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Faculty of Medicine Ramathibodi Hospital

Hypertension Data Warehouse

Htun Teza

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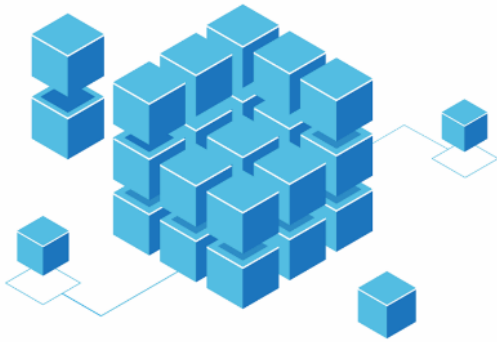
Data Warehouse



Hypertension

- A major modifiable risk factor of cardiovascular diseases, associated with all-cause death [1]
- persistent elevation of arterial blood pressure [2]
  - systolic blood pressure (SBP) ≥ 140 mmHg
  - diastolic blood pressure (DBP) ≥ 90 mmHg
- WHO 2021 Report [3]
  - 1.28 billion adults worldwide
  - 46% unaware of the condition
- Thailand National Health Survey 2014
  - 25% of adults in Thailand

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1. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (pure): a prospective cohort study. *Lancet (London, England)*. (2020) 395(10226):795–808. 10.1016/S0140-6736(19)32008-2

2. Kunanon S, Chattranukulchai P, Chotruangnapa C, Kositanurit W, Methavigul K, Boonyasirinant T, et al. Thai Guidelines on the Treatment of Hypertension: Executive Summary. *J Med Assoc Thai*. (2019) 104:1729–38. 10.35755/jmedassocthai.2021.10.12199

3. WHO. Hypertension World Health Organization Newsroom: World Health Organization (WHO) (2023). Available at: https://www.who.int/news-room/fact-sheets/detail/hypertension (Updated March 16, 2023; Cited March 29, 2023)

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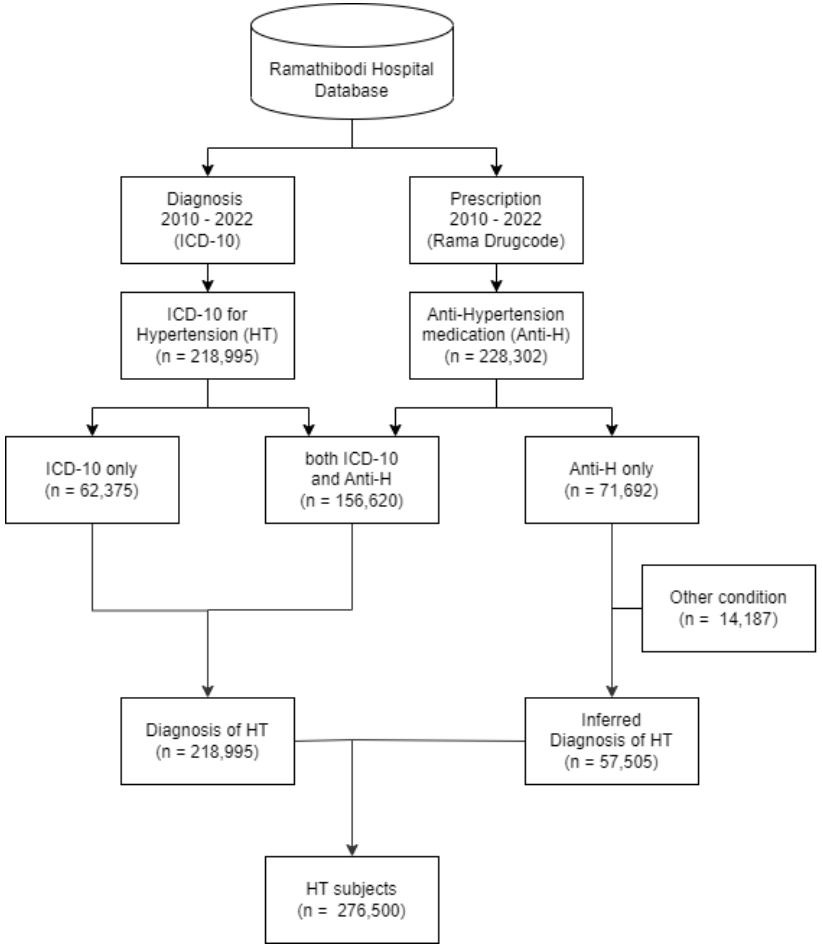
13 Years cohort



ICD-10 codes used for Diagnosis of Hypertension (HT)

I10 Essential (primary) hypertension
I11 Hypertensive heart disease
I12 Hypertensive chronic kidney disease
I13 Hypertensive heart and chronic kidney disease
I15 Secondary hypertension

Antihypertensive Medications (Anti-H) used for Diagnosis of HT

At least one drug group prescribed
Angiontensin-converting Enzyme Inhibitor,
Angiotensin II Receptor Blocker,
Calcium Channel Blocker,
Alpha Agonist,
Alpha Blocker,
Alpha Beta Blocker,
Beta Blocker,
Diuretic,
Ergot Alkaloid,
Hydralazine,
Minoxidil,
Neprilysin Inhibitor,
Renin Inhibitor,
Reserpine,
Statin

Other conditions commonly prescribed with Anti-H

Angiontensin-converting Enzyme Inhibitor: Heart Failure
Angiotensin II Receptor Blocker: Heart Failure
Calcium Channel Blocker: Arrhythmia (non-Dihydropyridine)
Alpha Agonist: Hypertension in Pregnancy
Alpha Blocker: Benign Prostatic Hyperplasia
Beta Blocker: Hyperthyroidism
Neprilysin Inhibitor: Heart Failure

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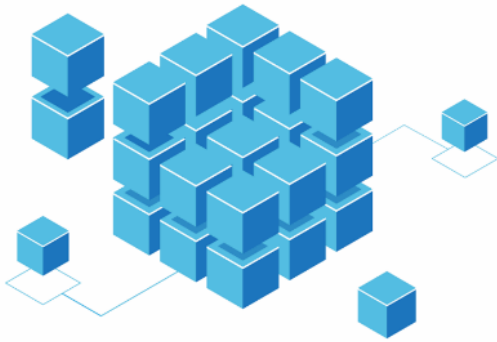
Features (54)

Demographics	Physical Examination	Comorbidity	Laboratory	Medication		Death
Age	Heart rate	Hypertension	Fasting plasma glucose	Angiotensin converting enzyme inhibitors	Hydralazine	Death
Gender	Temperature	Type 2 diabetes mellitus	Cholesterol	Angiotensin receptor blockers	Minoxidil	Main cause of death
Nationality	Oxygen saturation	Atrial fibrillation	High-density lipoprotein	Calcium channel blockers (dihydropyridine)	Neprilysin inhibitor	Cause of death
Ethnic	Body mass index	Dyslipidaemia	Low-density lipoprotein	Calcium channel blockers (non dihydropyridine)	Renin inhibitor	
Province	Height	Chronic kidney disease	Uric acid	Alpha 2 agonists	Reserpine	
Insurance scheme	Body weight	Coronary artery disease	Urine albumin	Alpha beta blockers	Statin	
Occupation	Systolic blood pressure	Stroke	Urine creatinine	Alpha blockers		
Martial status	Diastolic blood pressure	Heart failure	Urine protein (random urine)	Beta blockers		
	Respiratory rate		Urine protein (24 hours)	Diuretics		
			Renal eGFR	Ergot alkaloids		

Projects

Title		Investigator
Disease Progression of Hypertension		
1	Evaluation of transitions from early hypertension to hypertensive chronic kidney disease, coronary artery disease, stroke and mortality: A Thai real-world data cohort	Htun Teza
2	*Factors associated with disease progression of hypertension: A multi-state model (Tentative title)*	Htun Teza
3	*Treatment-effectiveness of anti-hypertensive drugs on disease progressions (Tentative Title)*	Sharmin Akter

Faculty of Medicine Ramathibodi Hospital contributed a resampled subset of this cohort as a resource in Thailand Health AI Datathon 2023, hosting at Khon Kaen University from October 4 to 5.



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Evaluation of transitions from early hypertension to hypertensive chronic kidney disease, coronary artery disease, stroke and mortality: a Thai real-world data cohort

Published May 2, 2023

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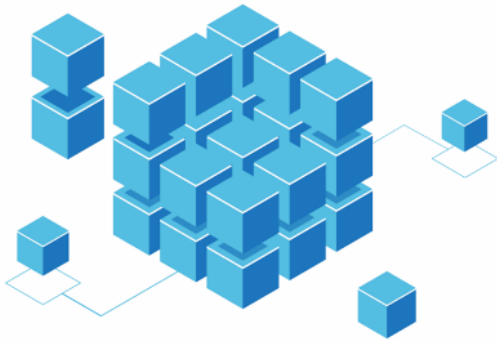

Aim

- To construct a real-world cohort profile of HT
- To estimate transition probabilities from the uncomplicated state to any of these long-term complications;
    1. chronic kidney disease (CKD),
    2. coronary artery disease (CAD),
    3. stroke, and
    4. all cause death.

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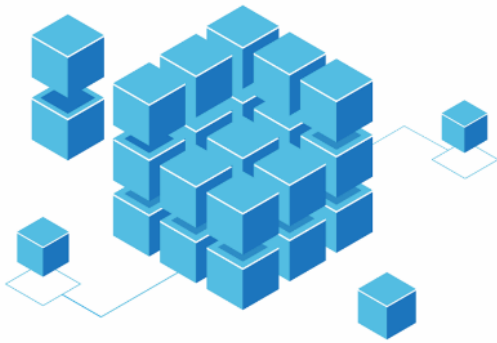

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Comorbidity Identification

Condition	Criteria
Hypertension (HT)	· International Statistical Classification of Diseases and Related Health Problems (ICD) tenth revision (**ICD-10**) codes for Hypertension [I10, I11, I12, I13, I15] · Use of at least one anti-Hypertensive **medications**
Chronic Kidney Disease (CKD)	· **ICD-10** diagnosis for CKD ['I770', 'N18', 'N19', 'T824', 'T825', 'T827', 'T828', 'T829', 'T85611', 'T85621', 'T85631', 'T85691', 'T8571', 'T861', 'Z49', 'Z490', 'Z4901', 'Z4902', 'Z492', 'Z940', 'Z992'] · **ICD-9** procedures for renal replacement therapy ['38.93', '38.95', '39.27', '39.42', '39.43', '39.53', '39.95', '54.93', '54.98', '55.6'] · **eGFR** measurements less than 60 ml/min/1.73m2 for 2 consecutive tests of more than 90 days interval

Condition	Criteria
Stroke	· **ICD-10** diagnosis for Ischemic strokes ['I63', 'I64'] · **ICD-10** diagnosis for Hemorrhagic strokes ['I60', 'I61', 'I62', 'I69'] · **ICD-10** diagnosis for Transient Ischemic Attack ['G45']
Coronary Artery Disease (CAD)	· **ICD-10** diagnosis for Coronary Artery Disease ['I20', 'I21', 'I22', 'I23', 'I24', 'I25] · **ICD-9** procedures for percutaneous coronary intervention (PCI) or coronary artery bypass surgery (CABG) ['00.4', '00.66', '17.55', '36.0', '36.1', '36.31', '36.99'] · **Troponin** value more than 14 ng/ml with abnormal EKG result 14 days before and after
Death	· Ramathibodi Hospital Death **Registry**

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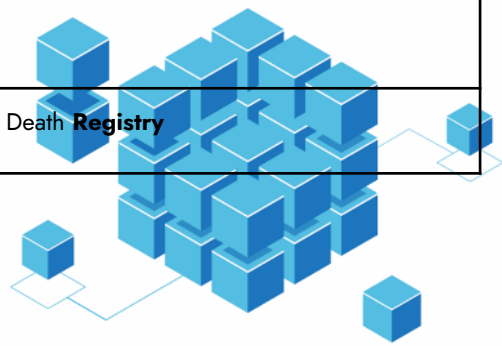
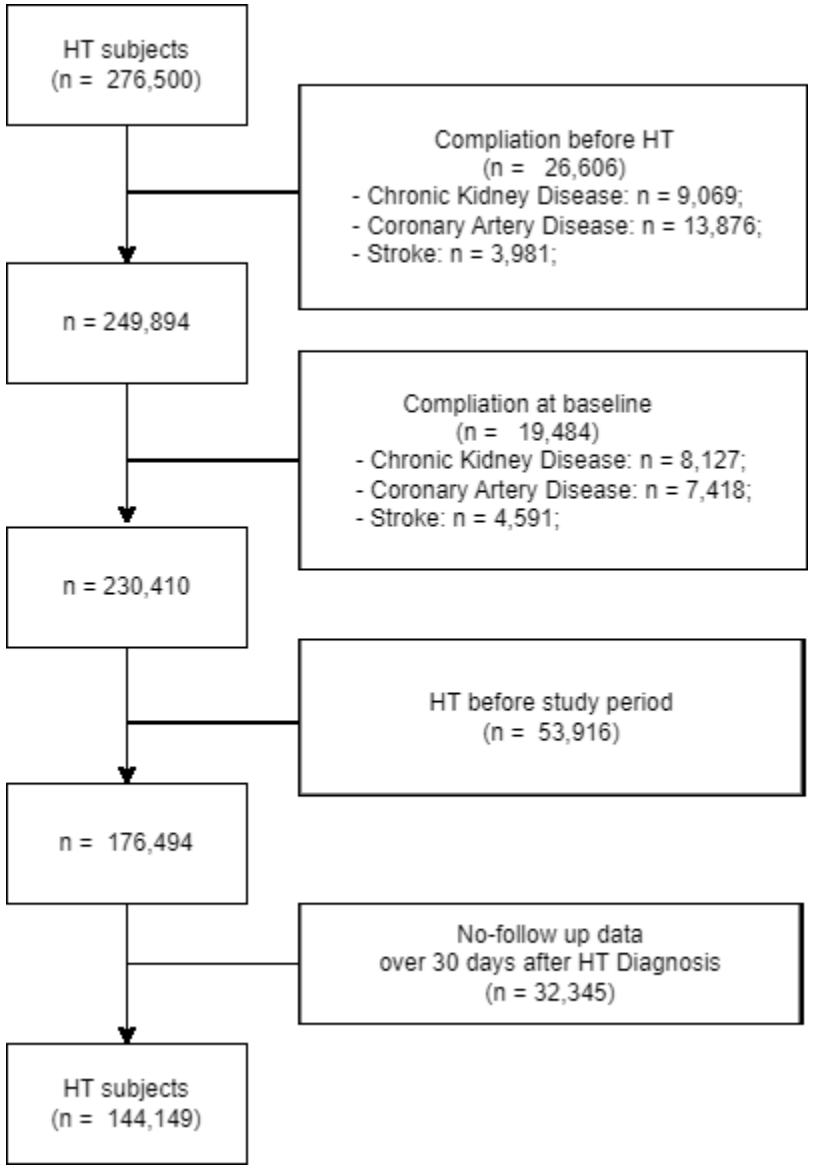


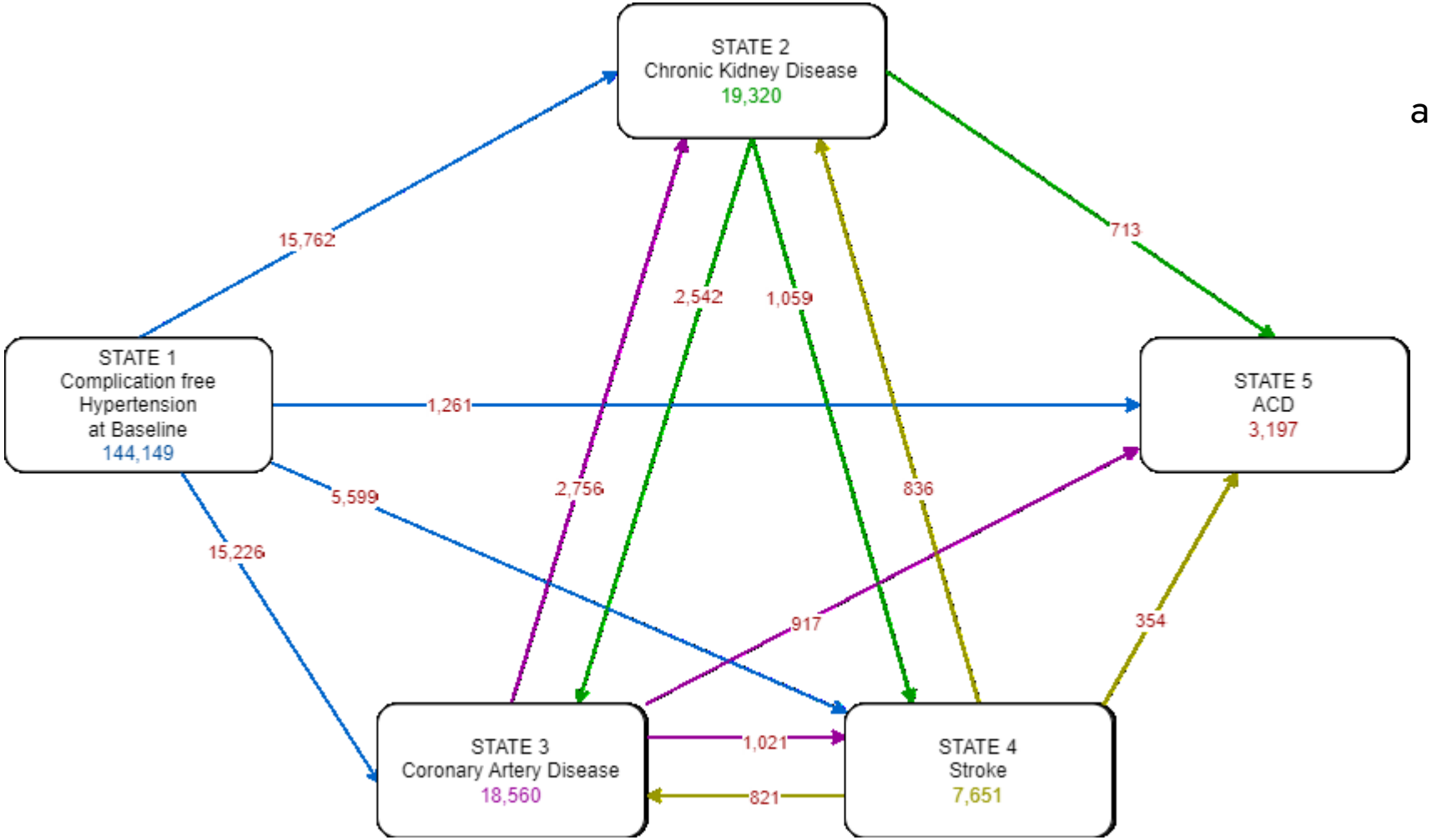
Study data 2010-2022

- Total number of HT: 144,149

- During the 13-years cohort,
  - Total number of CKD developed: 19,320
  - Total number of CAD developed: 18,560
  - Total number of Stroke developed: 7,651
  - Total number of death: 3,197



Materials and Methods



alysis using Kaplan Meier test

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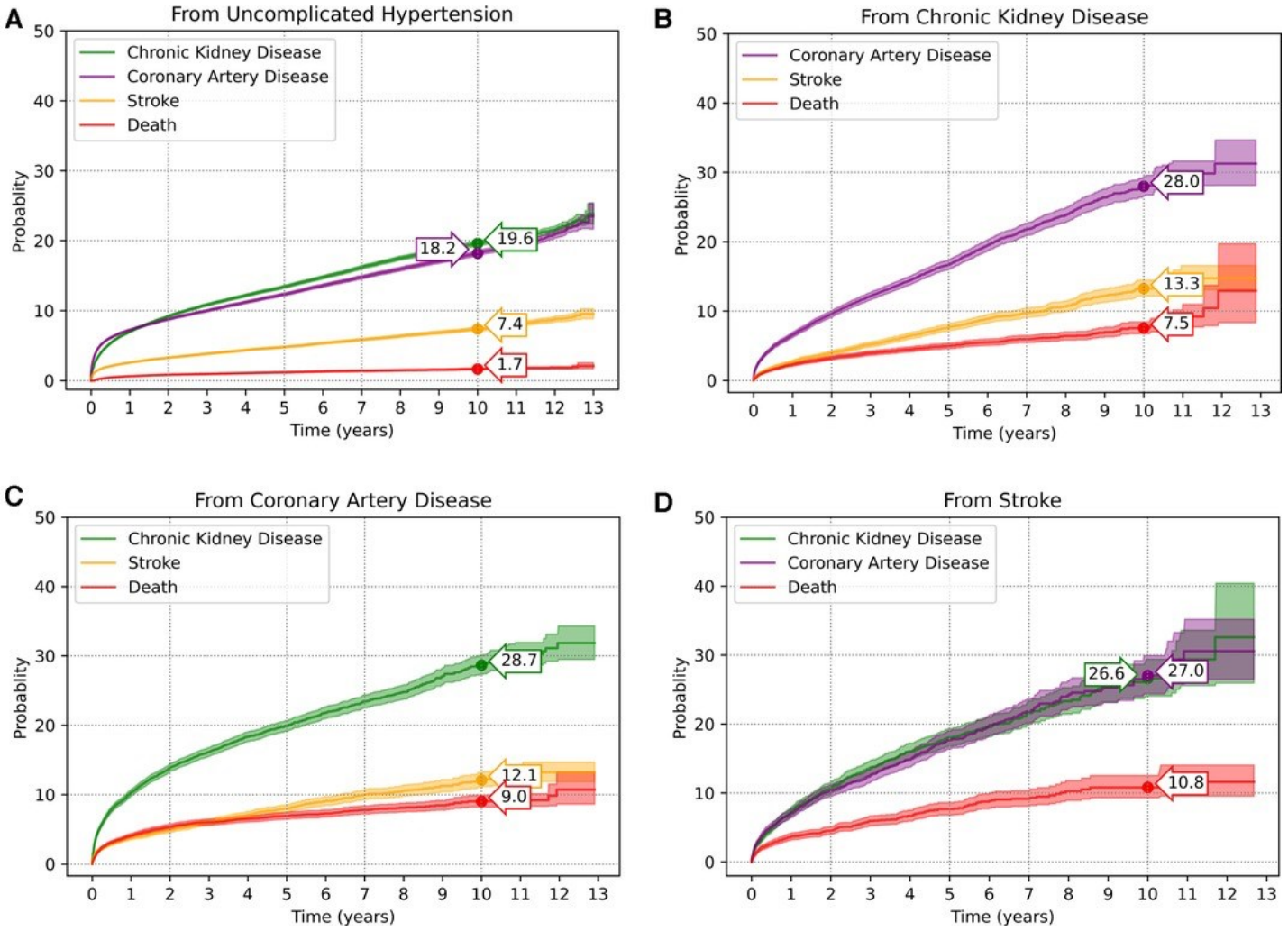
Findings

- CKD — most common in HT, followed by CAD and stroke.
- Stroke — highest risk of ACD, followed by CAD and CKD.
- CKD and CAD — bi-directional relationship.



Findings

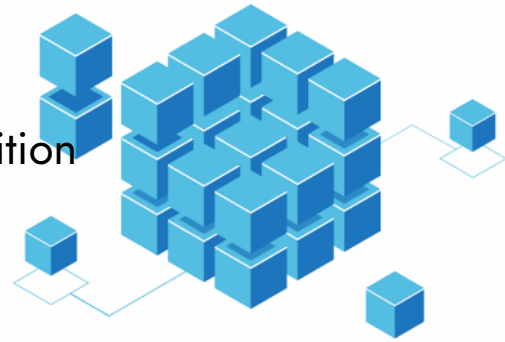
- This study applied clinical visit data as real world data for Hypertension

Strengths

- Longitudinal observation of 144,149 hypertensive patients
  - Median follow-up time: 3.6 years *(range: 0.08-13.00)*
  - Median number of visits: 33 visits *(iqr: 11-76)*
- Observation of disease progression from early uncomplicated state to progressive complication states

Limitations

- Lack of data linkage across health providers leads to loss of observations
- Date of visit in Ramathibodi Hospital had to be considered as date of diagnosis of condition



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Presentations

The findings has been

1. Published at Frontiers in Cardiovascular Medicine, on 2nd of May, 2023.

Front Cardiovasc Med. 2023 May 2;10:1170010. doi: 10.3389/fcvm.2023.1170010. eCollection 2023.

Evaluation of transitions from early hypertension to hypertensive chronic kidney disease, coronary artery disease, stroke and mortality: a Thai real-world data cohort

Htun Teza [1], Suparee Boonmanunt [1], Nattawut Unwanatham [1], Kunlawat Thadanipon [1], Thosaphol Limpijankit [2], Oraluck Pattanaprateep [1], Anuchate Pattanateepapon [1], Gareth J McKay [3], John Attia [4], Ammarin Thakkinstian [1]

Affiliations

PMID: 37206104 PMCID: PMC10191197 DOI: 10.3389/fcvm.2023.1170010

Free PMC article

Abstract

Objective: Systemic arterial hypertension (HT) is a major modifiable risk factor for cardiovascular disease (CVDs), associated with all-cause death (ACD). Understanding its progression from the early state to late complications should lead to more timely intensification of treatment. This study aimed to construct a real-world cohort profile of HT and to estimate transition probabilities from the uncomplicated state to any of these long-term complications; chronic kidney disease (CKD), coronary artery disease (CAD), stroke, and ACD.

Methods: This real-world cohort study used routine clinical practice data for all adult patients diagnosed with HT in the Ramathibodi Hospital, Thailand from 2010 to 2022. A multi-state model was developed based on the following: state 1-uncomplicated HT, 2-CKD, 3-CAD, 4-stroke, and 5-ACD. Transition probabilities were estimated using Kaplan-Meier method.

Results: A total of 144,149 patients were initially classified as having uncomplicated HT. The transition probabilities (95% CI) from the initial state to CKD, CAD, stroke, and ACD at 10-years were 19.6% (19.3%, 20.0%), 18.2% (17.9%, 18.6%), 7.4% (7.1%, 7.6%), and 1.7% (1.5%, 1.8%), respectively. Once in the intermediate-states of CKD, CAD, and stroke, 10-year transition probabilities to death were 7.5% (6.8%, 8.4%), 9.0% (8.2%, 9.9%), and 10.8% (9.3%, 12.5%).

Conclusions: In this 13-year cohort, CKD was observed as the most common complication, followed by CAD and stroke. Among these, stroke carried the highest risk of ACD, followed by CAD and CKD. These findings provide improved understanding of disease progression to guide appropriate prevention measures. Further investigations of prognostic factors and treatment effectiveness are warranted.

Keywords: cohort profile; hypertension; hypertension progression; multi-state model; real-world data; survival analysis; transition probability.

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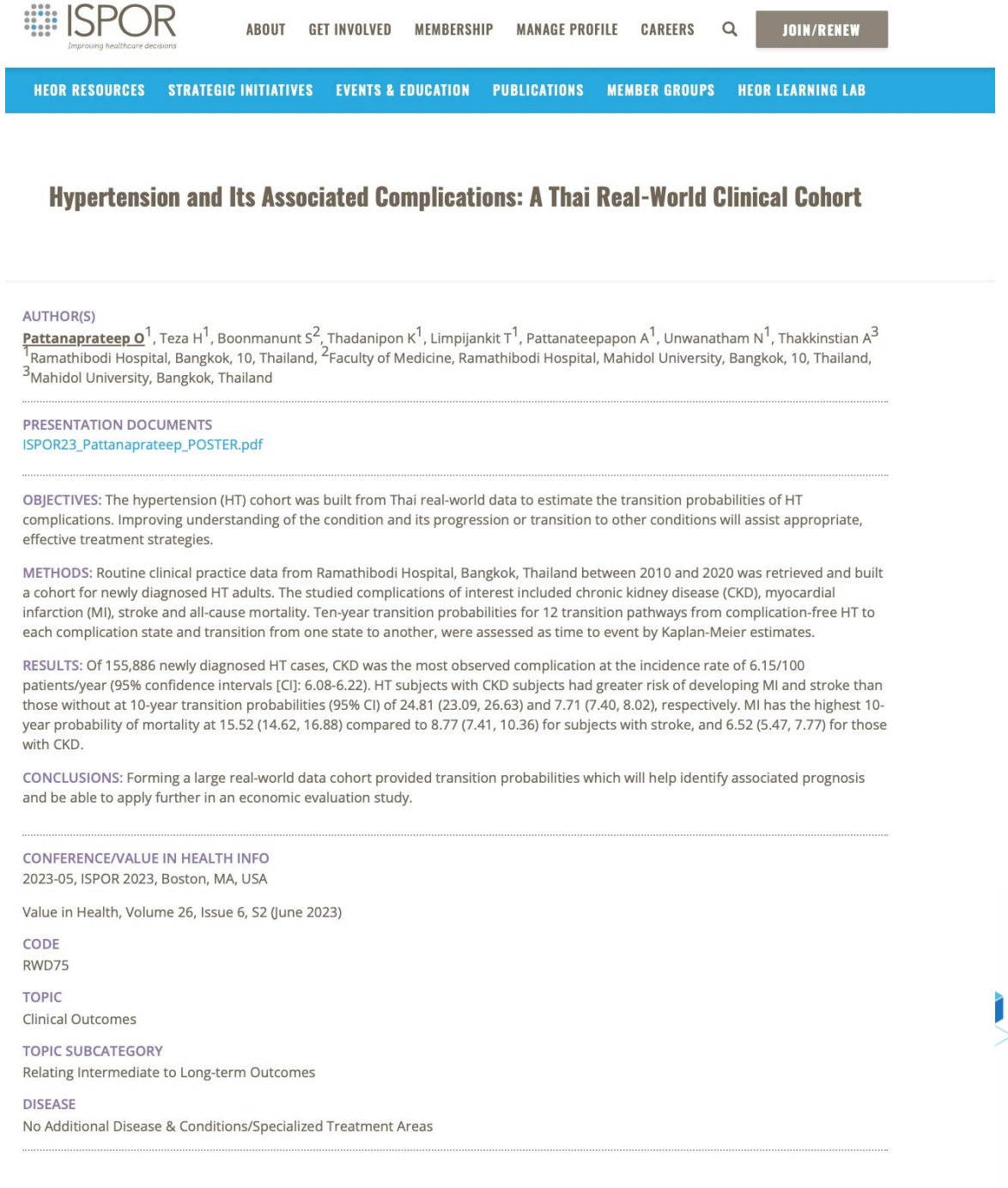
Presentations

The findings has been

1. Published at Frontiers in Cardiovascular Medicine, on 2nd of May, 2023.
2. Presented at ISPOR — The Professional Society for Health Economics and Outcomes Research, Boston Convention & Exhibition Center, Boston, Massachusetts, United States, from 7th to 10th of May, 2023.



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Hypertension and Its Associated Complications: A Thai Real-World Clinical Cohort

AUTHOR(S)

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PRESENTATION DOCUMENTS

ISPOR23_Pattanaprateep_POSTER.pdf

OBJECTIVES: The hypertension (HT) cohort was built from Thai real-world data to estimate the transition probabilities of HT complications. Improving understanding of the condition and its progression or transition to other conditions will assist appropriate, effective treatment strategies.

METHODS: Routine clinical practice data from Ramathibodi Hospital, Bangkok, Thailand between 2010 and 2020 was retrieved and built a cohort for newly diagnosed HT adults. The studied complications of interest included chronic kidney disease (CKD), myocardial infarction (MI), stroke and all-cause mortality. Ten-year transition probabilities for 12 transition pathways from complication-free HT to each complication state and transition from one state to another, were assessed as time to event by Kaplan-Meier estimates.

RESULTS: Of 155,886 newly diagnosed HT cases, CKD was the most observed complication at the incidence rate of 6.15/100 patients/year (95% confidence intervals [CI]: 6.08-6.22). HT subjects with CKD subjects had greater risk of developing MI and stroke than those without at 10-year transition probabilities (95% CI) of 24.81 (23.09, 26.63) and 7.71 (7.40, 8.02), respectively. MI has the highest 10-year probability of mortality at 15.52 (14.62, 16.88) compared to 8.77 (7.41, 10.36) for subjects with stroke, and 6.52 (5.47, 7.77) for those with CKD.

CONCLUSIONS: Forming a large real-world data cohort provided transition probabilities which will help identify associated prognosis and be able to apply further in an economic evaluation study.

CONFERENCE/VALUE IN HEALTH INFO

2023-05, ISPOR 2023, Boston, MA, USA

Value in Health, Volume 26, Issue 6, S2 (June 2023)

CODE

RWD75

TOPIC

Clinical Outcomes

TOPIC SUBCATEGORY

Relating Intermediate to Long-term Outcomes

DISEASE

No Additional Disease & Conditions/Specialized Treatment Areas

Further studies

Factors associated with *disease progression of hypertension: A multi-state model (Tentative title)*

- To assess the factors associated with the disease progression
  - Prognostic factors were not considered in the previous subproject.
  - Findings may aid clinicians and patients delay disease progression, particularly in high-risk patients.
  - Analysis will be done using Cox Proportional hazards model.
- To compare the data preparation approaches for analyses using electronic medical records.
  - Clinical visit data have limitations regarding the date of diagnosis for studied conditions.
  - Different approaches will be proposed and compared.