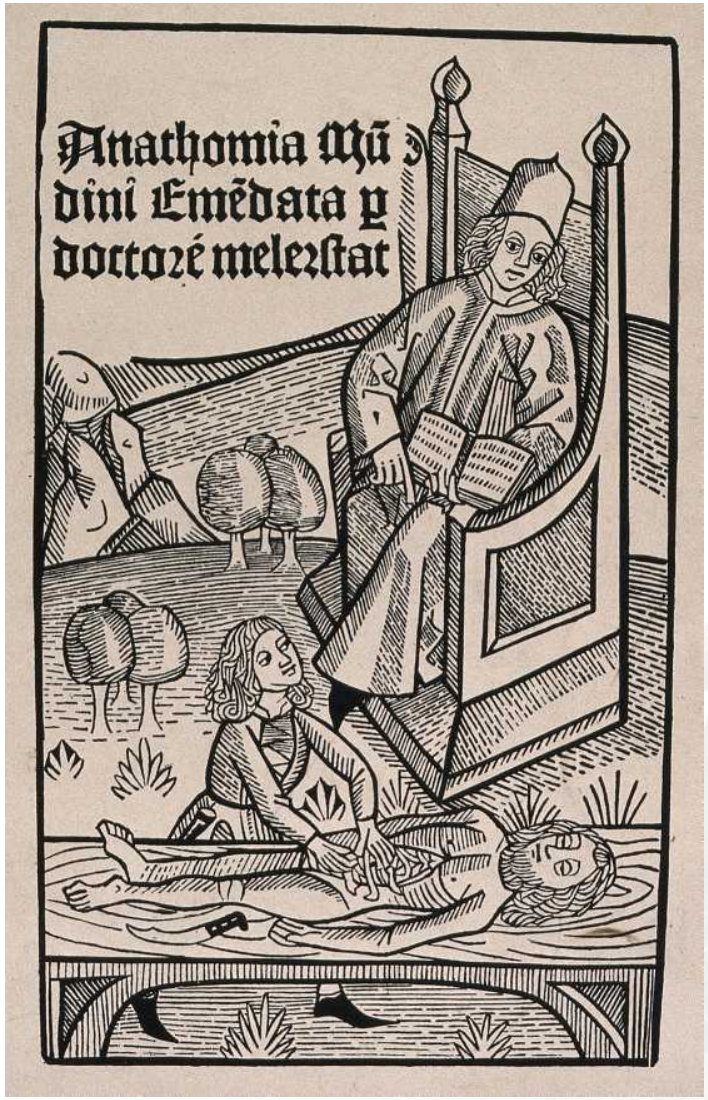
14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

ASEAN NETWORK of ADRENAL HYPERTENSION

Advance Notice

I am going to say some things that contradict the PA guidelines: the perspective of the global citizen who has little/no access to PA diagnosis

A boy tears up his school textbooks in a fit of anger against his education.
Engraving W.C. Wrankmore open: Wellcome Collection



Open Access, Wellcome Collection

Visual Arts Legacy Collection
Access via University of Calgary

Why does PA matter? Outcomes and Treatment

	Primary aldosteronism		Essential hypertension			OR (95% CI)
	Events	Total	Events	Total	Weight	
Not matched studies						
Monticone at al (2017)[21]	6	99	53	1573	11·1%	1·85 (0·78–4·42)
Murata et al (2017)[17]	30	292	22	498	25·7%	2·48 (1·40–4·38)
Subtotal (95% CI)		**391**		**2071**	**36·8%**	**2·27 (1·41–3·66)**
Total events	36		75			
Heterogeneity: τ^2=0·00; χ^2=0·30, df=1 (p=0·59); I^2=0%						
Test for overall effect: Z=3·37 (p=0·0008)						
Matched studies						
Catena et al (2008)[23]	6	54	9	323	7·2%	4·36 (1·49–12·80)
Milliez et al (2015)[24]	16	124	16	465	15·9%	4·16 (2·02–8·58)
Mulatero et al (2013)[14]	20	270	28	810	23·9%	2·23 (1·24–4·04)
Takedaet al (1995)[13]	24	224	12	224	16·2%	2·12 (1·03–4·35)
Subtotal (95% CI)		**672**		**1822**	**63·2%**	**2·78 (1·93–4·00)**
Total events	66		65			
Heterogeneity: τ^2=0·00; χ^2=2·93, df=3 (p=0·40); I^2=0%						
Test for overall effect: Z=5·52 (p<0·00001)						
Total (95% CI)		**1063**		**3893**	**100·0%**	**2·58 (1·93–3·45)**
Total events	102		140			
Heterogeneity: τ^2=0·00; χ^2=3·68, df=5 (p=0·60); I^2=0%						
Test for overall effect: Z=6·43 (p<0·00001)						
Test for subgroup differences: χ^2=0·44, df=1 (p=0·51); I^2=0%						

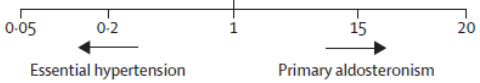


Figure 2: **Stroke in patients with primary aldosteronism versus essential hypertension**
Forest plot of the OR of stroke in in patients with primary aldosteronism and essential hypertension. Central squares of each horizontal line represent the OR for each study. Horizontal lines indicate the range of the 95% CI and the vertical line indicates an OR of 1·0 (which indicates no differences in the odds ratio between patients with primary aldosteronism and patients with essential hypertension). OR=odds ratio.

Stroke in PA vs EH:

OR 2.58 (1.93-3.45

Monticone S. Lancet Diab Endocrinol 2018;6:41-50

	Primary aldosteronism		Essential hypertension			OR (95% CI)
	Events	Total	Events	Total	Weight	
Not matched studies						
Monticone et al (2017)[21]	4	99	19	1573	10·4%	3·44 (1·15–10·32)
Murata et al (2017)[22]	7	292	8	498	11·2%	1·50 (0·54–4·19)
Subtotal (95% CI)		**391**		**2071**	**21·5%**	2·22 (0·99–4·99)
Total events	11		27			
Heterogeneity: τ^2=0·05; χ^2=1·17, df=1 (p=0·28); I^2=14%						
Test for overall effect: Z=1·93 (p=0·05)						
Matched studies						
Catena et al (2008)[23]	11	54	27	323	14·5%	2·80 (1·30–6·06)
Milliez et al (2015)[24]	5	124	3	465	7·3%	6·47 (1·52–27·46)
Mulatero et al (2013)[14]	7	270	25	810	13·4%	0·84 (0·36–1·95)
Reincke et al (2012)[25]	13	281	10	281	13·5%	1·31 (0·57–3·05)
Savard et al (2013)[12]	46	459	58	1290	20·3%	2·37 (1·58–3·54)
Takeda et al (1995)[13]	4	224	9	224	9·4%	0·43 (0·13–1·43)
Subtotal (95% CI)		**1412**		**3393**	**78·5%**	**1·65 (0·92–2·95)**
Total events	86		132			
Heterogeneity: τ^2=0·33; χ^2=15·08, df=5 (p=0·01); I^2=67%						
Test for overall effect: Z=1·67 (p=0·10)						
Total (95% CI)		**1803**		**5464**	**100·0%**	**1·77 (1·10–2·83)**
Total events	97		159			
Heterogeneity: τ^2=0·24; χ^2=16·41, df=7 (p=0·02); I^2=57%						
Test for overall effect: Z=2·38 (p=0·02)						
Test for subgroup differences: χ^2=0·35, df=1 (p=0·56); I^2=0%						

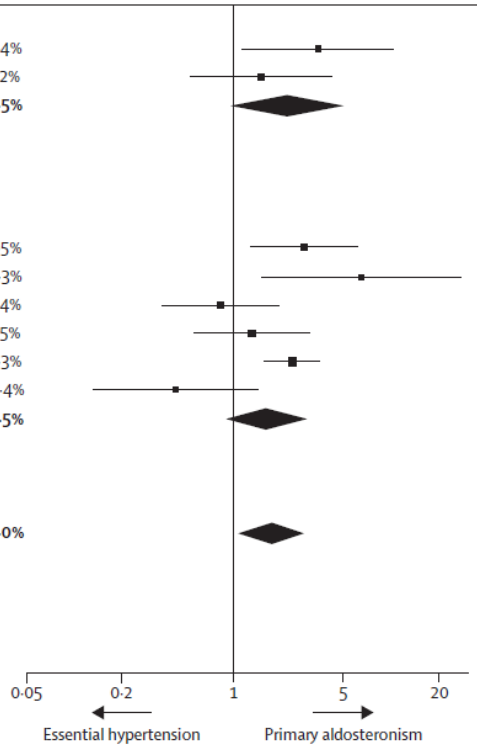
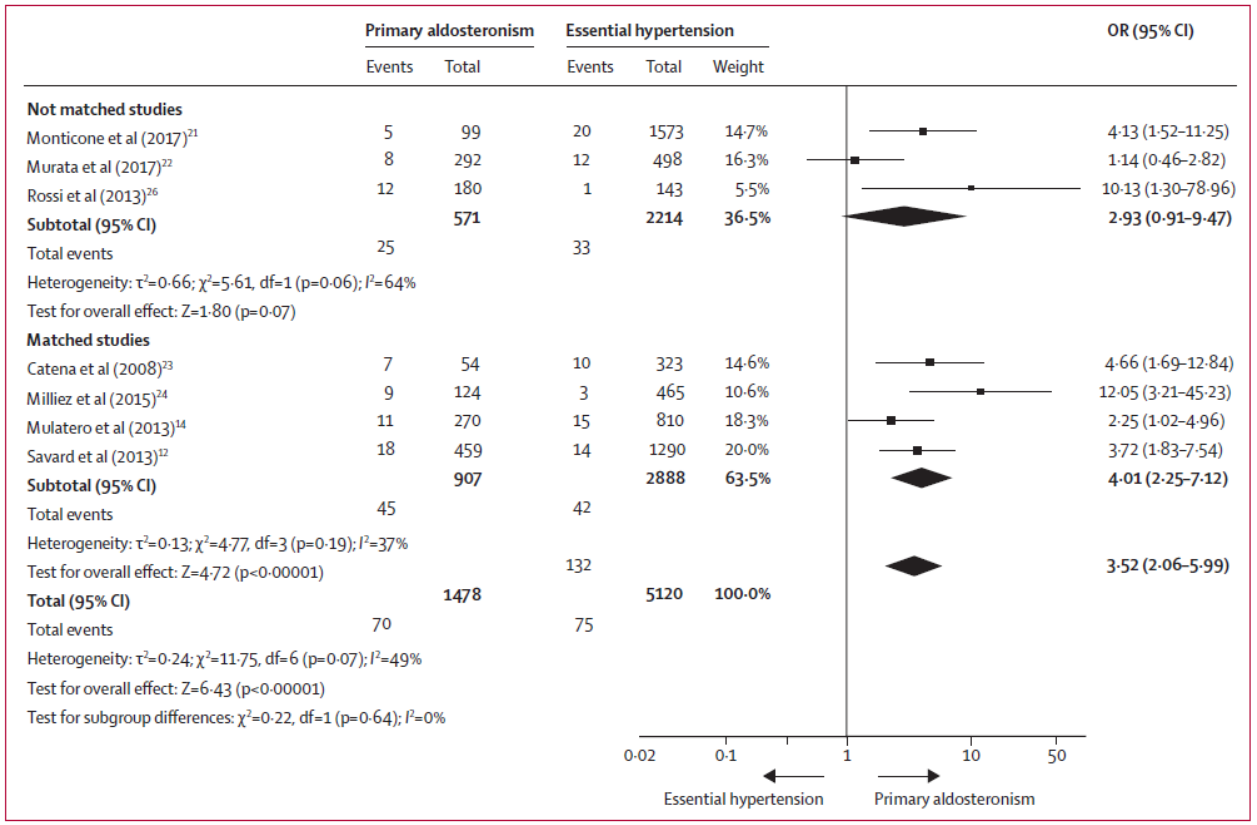


Figure 3: **Coronary artery disease in patients with primary aldosteronism versus essential hypertension**
Forest plot of the OR of coronary artery disease (myocardial infarction or cardiac revascularisation) in patients with primary aldosteronism and essential hypertension. Central squares of each horizontal line represent the OR for each study. Horizontal lines indicate the range of the 95% CI and the vertical line indicates an OR of 1·0 (which indicates no differences in the OR between patients with primary aldosteronism and patients with essential hypertension). OR=odds ratio.

CAD in PA vs EH

OR 1.77 (1.1-2.8

Monticone S. Lancet Diab Endocrinol 2018;6:41-50



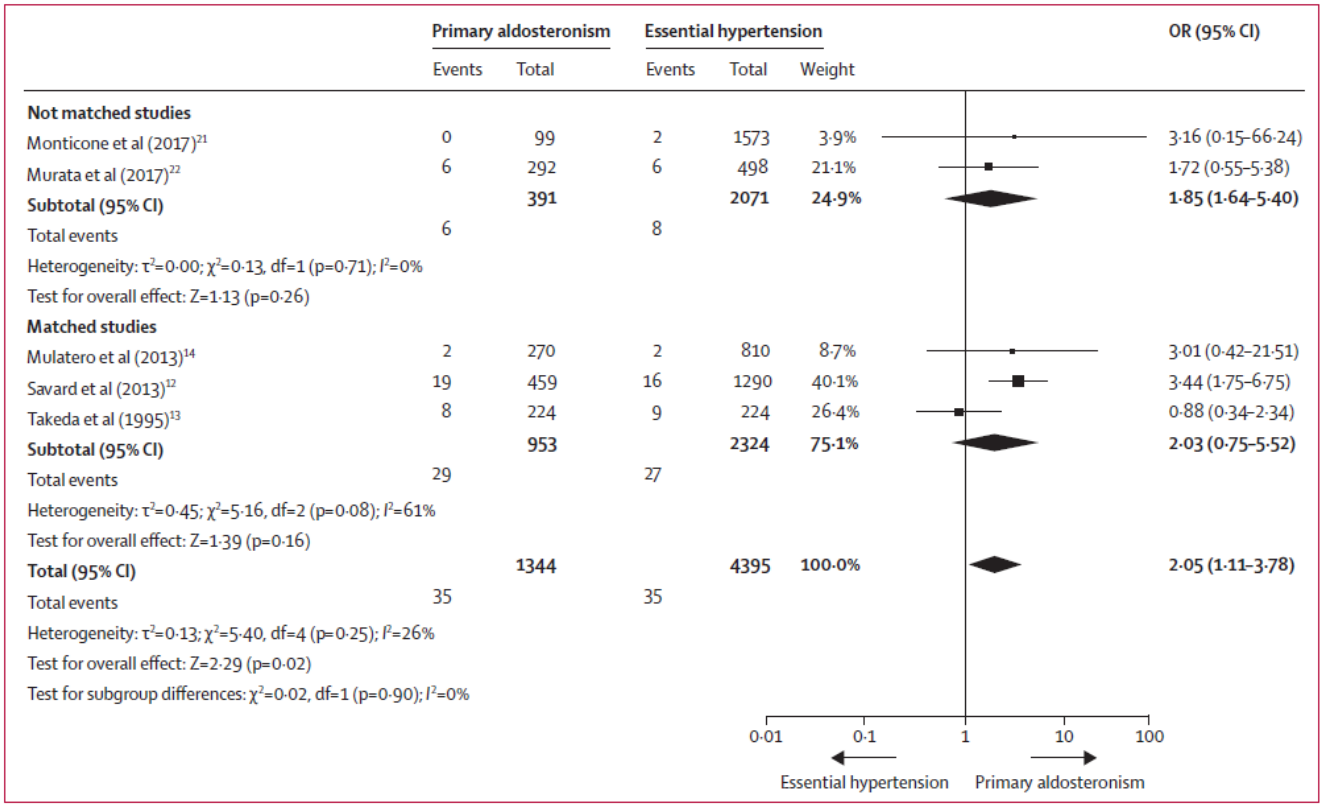
	Primary aldosteronism		Essential hypertension			OR (95% CI)
	Events	Total	Events	Total	Weight	
Not matched studies						
Monticone et al (2017)[21]	5	99	20	1573	14·7%	4·13 (1·52–11·25)
Murata et al (2017)[22]	8	292	12	498	16·3%	1·14 (0·46–2·82)
Rossi et al (2013)[26]	12	180	1	143	5·5%	10·13 (1·30–78·96)
Subtotal (95% CI)		**571**		**2214**	**36·5%**	**2·93 (0·91–9·47)**
Total events	25		33			
Heterogeneity: τ^2=0·66; χ^2=5·61, df=1 (p=0·06); I^2=64%						
Test for overall effect: Z=1·80 (p=0·07)						
Matched studies						
Catena et al (2008)[23]	7	54	10	323	14·6%	4·66 (1·69–12·84)
Milliez et al (2015)[24]	9	124	3	465	10·6%	12·05 (3·21–45·23)
Mulatero et al (2013)[14]	11	270	15	810	18·3%	2·25 (1·02–4·96)
Savard et al (2013)[12]	18	459	14	1290	20·0%	3·72 (1·83–7·54)
Subtotal (95% CI)		**907**		**2888**	**63·5%**	**4·01 (2·25–7·12)**
Total events	45		42			
Heterogeneity: τ^2=0·13; χ^2=4·77, df=3 (p=0·19); I^2=37%						
Test for overall effect: Z=4·72 (p<0·00001)						**3·52 (2·06–5·99)**
Total (95% CI)		**1478**		**5120**	**100·0%**	
Total events	70		75			
Heterogeneity: τ^2=0·24; χ^2=11·75, df=6 (p=0·07); I^2=49%						
Test for overall effect: Z=6·43 (p<0·00001)						
Test for subgroup differences: χ^2=0·22, df=1 (p=0·64); I^2=0%						

Figure 4: **Atrial fibrillation in patients with primary aldosteronism versus essential hypertension**
Forest plot of the OR of atrial fibrillation in patients with primary aldosteronism and essential hypertension. Central squares of each horizontal line represent the OR for each study. Horizontal lines indicate the range of the 95% CI and the vertical line indicates an OR of 1·0 (which indicates no differences in the OR between patients with primary aldosteronism and patients with essential hypertension). OR=odds ratio.

Atrial fibrillation

OR 3.5 (2.0-6.0

Monticone S. Lancet Diab Endocrinol 2018;6:41-50



	Primary aldosteronism		Essential hypertension			OR (95% CI)
	Events	Total	Events	Total	Weight	
Not matched studies						
Monticone et al (2017)[21]	0	99	2	1573	3·9%	3·16 (0·15–66·24)
Murata et al (2017)[22]	6	292	6	498	21·1%	1·72 (0·55–5·38)
Subtotal (95% CI)		**391**		**2071**	**24·9%**	**1·85 (1·64–5·40)**
Total events	6		8			
Heterogeneity: τ^2=0·00; χ^2=0·13, df=1 (p=0·71); I^2=0%						
Test for overall effect: Z=1·13 (p=0·26)						
Matched studies						
Mulatero et al (2013)[14]	2	270	2	810	8·7%	3·01 (0·42–21·51)
Savard et al (2013)[12]	19	459	16	1290	40·1%	3·44 (1·75–6·75)
Takeda et al (1995)[13]	8	224	9	224	26·4%	0·88 (0·34–2·34)
Subtotal (95% CI)		**953**		**2324**	**75·1%**	**2·03 (0·75–5·52)**
Total events	29		27			
Heterogeneity: τ^2=0·45; χ^2=5·16, df=2 (p=0·08); I^2=61%						
Test for overall effect: Z=1·39 (p=0·16)						
Total (95% CI)		**1344**		**4395**	**100·0%**	**2·05 (1·11–3·78)**
Total events	35		35			
Heterogeneity: τ^2=0·13; χ^2=5·40, df=4 (p=0·25); I^2=26%						
Test for overall effect: Z=2·29 (p=0·02)						
Test for subgroup differences: χ^2=0·02, df=1 (p=0·90); I^2=0%						

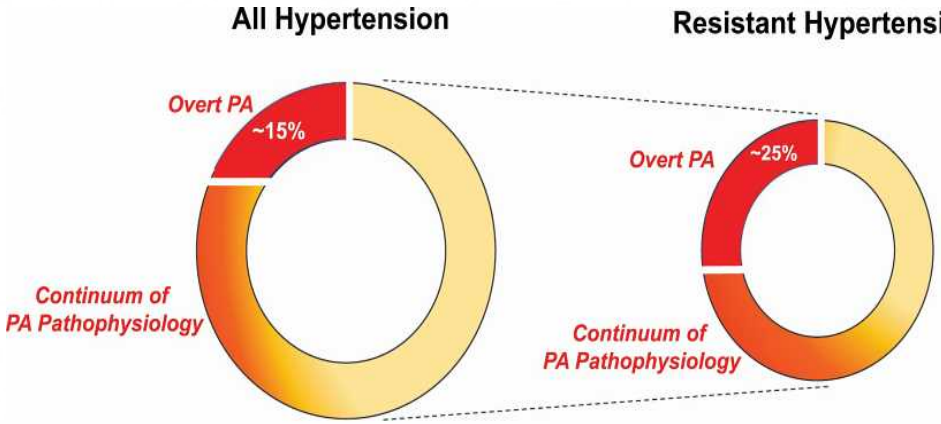
Figure 5: **Heart failure in patients with primary aldosteronism versus essential hypertension**
Forest plot of the OR of heart failure in patients with primary aldosteronism and essential hypertension. Central squares of each horizontal line represent the OR for each study. Horizontal lines indicate the range of the 95% CI and the vertical line indicates an OR of 1·0 (which indicates no differences in the OR between patients with primary aldosteronism and patients with essential hypertension). OR=odds ratio.

Heart failure in PA

OR 2.1 (1.1-3.8)

Monticone S. Lancet Diab Endocrinol 2018;6:41-50

PA epidemiology – very very common



Am J Hypertens, Volume 35, Issue 12, December 2022, Pages 967–988, https://doi.org/10.1093/ajh/hpac079

Jambart et al. • Medicine (2025) 104:6

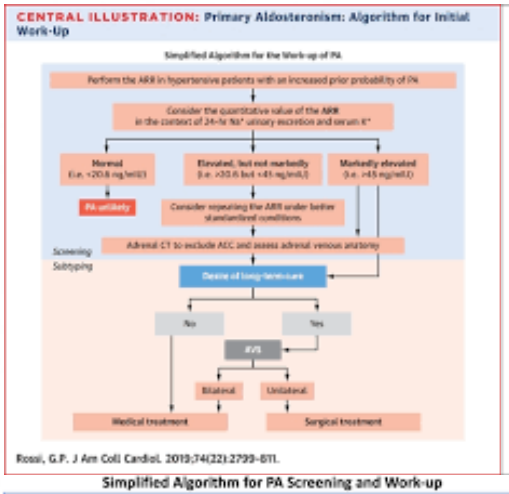
Table 3

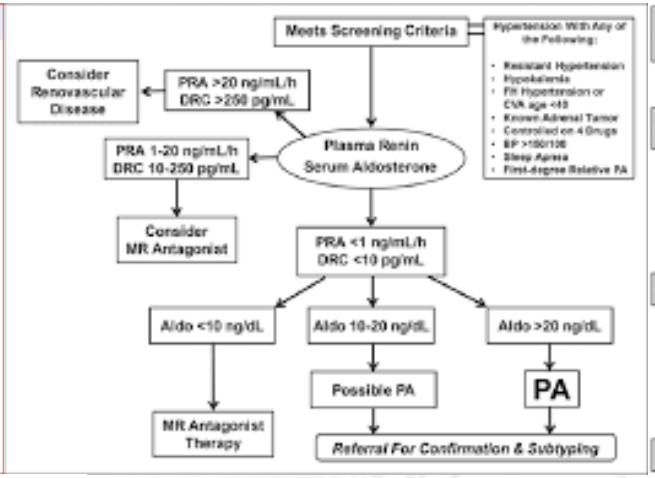
Various studies reporting the prevalence of primary aldosteronism in different countries around the world.

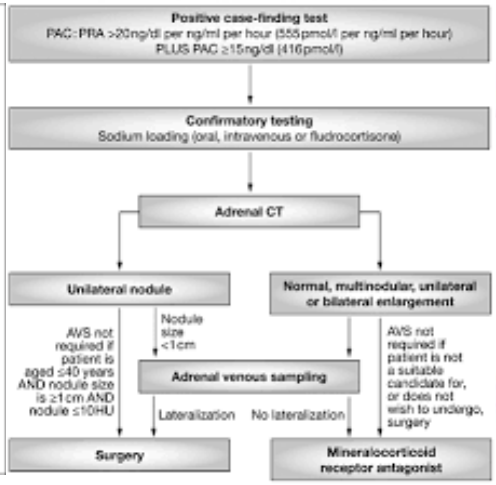
Study	Type of study	Country	Centre	Number of patients	Prevalence, %	After confirmation
Xu et al[17]	Prospective	China	Centre for cardiovascular diseases	7594	8.12	3.3%* (251/367 not 617)
Ribeiro et al[18]	Prospective	Brazil	Cardiology outpatient clinics	105	8.5	0.96%* (1/8 not 9)
Mosso et al[22]	Cross-sectional	Chile	Primary care	609	10.3	6.1%
Omura et al[23]	Prospective	Japan	Cardiology outpatient clinics	1020	11.7	8.1%
Gordon et al[3]	Cross-sectional	Australia	Newspaper announcement	52	12	12%
Rossi et al[15]	Prospective	Italy	General practice	1046	12.8	6.3%
Monticone et al[24]	Prospective	Italy	Primary care	1672	13.9	5.9%
Loh et al[19]	Prospective	Singapore	Primary care	350	18	4.5%* (16/56 not 63)
Asbach et al[20]	Prospective	Germany	Primary care	200	21	5.5%* (11/33 not 42)
Strauch et al[25]	Prospective	Czech Republic	Hypertension unit	402	21.6	19%
Käyser et al[5]	Cross-sectional	The Netherlands	Primary care	343	21.6	2.6%
Chen et al[21]	Prospective	China	Cardiology outpatient clinics	1329	26.2	12.2%* (163/175 not 348)

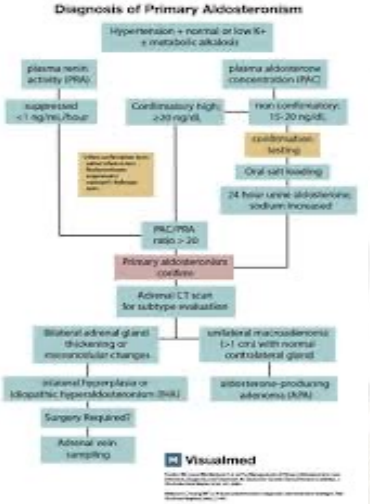
How do we get from Hypertension to PA Treatment?

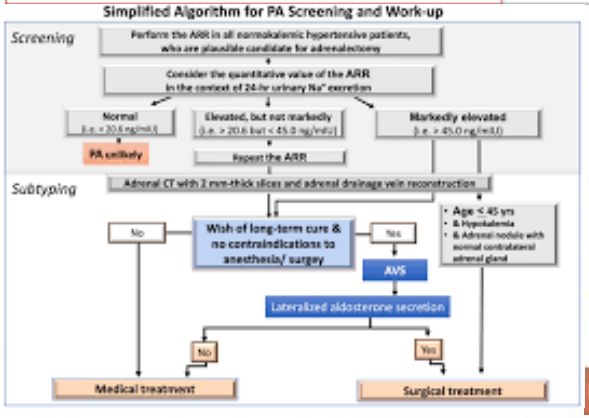
PA diagnostic algorithms - guidelines

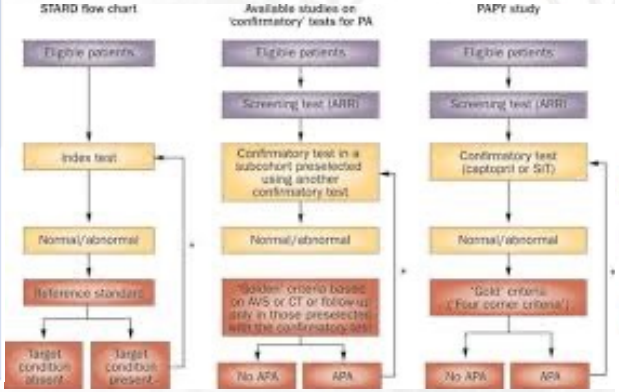


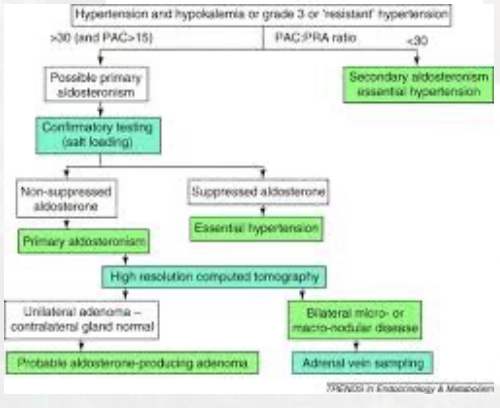




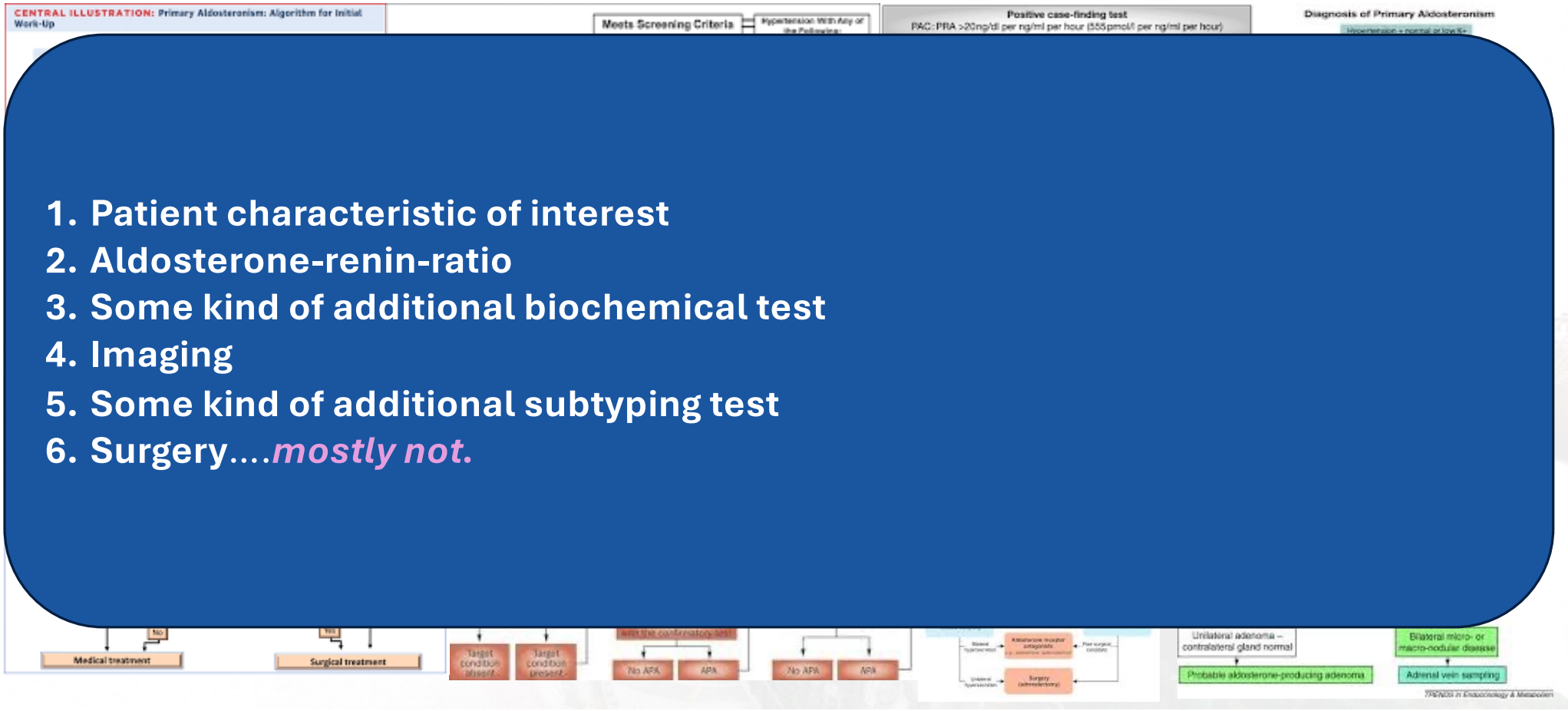








PA diagnostic algorithms - commonalities



1. Patient characteristic of interest
2. Aldosterone-renin-ratio
3. Some kind of additional biochemical test
4. Imaging
5. Some kind of additional subtyping test
6. Surgery….*mostly not.*

Health Care Challenges in the Management of Primary Aldosteronism in Southeast Asia

Norlela Sukor,[1,2] Sarat Sunthornyothin,[3] Thang V. Tran,[4] Tri Juli Tarigan,[5] Leilani B. Mercado-Asis,[6] Satha Sum,[7] Moe Wint Aung,[8] Alice M. L. Yong,[9] Tania Tedjo,[10] Michael Villa,[11] Nang Ei Ei Khaing,[12] Elena Aisha Azizan,[1,2] Waye Hann Kang,[13] Vivien Lim,[14] Ada E. D. Teo,[15] Meifen Zhang,[16] Hieu Tran,[4] and Troy H. Puar[16,17]

ASEAN NETWORK of ADRENAL HYPERTENSION

Breaking Boundaries in Adrenal Disorders
ANAH-AFES Joint Symposium 2025
14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

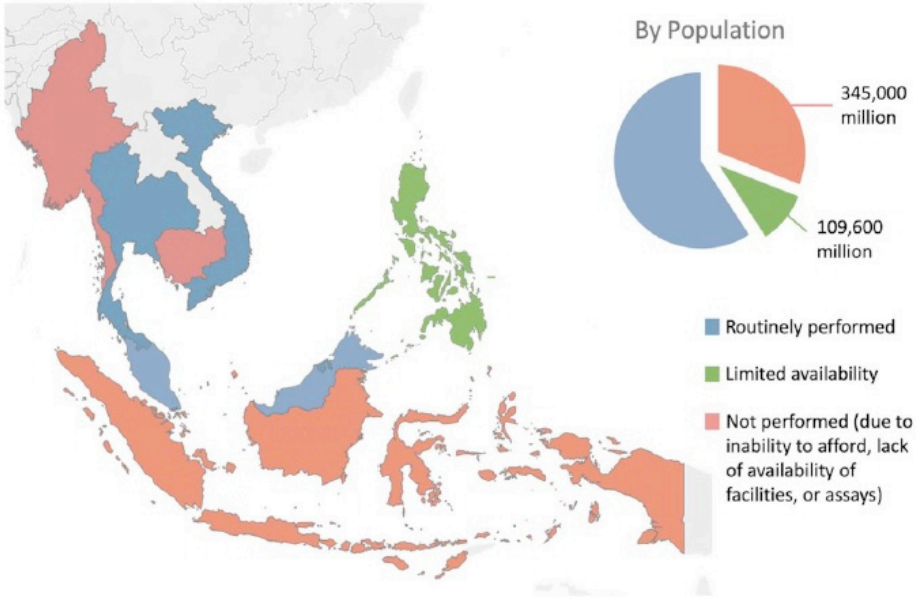


Figure 1. Access to confirmatory testing in ASEAN (Association of Southeast Asian Nations).

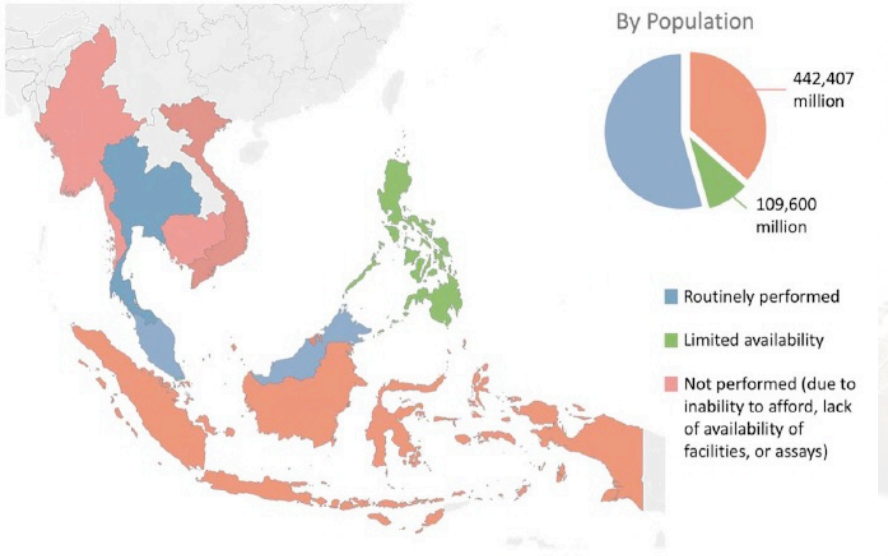
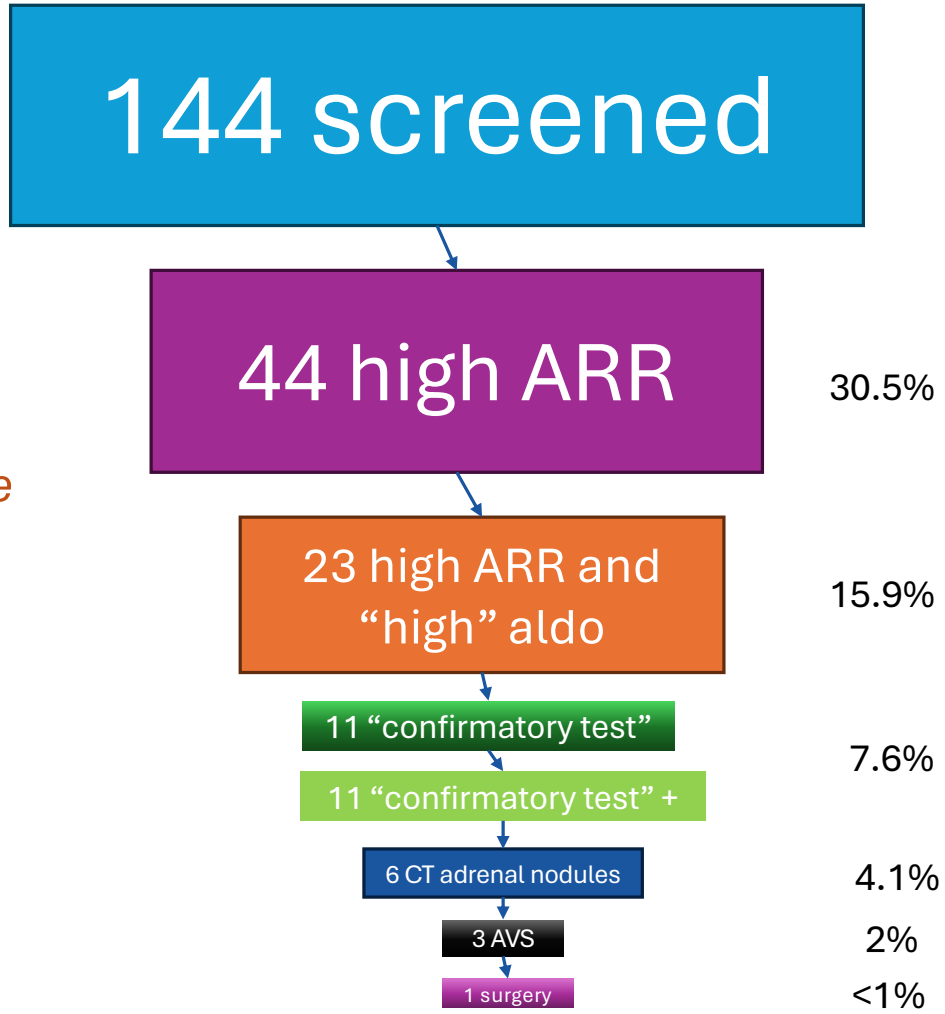


Figure 2. Access to adrenal vein sampling in ASEAN (Association of Southeast Asian Nations).

High prevalence of primary aldosteronism in a tertiary care hospital in Lebanon

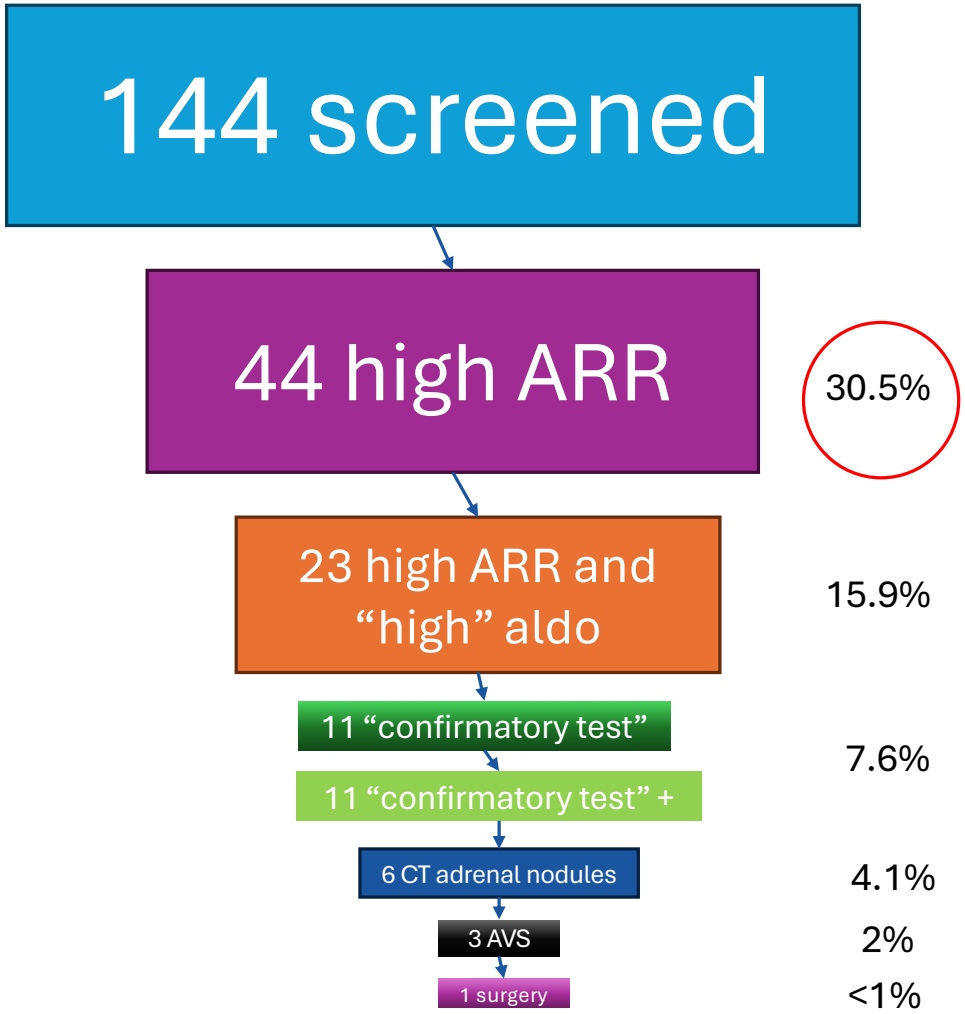
Isabelle Jambart, MD[a], Rebecca Kassab, MD, MSc[a], Marie-Hélène Gannagé-Yared, MD, MSc[a], Roland Kassab, MD[b], Charbel Naim, MD[c], Nada El Ghorayeb, MD[a,*]

Not a criticism of the authors, they are following standard guidelines.

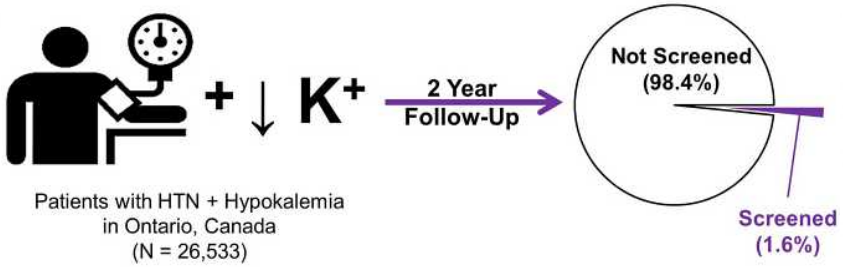


High prevalence of primary aldosteronism in a tertiary care hospital in Lebanon

Isabelle Jambart, MD[a], Rebecca Kassab, MD, MSc[a], Marie-Hélène Gannagé-Yared, MD, MSc[a], Roland Kassab, MD[b], Charbel Naim, MD[c], Nada El Ghorayeb, MD[a,*]

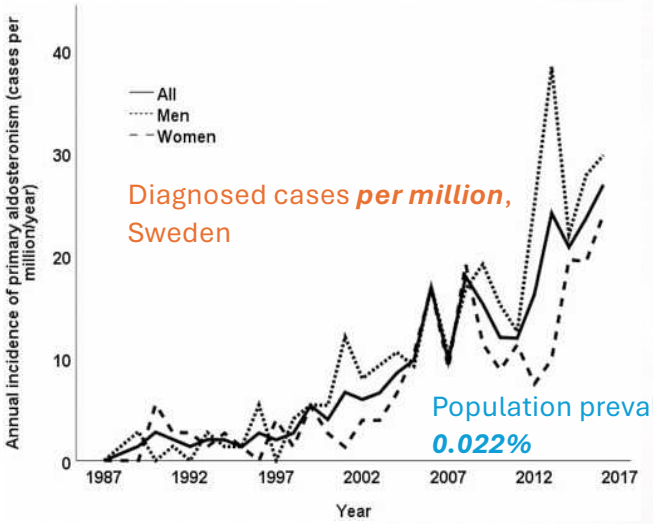


How often are patients with hypertension plus hypokalemia being screened for primary aldosteronism at the population level?



Conclusion: Population-level uptake of guideline-recommended screening for primary aldosteronism is exceedingly low. This underscores a lack of awareness and testing as the primary reason for why primary aldosteronism is severely unrecognized.

Hundemer GL et al.Hypertension. 2022 Jan;79(1):178-86.



Diagnosed cases ***per million***, Sweden

Population prevalence ***0.022%***

J Clin Endocrinol Metab, Volume 106, Issue 9, September 2021, Pages e3603–e3610

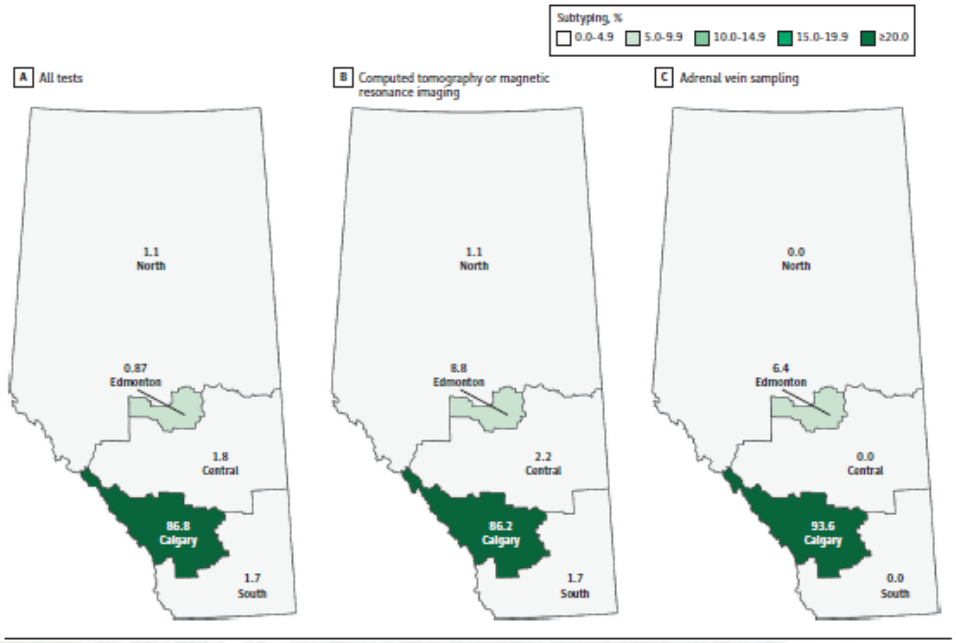
Breaking Boundaries in Adrenal Disorders

ANAH-AFES Joint Symposium 2025

14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

ASEAN NETWORK of ADRENAL HYPERTENSION

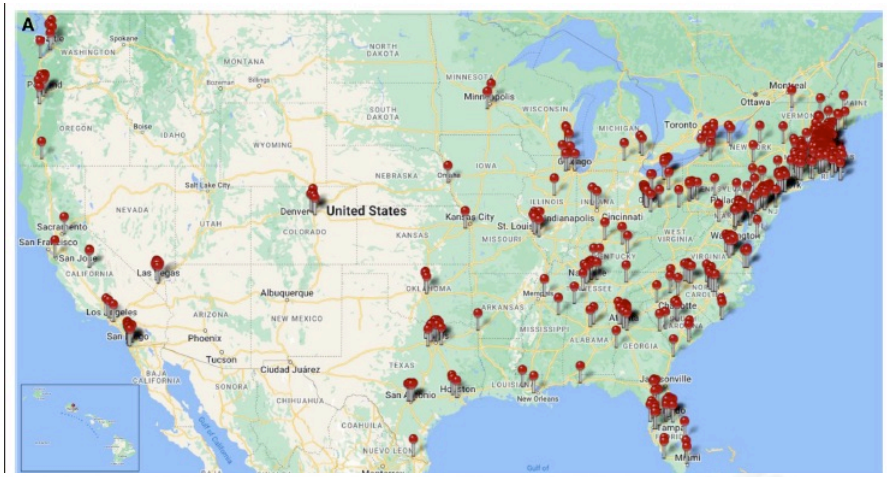
Figure 2. Subtyping Among Patients With Positive Screening Test Results, According to Zones

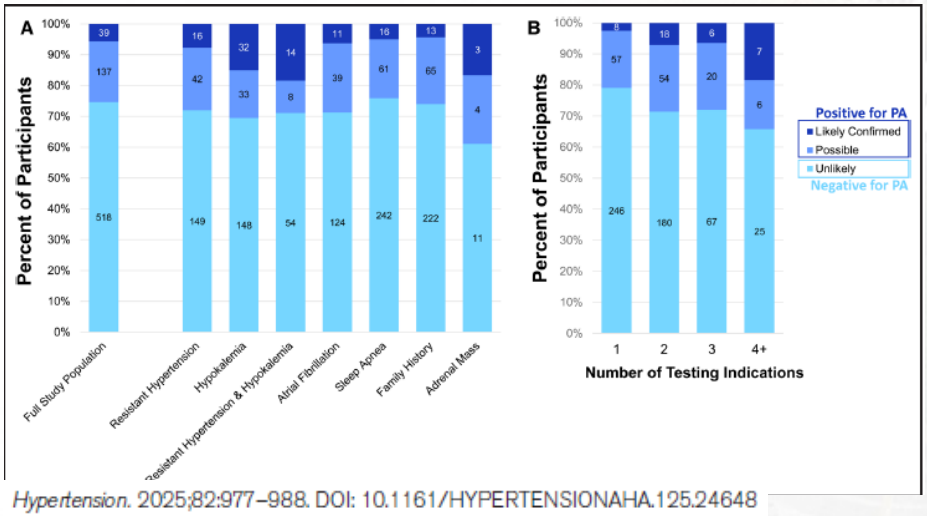


Breaking Boundaries in Adrenal Disorders
ANAH-AFES Joint Symposium 2025
14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

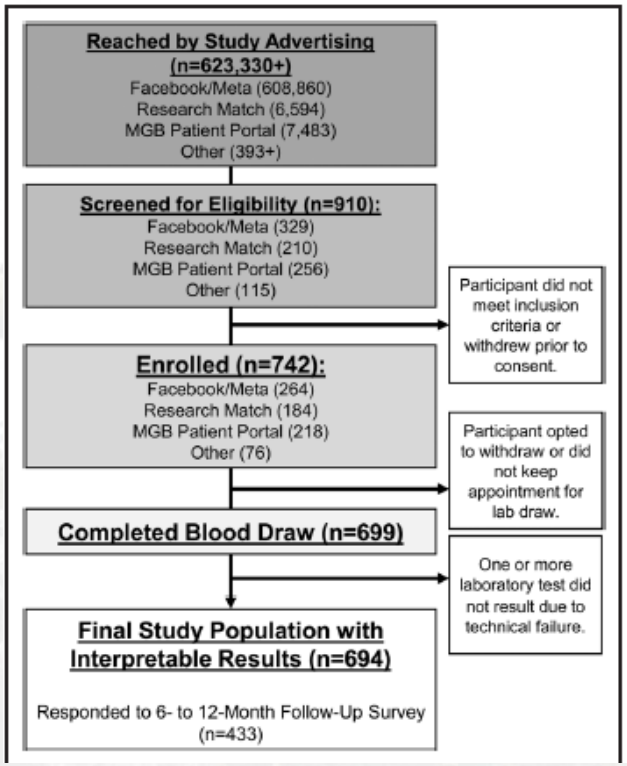
Nationwide, Pragmatic, Direct-to-Patient Primary Aldosteronism Testing Program

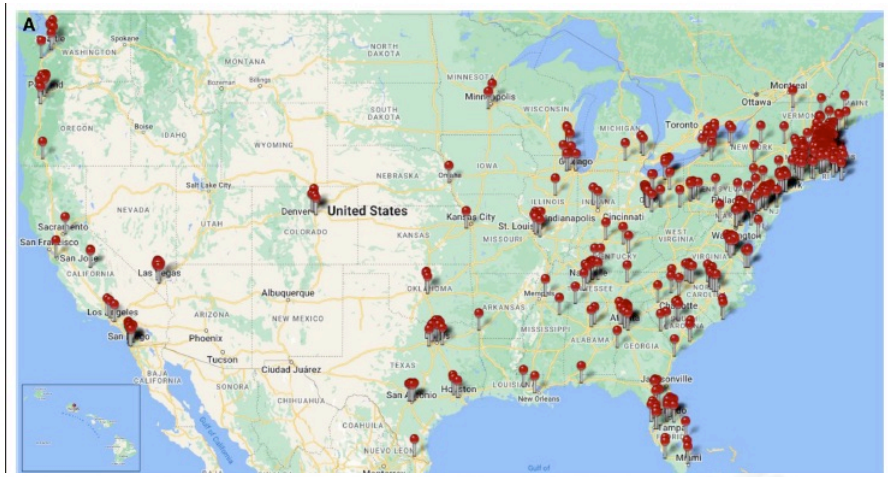
Jenifer M. Brown, Laura C. Tsai, Eva E. Abel, Arnaldo Ferrebus, Anna E. Moore, Yvonne M. Niebuhr, Bassil Bacare, Brooke Honzel, Julia Milks, Kristen Foote, Andrew J. Newman, Wasita W. Parksook, Anand Vaidya

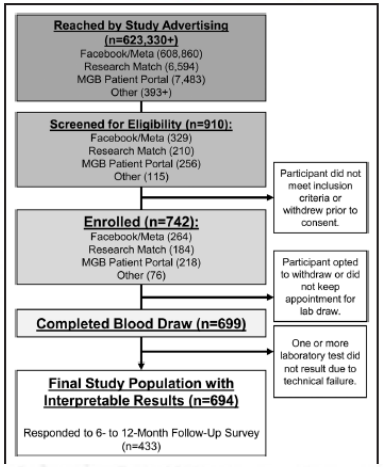




Hypertension. 2025;82:977–988. DOI: 10.1161/HYPERTENSIONAHA.125.24648





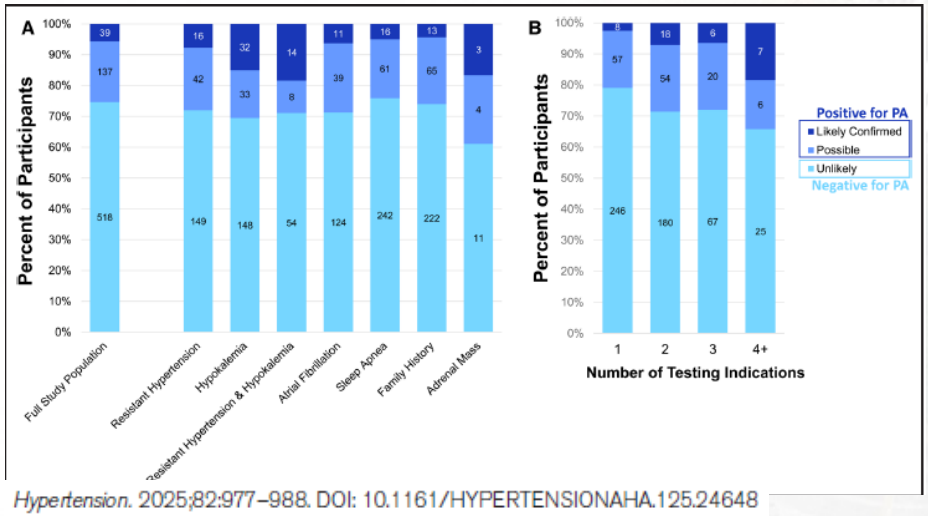


ASEAN NETWORK of ADRENAL HYPERTENSION

Breaking Boundaries in Adrenal Disorders

ANAH-AFES Joint Symposium 2025

14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam



Hypertension. 2025;82:977–988. DOI: 10.1161/HYPERTENSIONAHA.125.24648

Positive PA screening with f/u, n=102 — 14.65%

75 discussed result with MD

26 got more testing (lab or CT or AVS)

13 got MRA

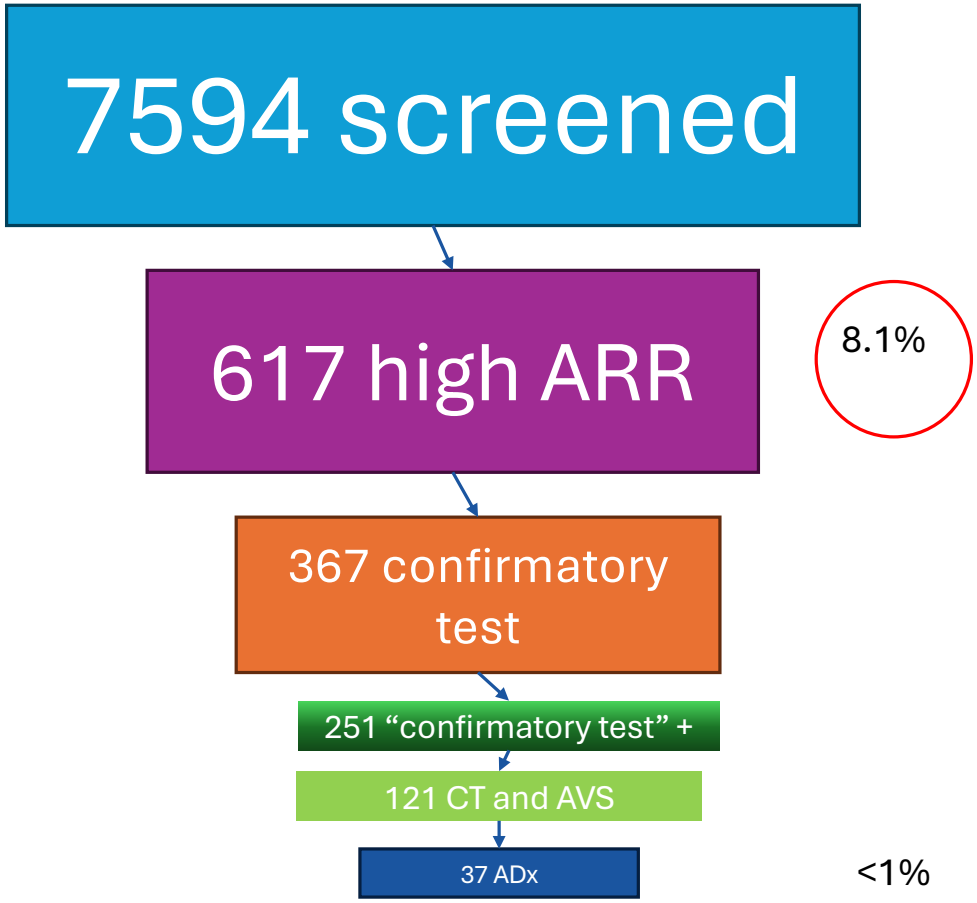
1 got surgery

Prevalence, Subtype Classification, and Outcomes of Treatment of Primary Aldosteronism: A Prospective Study in China

Fen Xu, PhD [1], Zhangwei Gao, BS [1], Guoqiang Wang, MS [1], Yang Gao, MD [2], Yang Guo, BS [2], Yutong Guo, BS [1], Zhou Zhou, PhD [1,*]

Endocrine Practice 27 (2021) 478–483

*Not a criticism of the authors, they are following standard guidelines.

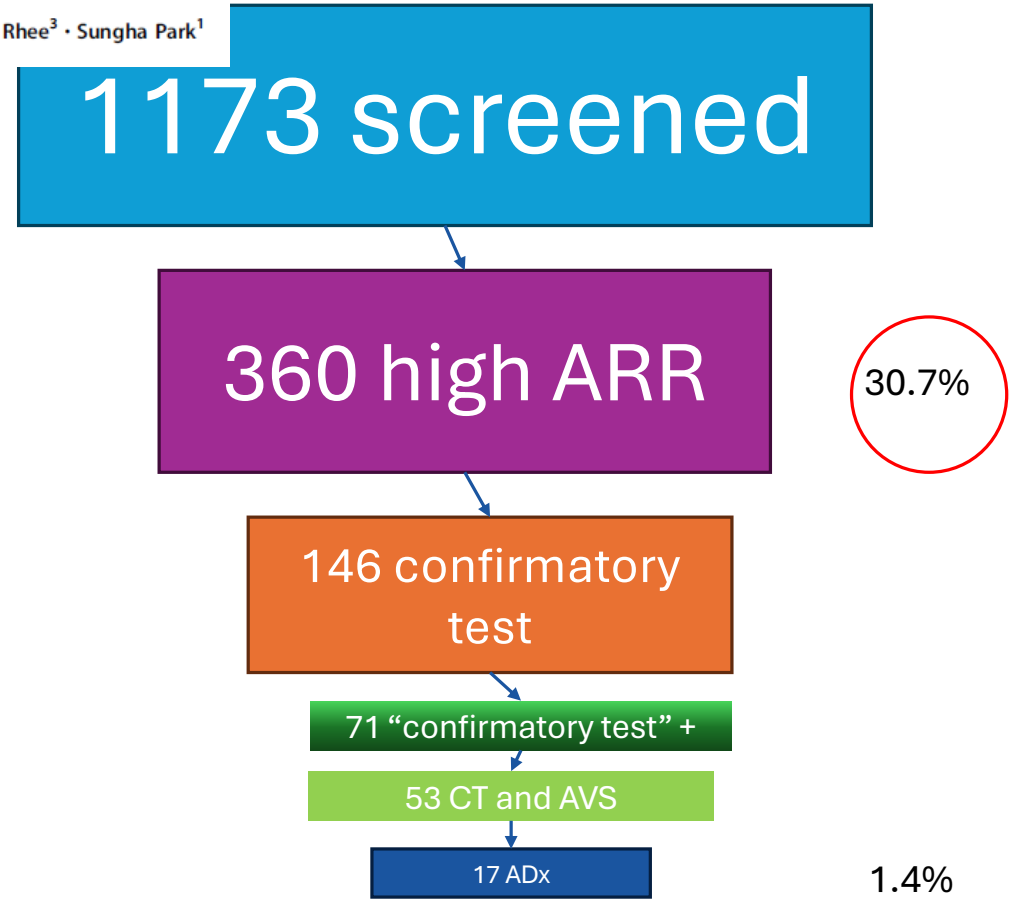


Prevalence and clinical characteristics of primary aldosteronism in a tertiary-care center in Korea

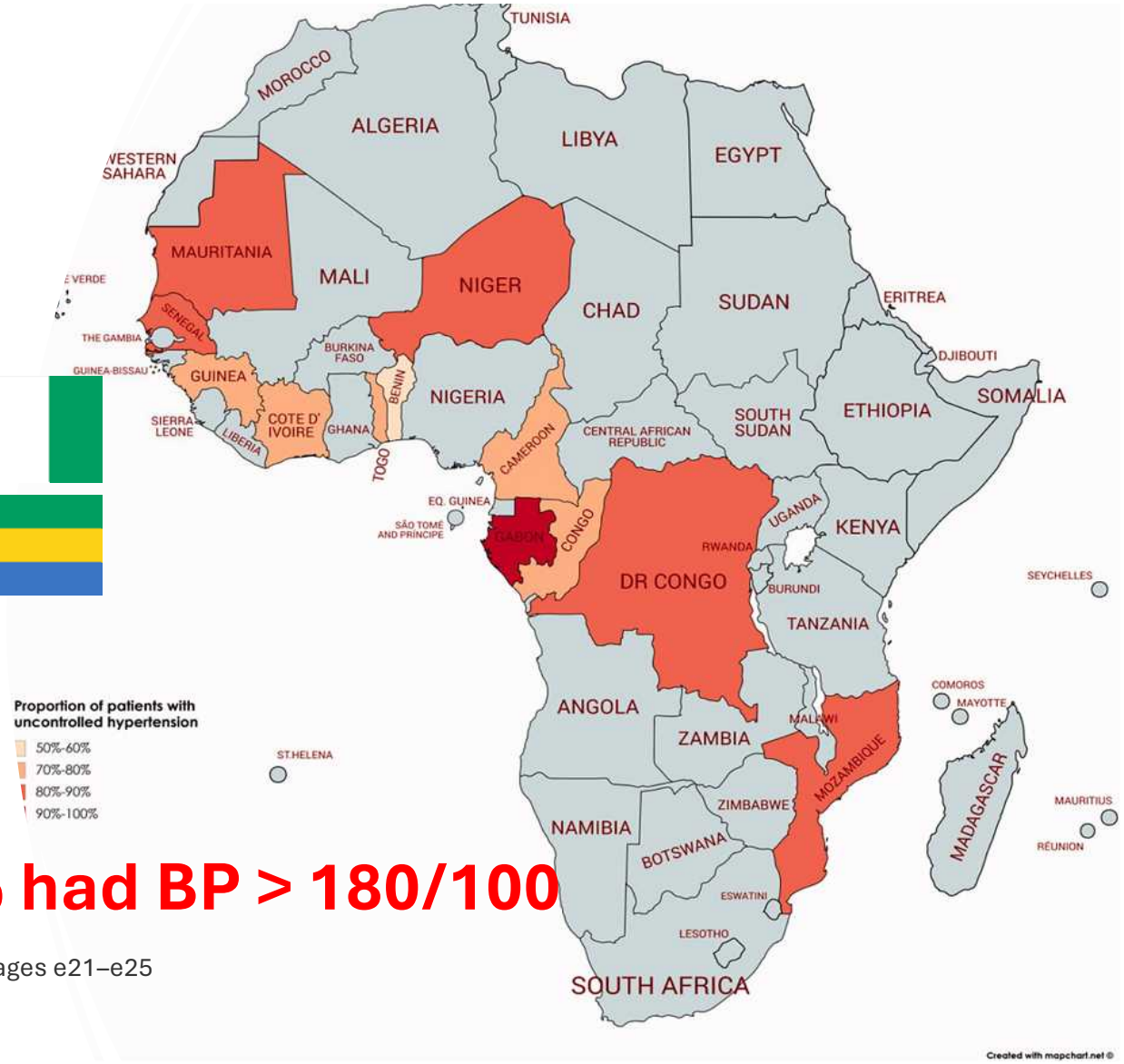
Minjae Yoon[1,2] · Namki Hong[3] · Jaehyung Ha[1] · Chan Joo Lee[1] · Cheol Ryong Ku[3] · Yumie Rhee[3] · Sungha Park[1]

Hypertension Research (2022) 45:1418–1429

**Not a criticism of the authors, they are following standard guidelines.*



Proportions of patients with uncontrolled **(but treated)** hypertension. Grey countries were not included in the study.



20-50% had BP > 180/100

Eur. J. Prev. Cardiol., Volume 28, Issue 11, November 2021, Pages e21–e25

ASEAN NETWORK of ADRENAL HYPERTENSION
Breaking Boundaries in Adrenal Disorders
ANAH-AFES Joint Symposium 2025
14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

Summary

Despite predictions of universal high prevalence, access to PA diagnosis is essentially non-existent at the GLOBAL level

Both high and low resource settings

Does it have to be this way?
GLOBAL vs GUIDELINE perspectives

1

Do we NEED to be thinking of surgery from the start?

NICE but **NO**

2

Do we NEED adrenal vein sampling?

NO

SPARTACUS

Dekkers T et al. Lancet D&E 2016 Sep 1;4(9):739-46.

3

Do we NEED confirmatory testing?

NO

Leung AA et al. Ann Intern Med 2025

4

Do we NEED aldo-renin-ratio screening?

NICE but NO

- Resistant hypertension [PATHWAY-2]
- Hypertension with hypokalemia/thiazide-induced hypokalemia
- Hypertension in Africans (?)

In development…a PA GLOBAL perspective

Health resource and context-informed recommendations for PA

- **Diagnosis:** [resistant] hypertension, hypokalemia or ARR if possible
- **Paradigm shift:** PA as *contributor* not *stand-alone* diagnosis

- **High resource:** ***MRA therapy for most*** – with resources available to pursue surgical cases if desired. (Endo Soc guidelines)
- **Moderate resource:** ***MRA therapy for most*** – with CT imaging-guided surgery an option for severe cases with unilateral mass
- **Low resource:** ***MRA therapy early and thoroughly***

Breaking Boundaries in Adrenal Disorders

ANAH-AFES Joint Symposium 2025

14 - 16 Nov 2025 | Ariyana Convention Centre, Da Nang City, Vietnam

ASEAN NETWORK of ADRENAL HYPERTENSION

PA in a GLOBAL perspective……

….MUST be *translatable* into ALL contexts…

…if it is to move out of the UNIVERSITIES…

….and save lives.

Thank you

gakline@ucalgary.ca

CIHR IRSC
Canadian Institutes of Health Research | Instituts de recherche en santé du Canada

UCARG

Alberta Health Services

UNIVERSITY OF CALGARY