Hypertension Prevalence Measure Definition

April 2025

Prepared for:
Administration for Community Living

MITRE | Center for Transforming Health

Operator of the CMS Alliance to Modernize Healthcare (The Health FFRDC)

A Federally Funded Research and Development Center

This and other CODI resources are available at .

Notice

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Acknowledgments

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1 Introduction

1.1 Purpose

This document describes a method for measuring hypertension prevalence among a general population and within populations that received clinical intervention or health-related services and programs. This document is intended for health information exchanges (HIEs) or organizations holding data from clinical settings who are interested in measuring hypertension prevalence.

This work is part of an Administration for Community Living (ACL) sponsored project, the Community and Clinical Data Initiative (CODI) Maryland pilot.[1] This measure was collaboratively developed by MITRE and the Chesapeake Regional Information System for our Patients (CRISP), the HIE in Maryland, and will function as a standalone measure and provide a foundation for the assessment of hypertension control.

1.2   Background Research

MITRE reviewed published hypertension guidelines and measurement literature to identify candidate hypertension measurement approaches for consideration. Appendix A summarizes findings from relevant literature, which provided general background information, measurement thresholds, intervals, and analytic approaches that informed measure development.

The literature review highlighted the following foundational information about hypertension:

- The current (2017) hypertension clinical practice guidelines from the American College of Cardiology and the American Heart Association define hypertension as "anyone with a systolic blood pressure (SBP) ≥ 130 millimeters of mercury (mm Hg) or diastolic blood pressure (DBP) ≥ 80 mm Hg" (i.e., 130/80).[2]
- High blood pressure is common; roughly half of US adults had hypertension between August 2021–August 2023 (47.7%).[3]
- Only 59% of adults with hypertension were aware of their condition, suggesting that 41% of adults with hypertension are undiagnosed.
- BP is influenced by body position such that thresholds for BP elevation are different for an individual that is sitting or standing compared to an individual that is laying down.
- BPs values can change very rapidly. Providers may collect BP repeatedly during a single healthcare encounter to ensure accuracy. Providers may elect to record all, some or only the one more accurate BP value.

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[1] This and other CODI resources are available at https://mitre.github.io/codi/.

[2] Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., ... & Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Journal of the American College of Cardiology, 71(19), e127-e248.

[3] Fryar CD, Kit B, Carroll MD, Afful J. Hypertension prevalence, awareness, treatment, and control among adults age 18 and older: United States, August 2021–August 2023. NCHS Data Brief, no 511. Hyattsville, MD: National Center for Health Statistics. 2024. DOI: https://dx.doi.org/10.15620/cdc/164016.

1.3 Assumptions

The assumptions for the hypertension prevalence measure include:

- Since the measure focuses on essential hypertension, assume that subsequent use of the term hypertension in this document refers to essential hypertension. The measure will not identify:
  - gestational or postpartum, secondary, or white coat hypertension
  - individuals with undiagnosed hypertension, or
  - incident cases of hypertension. An incident case refers to a new occurrence of a disease or health condition within a specified time period. Incident cases are a subset of prevalent cases.
- The measure assumes that a longitudinal dataset is not required since it is cross-sectional. As a result, the measure will not measure progression of hypertension in an individual over time.
- The measure assumes no primary data collection is required since computation of the measure only requires health data generated from routine delivery of healthcare services.
- The measure assumes that BP observations without specific coding regarding body position reflect a seated position.
- The measure assumes that HIEs have access to basic demographic attributes, encounter information, and diagnostic codes in the form of International Classification of Disease revision 10 (ICD-10) codes received from a HIE participant (i.e., a healthcare provider organization that shares data with a HIE.)
- The measure assumes that HIEs implementing this measure may have to translate aspects of the measure definition based on their systems and data availability since each HIE receives different types and formats of health data through various mechanisms.
  - For instance, HIEs may have to interpret the concept of a clinical service or an encounter and what evidence is present in the clinical data they receive. Although a Continuity of Care Document (CCD) suggests that an encounter occurred, it is not itself evidence of an encounter; however, a HIE may accept a CCD as evidence that a clinical service was received.
- The measure assumes that some individuals in a population of interest may lack sufficient clinical data to be included in the measure calculation. Lacking clinical data may indicate that a person did not receive any healthcare during the measurement period or that clinical data has not been shared with the HIE in a usable way. Thus, HIEs will need to determine criteria to select individuals with sufficient clinical data for the measure calculation.
- The measure assumes that patient matching and deduplication will be conducted either as an ongoing effort, or prior to the calculation of this measure by the HIE.

2 Measure Description

The hypertension prevalence measure identifies the proportion of individuals with a hypertension diagnosis among adults (18 years or older) from a population of interest who received a clinical service from an HIE participant within a measurement period.

The aims of this measure are to:

1. Assess the burden of hypertension among an adult population of interest within a designated time period.

2. Support calculation of related hypertension measures that require identifying a population of individuals with hypertension for whom other measures can be assessed (e.g., hypertension control among individuals diagnosed with hypertension).

2.1 Key Definitions

The following terms are used in the measure description as defined below.

- **Evidence of Receiving a Clinical Service:** A clinical service is generally assumed to be provided at an encounter (i.e., hospitalization or ambulatory visit). However, HIEs must infer what occurred during an encounter since a complete record of a healthcare encounter is not usually shared. A HIE may define evidence of receiving a clinical service in different ways; for example, evidence of an encounter (such as an HL7 V2[4] Admission, Discharge, and Transfer message or a CCD[5])) with at least one diagnostic code.

  For multi-day encounters that start before or extend beyond the measurement period, a HIE must consider whether to assess the receipt of clinical services at either the beginning or at the end of the encounter. The end date of the encounter may be preferred as diagnosis data may be more available at discharge.

- **Indication of Essential Hypertension:** Defined as individuals with one or more instances of the ICD-10 diagnostic code for essential hypertension (I10).[6]

2.2 Source Data

The minimum clinical data necessary to compute hypertension prevalence are described in Appendix B in the context of the CODI Data Model.

2.3 Data Quality

The quality of the clinical data used to calculate hypertension prevalence should be assessed regularly to improve the accuracy and reliability of the results. Users are encouraged to assess data quality based on completeness, accuracy, and stability, among others. Users should set their own measurement benchmarks and targets for this measure as appropriate for their data sources.

2.4 Selecting a Measurement Period

Users must define a measurement period to calculate prevalence; the measurement period is the time period during which hypertension prevalence will be calculated and assessed and also the time period used to select clinical data.

In defining a measurement period, users may consider their analytic goals, the data available to participating HIEs, and the information needs of HIE data-sharing partners like community-

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[4] HL7 V2 Specification: https://www.hl7.org/implement/standards/product_brief.cfm?product_id=185.

[5] HL7 Clinical Document Architecture: https://www.hl7.org/implement/standards/product_brief.cfm?product_id=7.

[6] Individuals who had an ICD-10 code indicating hypertensive heart disease (I11), hypertensive chronic kidney disease (I12), hypertensive heart and kidney disease (I13), secondary hypertension (I15) and hypertensive crisis (I16) are not classified as a hypertension case in this measure definition.

based organizations. Users may decide to align the measurement period to similar work (e.g., the reporting period for care quality measures) for comparability and validation.

A 12-month measurement period is recommended to compute hypertension prevalence. Longer measurement periods may be beneficial in some circumstances and extending the measurement period can increase the size of the population included in the denominator. Users are cautioned that applying an abbreviated measurement period that is less than a year could introduce bias.

Important in the selection of a measurement period is the recognition that individuals seek and consume healthcare in non-standard and non-random patterns, meaning that people seek and receive healthcare at different frequencies, and some are totally disengaged from the healthcare system. That means that no measurement period can be designed to capture everyone and users should carefully consider healthcare utilization patterns when creating a measurement period.

2.5 Selecting a Population of Interest

Users must define the population of interest—the group for whom hypertension prevalence will be calculated. The population of interest may be defined based on the demographic, clinical, and/or other characteristics required for reporting. For instance, a defined population may be all participants that received services from a community-based organization. Selecting the population of interest is the first step in calculating hypertension prevalence (see calculation logic below).

2.6 Calculating Age

Users must calculate individual age as part of this measure. Individuals must have only one age in this measure calculation that is calculated based on a single date in the measurement period to determine if they meet the denominator's exclusion criteria. There are several ways that age can be calculated, but a consistent approach should be used for all individuals.

The recommended approach is to calculate an individual's age on the first day of the measurement period as follows:

$$Age = [Start\ Date\ of\ Measurement\ Period] - [Date\ of\ Birth]$$

2.7 Defining the Denominator

Individuals in the denominator are those during the measurement period who:

- are in the defined population of interest,
- are 18 years or older,[7] and
- have evidence of receiving at least one clinical service during the measurement period.

2.7.1 Denominator Exclusions

The denominator excludes:

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[7] Essential hypertension is generally a disease of adulthood and excluding children from the measure calculation limits bias from an inflated denominator.

- Any individual with clinical data but no documented clinical services during the measurement period.

While not required, users may elect to further refine their denominator by implementing one or more of the following criteria:

- Excluding individuals who died during the measurement period
- Excluding some types of clinical services due to the known variations in healthcare encounters such as:
  - Excluding clinical services provided at telehealth and virtual care encounters since blood pressure recordings are either measured by the patient or are missing; users may choose to include only clinical services that occur in person.
  - Excluding clinical services provided while an individual is hospitalized since there are many factors that may result in elevated blood pressure readings that are not related to essential hypertension; users may choose to focus on clinical services provided in an outpatient setting.
- Requiring at least one recorded blood pressure during the measurement period. The rationale for such an approach is that patients who have no recorded blood pressures may have only received healthcare in a setting where hypertension could not have been identified. If no blood pressure was taken or recorded, providers would not have had the information necessary to identify hypertension.

2.8 Calculating the Numerator

Individuals in the numerator are those who have an indication of essential hypertension, defined as individuals with one or more instances of the ICD-10 diagnostic code for essential hypertension (I10).[8] The population diagnosed with hypertension should be calculated as a proportion of the denominator (e.g., percent of individuals 18 years or older with evidence of receiving a clinical service during the measurement period).

2.9 Specifying the Calculation Logic

The **hypertension prevalence measure** calculation logic is described below; see Appendix C for the calculation logic diagram. This logic should be applied after the population of interest and measurement period have been defined and patient matching and linkage has been completed.

1. Is the individual 18 years or older? (Y/N)

   - If no, exclude.
   - If yes, proceed to next step.

2. Did the individual have evidence of at least one clinical service in the measurement period? (Y/N)

   - If no, exclude.
   - If yes, proceed to next step.

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[8] Individuals who had an ICD-10 code indicating hypertensive heart disease (I11), hypertensive chronic kidney disease (I12), hypertensive heart and kidney disease (I13), secondary hypertension (I15) and hypertensive crisis (I16) are not classified as a hypertension case in this measure definition.

3. Did the individual have one or more ICD-10 diagnostic code(s) indicating essential hypertension (I10) in the measurement period? (Y/N)

  o If no, classify as "Does Not Have Hypertension" in the numerator. Calculate as proportion of denominator.
  o If yes, classify as "Has Hypertension" in the numerator. Calculate as proportion of denominator.

3 Limitations

This measure has the following limitations:

- Data from healthcare providers that do not share data with the HIE are not included. As a result, the measure cannot evaluate the burden of hypertension for individuals unengaged with the healthcare system since the measure can only use data accessible by the implementing HIE.
- The denominator may be incomplete because vitals (e.g., recorded blood pressure) and medication data are not used to infer a new or existing diagnosis of hypertension where one was not documented explicitly in the record using diagnostic codes.
- This measure does not include tools or recommendations to clean blood pressure values. Blood pressure data are prone to errors and the frequency of recording blood pressures varies by care setting.
    o Diastolic and systolic blood pressure values may be reversed or manually entered with incorrect values (e.g., entering 310 or 1300 rather than 130).
    o Patients admitted to the hospital may have many blood pressures in a single day while patients visiting outpatient clinics may have one or no blood pressure readings recorded.

- BP observations for individuals who are hospitalized or seeking emergency care are likely a reflection of health conditions other than hypertension or an extraordinary event such as injury or episodic illness. Excluding inpatient and emergency department BPs may decrease the overall completeness of the denominator by excluding some individuals with hypertension. This measure excludes BPs collected in inpatient settings when feasible to improve measure accuracy.

- In many systems, it is difficult to remove or filter out BPs associated with a specific type of healthcare encounter. BPs are a type of vitals data that generally do not have a required reference to a healthcare encounter. This is because requiring a referential relationship would not allow vitals collected at home or in an unconventional care setting to be recorded. Thus, BPs collected during a specific type of healthcare or service cannot be easily identified and excluded such as blood pressures from surgery when a person is anesthetized or from the emergency room when a person was in pain.

- The denominator may be incomplete since this measure excludes BPs collected in the supine (laying down) position as the control thresholds are different than thresholds for a seated position; this may decrease the overall completeness of the denominator by excluding some individuals with hypertension.

Appendix A   Background Research Findings

This appendix summarizes findings from relevant hypertension literature.

Table A-1. Hypertension Prevalence Algorithms

ID	Title	Summary	Hypertension Identification	Inclusion and Exclusion Criteria
1	[National Committee for Quality Assurance (NCQA)[9] Measure Definition for Controlling High Blood Pressure](#)	This 2023 measure definition identifies hypertension and assesses control. Controlling high blood pressure is defined as the percentage of patients 18-85 years of age who had a diagnosis of essential hypertension starting before and continuing into or starting during the first six months of the measurement period, and whose most recent blood pressure was adequately controlled.	Population: Patients 18-85 years of age who had a visit and diagnosis of essential hypertension starting before and continuing into, or starting during the first six months of the measurement period. Criteria: Patients 18 to 85 years of age on date of encounter AND Diagnosis for hypertension (ICD-10-CM): I10 AND qualifying patient encounter during performance period	Excluded: • Patients under 18 and over 85 years of age • Hypertension diagnoses other than essential hypertension • Patients receiving hospice or palliative care • Patients with end stage renal disease • Patients residing in a long term care facility • Patients with dementia, frailty, or advanced illness

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[9] NCQA is the organization that manages the Healthcare Effectiveness Data and Information Set (HEDIS), and sets performance measured to measure health plan and health system performance nationwide.

ID	Title	Summary	Hypertension Identification	Inclusion and Exclusion Criteria
2	Leveraging the Electronic Health Records for Population Health: A Case Study of Patients with Markedly Elevated Blood Pressure	This 2020 study evaluated patterns in blood pressure capture from a large, integrated, clinical data repository.	Population: Patients aged 18 to 85 years old with at least 1 outpatient encounter from January 1, 2013 (the go-live date for Epic electronic health record or EHR system through December 31, 2017.	Excluded: • Children under 18 and those over 85 years • Adults who were pregnant or on dialysis. • Inpatient, emergency department, or ambulatory surgery center blood pressure values to reduce the risk of transiently elevated blood pressure from acute medical conditions
3	Development of a Hypertension Electronic Phenotype for Chronic Disease Surveillance in Electronic Health Records: Key Analytic Decisions and Their Effects	This 2023 study used the Multi-State EHR-Based Network for Disease Surveillance system and data from 1,671,544 adults in Louisiana to examine the effect of different analytic decisions on estimates of hypertension prevalence.	Population: Patients with at least 1 clinical encounter with measured blood pressure in 2018 or 2019. Criteria: Six hypertension case definitions: • Any essential or secondary hypertension diagnosis (ICD codes: 401.x, 405.x, I10, I15) • Any ≥2 elevated blood pressure measurements (≥140/90 mm Hg on separate days) • Any antihypertensive medication • Any hypertension diagnosis OR any ≥2 elevated blood pressure measurement • Any hypertension diagnosis OR any antihypertensive medication • Any hypertension diagnosis OR antihypertensive medication OR ≥2 elevated blood pressure measurements	Excluded: • Patients with 0 clinical encounters with measure blood pressure in the previous two years • Patients under 18 years of age

ID	Title	Summary	Hypertension Identification	Inclusion and Exclusion Criteria
4	Methods of defining hypertension in electronic medical records: validation against national survey data	This 2015 study compared hypertension prevalence calculated using clinical data from the Health Improvement Network (THIN) database, UK, with results from Health Survey for England in 2011.	Population: patients actively registered in THIN database, UK, on January 31, 2011. Criteria: Three hypertension case definitions: • Diagnosis code: one or more hypertension READ codes (G2), • Abnormal blood pressure: two or more abnormal blood pressure measures (systolic blood pressure 140 mmHg or diastolic blood pressure 90 mmHg) within a 2-year period • Antihypertensive drug prescriptions: one or more prescriptions of antihypertensive drugs	Excluded: • Patients who died before January 31, 2011 • Patients who transferred out of the THIN before January 31, 2011 • Patients with invalid information out of sequence between year of birth and registry date.

ID	Title	Summary	Hypertension Identification	Inclusion and Exclusion Criteria
5	[Electronic Health Records for Population Health Management: Comparison of Electronic Health Record–Derived Hypertension Prevalence Measures Against Established Survey Data](#)[10]	This study sought to assess the comparability of six different EHR-based hypertension prevalence estimates with estimates from a national survey. Six prevalence estimates were calculated for Marion County using EHR data from the Indiana Network for Patient Care (INPC), a regional HIE. The overarching goal is to identify which phenotypes most closely align with nationally accepted estimations. The study found that phenotypes that relied on diagnosis code data performed less robustly.	Population: Adults living in Marion County with at least one outpatient, inpatient, or emergency department encounter at 1 of the 3 large integrated delivery networks that connect to the INPC between January 1, 2014, and December 31, 2015.[11] Criteria: Five hypertension case definitions: • Diagnostic codes: (either 1 inpatient or 1 outpatient encounter documenting a hypertension diagnosis) • Vital statistics: (at least 1 blood pressure reading above the hypertension threshold) • Vital statistics: (at least 2 blood pressure readings above the hypertension threshold) • Diagnostic code & vital statistics (1 & 2) • Diagnostic code & vital statistics (1 & 3) • Inclusive of 1-5 and medications (1, 2, or the use of hypertension medication)	Excluded: • Children under 18 years of age as of January 1, 2014

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[9] Two other publications from the same study are available here: https://formative.jmir.org/2023/1/e46413/PDF and
https://ojphi.jmir.org/2018/1/e62321?utm_medium=cpc&utm_source=TrendMD&utm_campaign=TrendMD_Internal.

[11] We used two years of data to capture a representative number of clinical encounters since individual health care use may not occur annually. This period was used due to the availability of comprehensive data from three of the five major health systems in the area.

Appendix B   CODI Data Model Attributes Required to Compute Hypertension Prevalence

This appendix defines the data attributes needed to compute the hypertension prevalence measure organized by the CODI Data Model tables; attributes are identified in ALL CAPS as they are defined in the CODI Data Model Data Dictionary.[12] If you are not using the CODI Data Model, you will need to map the fields from your source system to the attributes defined below.

The following attributes from the DEMOGRAPHICS table are required to calculate age. Notably, patient identifiers needed to match or link patients are stored in the DEMOGRAPHICS table but are not listed below. This measure definition assumes that patient matching or linkage has already occurred.

Table B-1. DEMOGRAPHICS Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use
PATID	Char	None	Arbitrary person-level identifier. Used to link across tables.		Primary Key
BIRTH_DATE	MM/DD/YYYY	None	Date of birth. Needed for the calculation of age.	12/09/1949	Age Calculation

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[12] Available at https://mitre.github.io/codi/

The ENCOUNTER table stores information about clinical encounters. The following attributes can provide evidence of a documented clinical encounter.

Table B-2. ENCOUNTER Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use
ENCOUNTERID	Char	None	Arbitrary encounter-level identifier used to link across tables.		Primary Key
PATID	Char	None	Arbitrary person-level identifier used to link across tables.		Foreign Key
ADMIT_DATE	MM/DD/YYYY	None	Encounter or admission date.	02/24/2024	Denominator: Evidence of documented clinical services
DISCHARGE_DATE	MM/DD/YYYY	None	Discharge date.	02/24/2024	Denominator: Evidence of documented clinical services

The CONDITION table stores information about a patient's diagnosed and self-reported health conditions and diseases. The patient's medical history and current state may both be represented. The following attributes may provide evidence of a hypertension diagnosis.

Table B-3. CONDITION Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use
CONDITIONID	Char	None	Arbitrary identifier used to link across tables.		Primary Key
PATID	Char	None	Arbitrary person-level identifier used to link across tables.		Foreign Key
CONDITION	seven-character, alphanumeric	ICD-10	Some codes will contain leading zeroes, and different levels of decimal precision may also be present. This field is a character field, not numeric, to accommodate these coding conventions. Please populate the exact value of this diagnosis code, but remove any source-specific suffixes and prefixes.	I10	Numerator: Evidence of hypertension diagnosis
CONDITION_TYPE	CHAR	CONDITION_ TYPE_TYPE	Condition code type.	10 for ICD-10	Numerator: Evidence of hypertension diagnosis

The DIAGNOSIS table stores diagnosis codes that indicate the results of diagnostic processes and medical coding within healthcare delivery. The following attributes may provide evidence of a hypertension diagnosis.

Table B-4. DIAGNOSIS Table Data Elements for Measure Calculations

| Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use
DIAGNOSISID	Char	None	Arbitrary identifier used to link across tables.		Primary Key
PATID	Char	None	Arbitrary person-level identifier used to link across tables.		Foreign Key
DX	seven-character, alphanumeric	ICD-10	Some codes will contain leading zeroes, and different levels of decimal precision may also be present. This field is a character field, not numeric, to accommodate these coding conventions. Please populate the exact value of this diagnosis code, but remove any source-specific suffixes and prefixes.	I10	Numerator: Evidence of hypertension diagnosis
DX_TYPE	Char	DX_TYPE	Diagnostic code type.	10 for ICD-10	Numerator: Evidence of hypertension diagnosis

Appendix C   Hypertension Prevalence Measure Calculation Logic Flow Chart
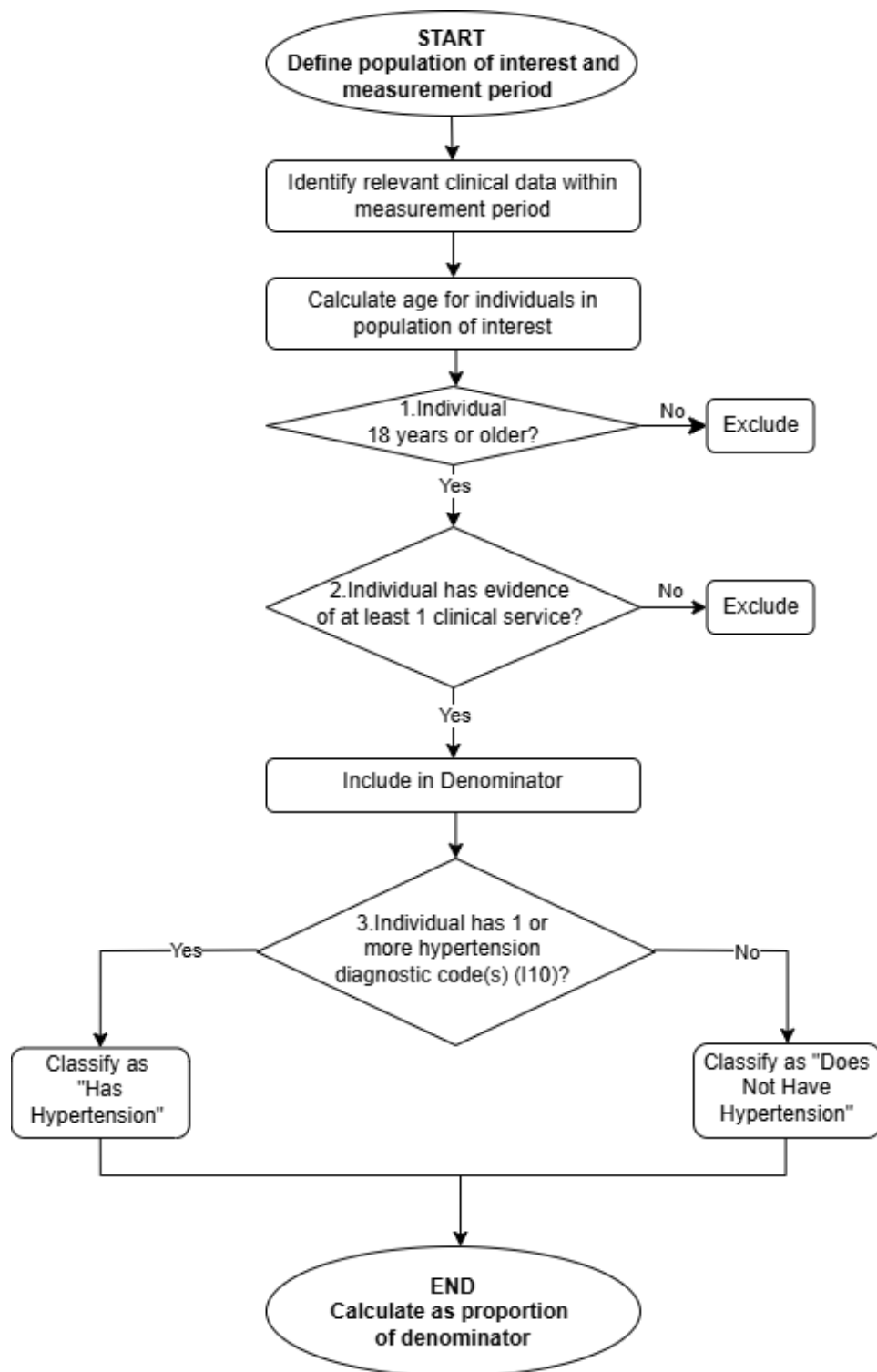
Figure C-1. Hypertension Calculation Flow Chart