COMMUNITY AND CLINICAL DATA INITIATIVE

Hypertension Control Measure Definition

June 2025

Prepared for:
Administration for Community Living

MITRE | Center for Transforming Health

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

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Acknowledgments

This measure was collaboratively developed by MITRE and the Chesapeake Regional Information System for our Patients (CRISP). We would like to thank the CRISP team for their time and contributions to the development of this hypertension control measure.

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1 Introduction

1.1 Purpose

This document describes a method for measuring hypertension control among a population of individuals diagnosed with hypertension. This document is intended for health information exchanges (HIEs) or organizations holding data from clinical settings who are interested in measuring hypertension control.

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 functions as a standalone measure.

1.2 Background Research

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

Information from the literature review that is most germane to this measure definition includes:

- 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 (BP) ≥ 130 millimeters of mercury (mm Hg) or diastolic BP ≥ 80 mm Hg” (i.e., 130/80).[2]
- High blood pressure is common; roughly half of American 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.
- BP 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.

[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.

- The National Committee for Quality Assurance (NCQA) Measure Definition for *Controlling High Blood Pressure* defines control as a BP below 140/90 mm Hg[4] which is different than the clinical guidelines which define control as a BP below 130/80 mm Hg.[5]
- Recent data suggest that only about 1 in 5 adults with hypertension have it controlled.[6]

1.3 Assumptions

The hypertension control measure assumes that the CODI definition of hypertension prevalence[7] is used to identify individuals with hypertension since hypertension control is assessed among individuals with hypertension. Thus, this hypertension control measure inherits the following assumptions of the CODI hypertension prevalence measure:

- 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.
- 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

[4] NCQA is the organization that manages the Healthcare Effectiveness Data and Information Set (HEDIS), a tool used to measure health plan performance. Measure definition available at: https://www.ncqa.org/report-cards/health-plans/state-of-health-care-quality-report/controlling-high-blood-pressure-cbp/.

[5] 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.

[6] 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.

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

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.

In addition to the assumptions inherited from hypertension prevalence, the following assumptions apply:

- The measure assumes that HIEs will determine an approach for selecting BPs to determine control.

2 Measure Overview

The hypertension control measure is composed of two metrics to accommodate different analytic goals, reporting needs, and data availability. A user may choose to measure hypertension control by implementing one or both of the following metrics:

- Hypertension Control Surveillance Metric (see Section 3)
- Pre/Post Change in Hypertension Control Status Metric (see Section 4)

An overview of information relevant to both metrics is described below. During the ACL sponsored CODI Maryland pilot (ending August 2025), both metrics were co-developed by MITRE and CRISP for future implementation.

2.1 Key Definitions

The following terms are used for both metrics as defined below.

- **Intervention**: A structured set of activities designed to address specific needs or goals. Interventions include programs, such as diabetes self-management classes, and services, such as home-delivered meals.
- **Participant**: An individual who receives an intervention, including participating in a program or receiving a service intended to address specific health-related needs. In the context of the Hypertension Control Measure, all participants should be living with hypertension at the time of the intervention.
- **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[8]

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

Admission, Discharge, and Transfer message or a CCD[9])) 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).[10]
- **Valid Blood Pressure:** A valid BP observation is defined as one documented biologically plausible systolic value and one documented biologically plausible diastolic value from the same day. BPs are identified by the following Logical Observation Identifiers Names and Codes (LOINC)[11] codes:
    - Systolic: 8459-0, 8480-6, 11378-7, and 8460-8
    - Diastolic: 8453-3, 8454-1, 8462-4

  The most commonly used LOINC codes for systolic and diastolic values are 8480-6 and 8462-4, respectively. This approach inherently excludes BPs that are not appropriately labeled with LOINC codes. BP observations where only a systolic or diastolic BP is recorded (but not both) are excluded.

  Biologically implausible BP observations are assumed to be errors and are excluded. A biologically implausible BP observation is defined as systolic blood pressure (SBP) values below 30 mm Hg or above 300 mm Hg and diastolic blood pressure (DBP) values below 20 mm Hg or above 150 mm Hg; when either the systolic or diastolic values are implausible, the entire BP observation should be excluded.[12] Therefore, a biologically plausible BP is defined as:

    - a systolic observation greater than or equal to (≥) 30 mm Hg and less than or equal to (≤) 300 mm Hg and
    - a diastolic observation greater than or equal to (≥) 20 mm Hg and less than or equal to (≤) 150 mm Hg

  BP observations from an inpatient setting are also excluded, when possible. This measure definition does not specify a method for identifying, marking, and excluding BPs from inpatient encounters. Rather, users will have to devise an approach to identify

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

[10] 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.

[11] LOINC website: https://loinc.org/.

[12] Published articles consulted to define biologically implausible BP observations include:

Hohman KH, Zambarano B, Klompas M, Wall HK, Kraus EM, Carton TW, Jackson SL. Development of a Hypertension Electronic Phenotype for Chronic Disease Surveillance in Electronic Health Records: Key Analytic Decisions and Their Effects. Prev Chronic Dis. 2023 Sep 14;20:E80. doi: 10.5888/pcd20.230026. Erratum in: Prev Chronic Dis. 2023 Oct 05;20:E87. doi: 10.5888/pcd20.230026e. PMID: 37708339; PMCID: PMC10516201.

Deakin C D, Low J L. Accuracy of the advanced trauma life support guidelines for predicting systolic blood pressure using carotid, femoral, and radial pulses: observational study BMJ 2000; 321 :673 doi:10.1136/bmj.321.7262.673.

Narloch JA, Brandstater ME. Influence of breathing technique on arterial blood pressure during heavy weight lifting. Arch Phys Med Rehabil. 1995 May;76(5):457-62. DOI: http://dx.doi.org/10.1016/s0003-9993(95)80578-8. PMID: 7741618.

and exclude BPs from inpatient encounters based on available data and practicable relationships between BPs and encounter information.

For the purpose of this document, a valid BP must also have been recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the measurement period[13] (e.g., a BP measured prior to documentation of a hypertension diagnosis cannot be used to assess control).

2.2 Source Data

The minimum clinical and intervention data necessary to compute hypertension control are described in Appendix B in the context of the CODI Data Model.[14]

2.3 Data Quality

The quality of the clinical data used to calculate hypertension control 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 these metrics as appropriate for their data sources.

3 Metric 1: Hypertension Control Surveillance

3.1 Metric Description

The surveillance metric is designed to monitor the overall risk of hypertension-related complications within a population of interest by evaluating BPs to determine the proportion of individuals with hypertension who are in a controlled or uncontrolled state. The hypertension control surveillance metric identifies the proportion of adults (18 years or older) with controlled hypertension among those with a hypertension diagnosis from a population of interest who received a clinical service from a HIE participant within the defined measurement period. This metric can be used to describe the proportion of a population whose hypertension is controlled at a specified time (e.g., calendar year 2024) or can be used to monitor changes in control over time within a population by applying this metric over two time periods. It is a cross-sectional (e.g., point in time) measure driven by a user-selected measurement period.

3.2 Selecting a Measurement Period

Users must define a measurement period to calculate hypertension control; the measurement period is the time period during which hypertension control 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-based organizations (CBOs). 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 for the hypertension control surveillance metric. Longer measurement periods may be beneficial in some circumstances and extending

[13] Individuals may have one or more hypertension diagnostic codes during the defined measurement period.

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

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 receive healthcare in non-standard and non-random patterns meaning that individuals seek and receive healthcare at different frequencies, and some individuals 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.

3.3 Selecting a Population of Interest

Users must define the population of interest that is the group for whom hypertension control will be assessed. 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 CBO.

3.4 Calculating Age

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

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

$$[Start\ Date\ of\ Measurement\ Period] - [Date\ of\ Birth].$$

3.5 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,[15]
- have evidence of receiving at least one clinical service during the measurement period,
- have an indication of essential hypertension during the measurement period, and
- have at least one valid BP during the measurement period.

3.5.1 Denominator Exclusions

The denominator excludes any individual:

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

- without at least one valid BP observation that was recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the measurement period[16]

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 individuals who have been diagnosed with end stage renal disease (ESRD) as ESRD has a significant impact on blood pressure
- Excluding some types of clinical services due to the known variations in healthcare encounters such as:
    - 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
    - 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

3.6 Calculating the Numerator

Individuals in the denominator are aggregated into two hypertension control categories[17] based on their latest (most recent) valid BP in the measurement period:

- **Controlled**: Individuals with a SBP below 140 mm Hg and a DBP below 90 mm Hg.
- **Not Controlled**: Individuals with a SBP equal to or above 140 mm Hg or a DBP equal to or above 90 mm Hg.

The population in each control category should be calculated as a proportion of the denominator (e.g., percent controlled).

Selecting from Multiple Valid BPs on the Same Day

When there are multiple valid BPs documented on one day and that day represents the latest day with a BP recorded in the measurement period, select or calculate a single BP to evaluate control using one of the following approaches:[18]

- Calculate mean arterial pressure (MAP).[19] For each valid BP value, the MAP is calculated by using the equation

[16] Individuals may have one or more hypertension diagnostic codes during the defined measurement period; a BP measured prior to documentation of a hypertension diagnosis cannot be used to assess control.

[17] Control threshold based on NCQA Controlling High Blood Pressure HEDIS measure definition. Available at: https://www.ncqa.org/report-cards/health-plans/state-of-health-care-quality-report/controlling-high-blood-pressure-cbp/.

[18] Hohman KH, Zambarano B, Klompas M, Wall HK, Kraus EM, Carton TW, Jackson SL. Development of a Hypertension Electronic Phenotype for Chronic Disease Surveillance in Electronic Health Records: Key Analytic Decisions and Their Effects. Prev Chronic Dis. 2023 Sep 14;20:E80. doi: 10.5888/pcd20.230026. Erratum in: Prev Chronic Dis. 2023 Oct 05;20:E87. doi: 10.5888/pcd20.230026e. PMID: 37708339; PMCID: PMC10516201.

[19] DeMers D, Wachs D. Physiology, Mean Arterial Pressure. [Updated 2023 Apr 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available at: https://www.ncbi.nlm.nih.gov/books/NBK538226/

$$\frac{(2 \times diastolic\ blood\ pressure) + systolic\ blood\ pressure}{3}$$

Select either the highest or lowest MAP for the day and use the associated systolic and diastolic BPs; the same approach to selecting a BP based on the MAP value (i.e. highest or lowest) should be applied to all individuals.

- Average all systolic blood pressure values for that day (X) and then average of all diastolic blood pressure values for the day (Y). The average values are combined to create an average BP value for the day (X/Y).
- Select the lowest systolic blood pressure and lowest diastolic blood pressure across the day's values.
- Select the lowest systolic and accompanying diastolic blood pressure.
- Select the lowest diastolic and accompanying systolic blood pressure.
- Select a BP (systolic and diastolic) from the day randomly.

3.7 Specifying the Calculation Logic

The **hypertension control surveillance metric** 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.

3. Did the individual have one or more ICD-10 diagnostic codes indicating essential hypertension (I10) in the measurement period? (Y/N)
    - If no, exclude.
    - If yes, proceed to next step.

4. Did the individual have one or more documented valid BP values constrained to the BP LOINC Code Values (Systolic: 8459-0, 8480-6, 11378-7, and 8460-8; Diastolic: 8453-3, 8454-1, 8462-4) in the measurement period? (Y/N)
    - If no, exclude.
    - If yes, include the individual in the denominator.

5. Did the individual have at least one BP recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the measurement period?
    - In no, exclude.
    - If yes, include the individual in the denominator.

6. What was the hypertension control status of the individual's latest BP in the measurement period?
    - If the SBP value was <140 mm Hg and the DBP value was <90 mm Hg, this individual's hypertension control status is classified as "Controlled." Calculate as proportion of denominator.
    - If the SBP value was ≥140 mm Hg or the DBP value was ≥90 mm Hg, this individual's diabetes control status is classified as "Not Controlled." Calculate as proportion of denominator.

4 Metric 2: Pre/Post Change in Hypertension Control Status

4.1 Metric Description

The pre/post metric compares two valid BP observations among adults diagnosed with hypertension—selecting BPs from before and after an intervention to determine if participants experienced a change in hypertension control category.

The metric compares a Post-Intervention period control status category to a Pre-Intervention control status category to assess change in hypertension control among participants which may indicate improved control, no change in control, or degradation in control.

4.2 Selecting a Measurement Period

Users must define a measurement period to calculate hypertension control among participants receiving an intervention; the measurement period is the time period during which hypertension control 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-based organizations (CBOs). Users may decide to align the measurement period to similar work (e.g., the reporting period for care quality measures) for comparability and validation.

For this pre/post metric calculation, time has more components and complexity compared to the surveillance measure. There are three relevant dates and time periods to consider when calculating the pre/post metric: a **participant's intervention start date**, the pre-intervention observation period to assess hypertension control before the intervention start date (referred to as "**look-back period**"), and a post-intervention observation period to assess change after the intervention start date (referred to as "**observation period**").

For group interventions like cooking classes, participants will have a common intervention start date. For asynchronous interventions such as home-delivered meals, participants may start the intervention on different days. This means that the measurement period may differ for each participant. This metric approaches time based on intervention start date rather than start **and** end dates because interventions, like home-delivered meals, vary in duration and some may be ongoing (i.e., no defined end date).

Users will define the measurement period for this metric by selecting the duration of the look-back period and observation period and those time periods are applied to each individuals' intervention start date. All three of the following time components must be populated to define the measurement period for selected participants.

- **Intervention Start Date**: Users will select a date attribute that provides an intervention start date. The selected date attribute should most closely correspond to the date a participant first received an intervention (e.g., participated in a program or first received a service). There may be instances when enrollment information is missing but delivery information is available. When appropriate, users may draw the intervention start date from multiple date attributes so that if one date from a selected attribute (e.g., intervention start date) is missing, a backup date (e.g., enrollment date) can be used to approximate the start. Some interventions may have been operating for many years such that the start date is so early that clinical data are unavailable; users should verify that the selected intervention start date time period aligns with clinical data availability. Users may improve precision by further constraining the metric to intervention start dates from specific periods of time (like calendar year 2024).
- **Look-Back Period:** Users will select a duration of time (days, weeks, or months) to look backwards from a participant's intervention start date to determine baseline hypertension control (such as 6 months). Participants must have an ICD-10 diagnostic code for essential hypertension (I10) during the look-back period to be assessed by the pre/post metrics.
- **Observation Period:** Users will select a duration of time to observe from a participant's intervention start date to determine hypertension control after an intervention has begun (such as 12 months). Because some interventions are time limited while others are ongoing, some participants may be receiving the intervention for some, most, or all of the observation period; some participants may still be receiving the intervention after the observation period ends.

Figure 1 illustrates how a participant's intervention start date, look-back period, and observation period are applied to define a participant's measurement period.

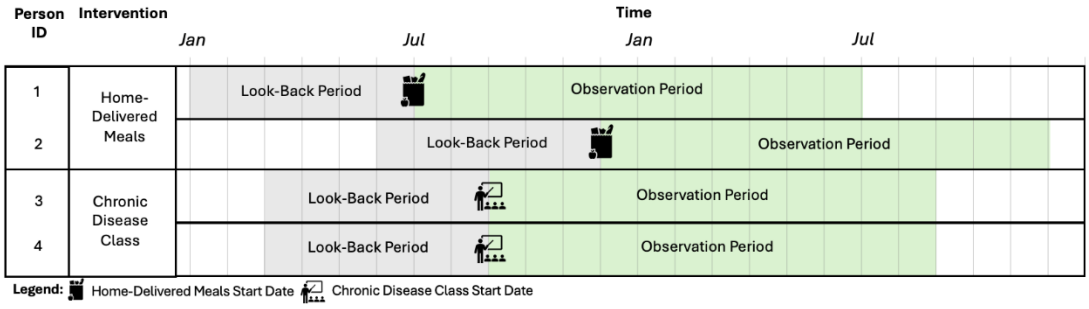


Figure 1. Example 6-Month Look-Back and 12-Month Observation Periods Based on Intervention Start Dates

Key Considerations about Time

In selecting look-back and observation periods for this pre/post metric, users should consider their analytic goals and the context of the intervention being assessed, and the following:

- Picking longer date ranges will likely select a more representative sample but is likely to introduce more factors that can influence blood pressure levels.
- For some analyses, having a look-back period and observation period of equal duration may be valuable.

- The amount of time between individual pre and post BPs may vary significantly. Date and time period selection should be driven by the intervention of interest and goals of reporting.
- Longer look-back and observation periods will reduce the number of participants excluded based on BP availability—longer time periods provide more time for individuals to receive healthcare and have a BP collected.
- Longer observation periods for interventions with greater duration and/or higher frequency, like receipt of low salt meals five times a week for one year, provide more time for the intervention to reduce elevated BPs and are more likely to show change in hypertension control.
- Longer observation periods for interventions with shorter duration and/or lower frequency, like low salt meals three times a week for two weeks, could provide a longer window after the intervention concludes for BPs to change based on factors unrelated to the intervention.
- If intervention start dates for selected participants span an extended time period (e.g., multiple years), interpretation of pre/post changes may be more difficult, especially if the intervention evolved over that time span.

4.3 Selecting a Population of Interest

Users must define the population of interest that is the group for whom hypertension control will be assessed. 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 CBO.

4.4 Calculating Age

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

The recommended approach for this pre/post hypertension control metric is to calculate an individual's age based on the selected intervention start date as follows:

$$Age = [Intervention\ Start\ Date] - [Date\ of\ Birth]$$

4.5 Selecting Pre/Post Blood Pressures

Based on the time components defined for the measurement period, users will select one pre-intervention valid BP during the look-back period and one valid BP during the observation period.

Selecting a Look-Back Period BP

A single valid BP is required during the look-back period. When there are multiple valid BPs documented during the look-back period, the metric should select the valid BP dated closest to the intervention start date (i.e., the latest valid BP in the look-back period).

- Participants who do not have at least one valid BP that was recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the look-back period[20] cannot be assessed by the pre/post metrics.
- Best practice is to select the valid BP that occurs as close to the intervention date as possible during the look-back period.
- Figure 2 illustrates this guidance and shows the potential impact of shorter look-back periods on inclusion.

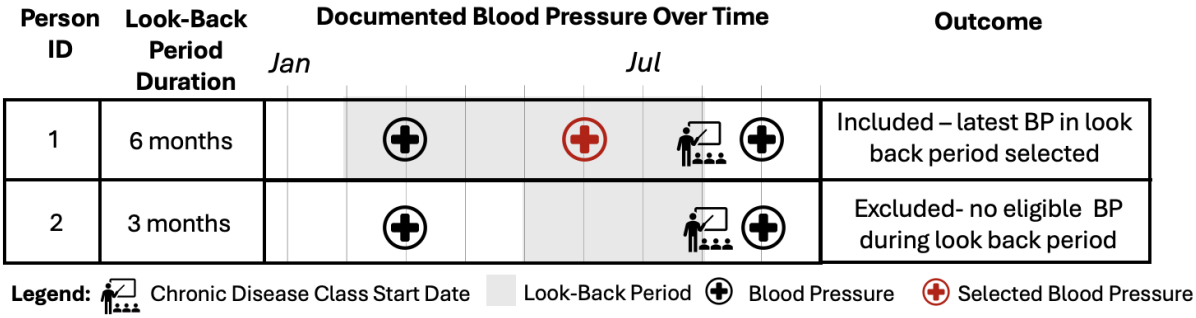


Figure 2. Pre-Intervention Blood Pressure Selection Example

Selecting an Observation Period BP

A single valid BP is required during the observation period. This should be the valid BP dated the furthest away from the intervention start date (i.e., the latest valid BP in the observation period).

- Participants who do not have a valid BP in the observation period cannot be assessed by the pre/post metrics.
- Figure 3 illustrates this guidance and shows the potential impact of shorter observation periods on inclusion.

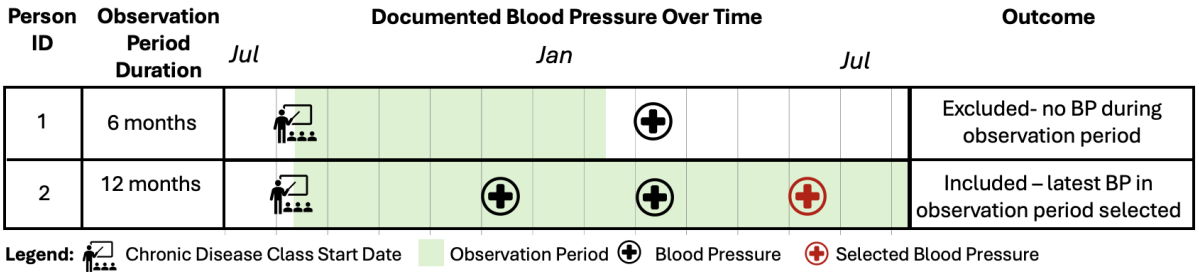


Figure 3. Observation Period Blood Pressure Example

[20] Individuals may have one or more hypertension diagnostic codes during the defined measurement period.

Selecting from Multiple Valid BPs on the Same Day (if applicable)

When there are multiple valid BPs documented on one day and that day represents the preferred date selected in the look-back or observation period, select or calculate a single BP to evaluate using one of the following approaches:[21]

- Calculate mean arterial pressure (MAP).[22] For each valid blood pressure value, the MAP is calculated by using the equation:

$$\frac{(2 \times diastolic\ blood\ pressure) + systolic\ blood\ pressure}{3}$$

  Select either the highest or lowest MAP for the day and use the associated systolic and diastolic BPs; the same approach to selecting a BP based on the MAP value (i.e. highest or lowest) should be applied to all individuals.
- Average all systolic blood pressure values for that day (X) and then average of all diastolic blood pressure values for the day (Y). The average values are combined to create an average BP value for the day (X/Y).
- Select the lowest systolic blood pressure and lowest diastolic blood pressure across the day's values.
- Select the lowest systolic and accompanying diastolic blood pressure.
- Select the lowest diastolic and accompanying systolic blood pressure.
- Select a BP (systolic and diastolic) from the day randomly.

4.6 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,[23]
- have evidence of receiving at least one clinical service during the measurement period,
- have an intervention start date for an intervention of interest delivered during the measurement period, and
- have an indication of essential hypertension during the measurement period,
- have at least one valid BP during the look-back period, and
- have at least one valid BP during the observation period.

[21] Hohman KH, Zambarano B, Klompas M, Wall HK, Kraus EM, Carton TW, Jackson SL. Development of a Hypertension Electronic Phenotype for Chronic Disease Surveillance in Electronic Health Records: Key Analytic Decisions and Their Effects. Prev Chronic Dis. 2023 Sep 14;20:E80. doi: 10.5888/pcd20.230026. Erratum in: Prev Chronic Dis. 2023 Oct 05;20:E87. doi: 10.5888/pcd20.230026e. PMID: 37708339; PMCID: PMC10516201.

[22] DeMers D, Wachs D. Physiology, Mean Arterial Pressure. [Updated 2023 Apr 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK538226/.

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

4.6.1 Denominator Exclusions

The denominator excludes any individual:

- without at least one valid BP during the look-back period that was recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the look-back period.[24]

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 individuals who have been diagnosed with ESRD) as ESRD has a significant impact on blood pressure.
- Excluding some types of clinical services due to the known variations in healthcare encounters such as:
    - 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.
    - 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.

4.7 Calculating the Numerator

Individuals included in the denominator are aggregated into three potential numerator categories based on the comparison of the hypertension control status category of the selected look-back period BP to the hypertension control status category of the selected observation period BP.

Selected look-back period and observation period BPs are first categorized into the following control status categories:

- **Controlled**: Individuals with a SBP below 140 mm Hg (<140 mm Hg) and a DBP below 90 mm Hg (<90 mm Hg).
- **Not Controlled**: Individuals with a SBP equal to or above 140 mm Hg (and a DBP equal to or above 90 mm Hg.

The change in an individual's hypertension control status is then categorized as follows:

- **Improved Hypertension Control Status**: Participants whose observation period hypertension control status category (post-intervention) was "Controlled" and their look-back period hypertension control status category (pre-intervention) was "Not Controlled"
- **No Change in Hypertension Control Status**: Participants whose look-back period and observation period hypertension control status categories were the same. This includes:
    - "Not Controlled" (pre-intervention) to "Not Controlled" (post-intervention)
    - "Controlled" (pre-intervention) to "Controlled" (post-intervention)

[24] Individuals may have one or more hypertension diagnostic codes during the defined measurement period.

- **Degraded Hypertension Control Status**: Participants whose observation period hypertension control status category (post-intervention) was “Not Controlled” and their look-back period hypertension control status category (pre-intervention) was “Controlled”

The population in each control status change category should be calculated as a proportion of the denominator (e.g., percent improved hypertension control status).

4.8 Specifying the Calculation Logic

The **pre/post change in hypertension control status metric** calculation logic is described below; see Appendix D for 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. Did the participant have an intervention start date? (Y/N)
   - If no, exclude.
   - If yes, proceed to next step.

2. Is the participant 18 years or older? (Y/N)
   - If no, exclude.
   - If yes, proceed to next step.

3. Did the participant have evidence of at least one clinical service in the look-back period? (Y/N)
   - If no, exclude.
   - If yes, proceed to next step.

4. Did the participant have one or more ICD-10 diagnostic codes indicating essential hypertension (I10) in the look-back period? (Y/N)
   - If no, exclude.
   - If yes, proceed to next step.

5. Did the individual have one or more valid BP(s) constrained to the BP LOINC Code Values (Systolic: 8459-0, 8480-6, 11378-7, and 8460-8; Diastolic: 8453-3, 8454-1, 8462-4) in the look-back period? (Y/N)
   - If no, exclude.
   - If yes, proceed to next step.

6. Did the individual have at least one BP recorded on or after the earliest date associated with an ICD-10 diagnostic code for essential hypertension (I10) during the look-back period?
   - If no, exclude.
   - If yes, proceed to next step.

7. Did the individual have one or more valid BP constrained to the BP LOINC Code Values (Systolic: 8459-0, 8480-6, 11378-7, and 8460-8; Diastolic: 8453-3, 8454-1, 8462-4) in the observation period? (Y/N)
   - If no, exclude.
   - If yes, include the individual in the denominator.

8. What was the individual's latest BP in the look-back period?
    - If the SBP value was <140 mm Hg and the DBP value was <90 mm Hg, this individual's look-back period (pre-intervention) hypertension control status is classified as "Controlled."
    - If the SBP value was ≥140 mm Hg or the DBP value was ≥90 mm Hg, this individual's look-back period (pre-intervention) hypertension control status is classified as "Not Controlled."

9. What was the individual's latest BP in the observation period?
    - If the SBP value was <140 mm Hg and the DBP value was <90 mm Hg, this individual's observation period (post-intervention) hypertension control status is classified as "Controlled."
    - If the SBP value was ≥140 mm Hg or the DBP value was ≥90 mm Hg, this individual's observation period (post-intervention) hypertension control status is classified as "Not Controlled."

10. What was the difference from the participant's look-back period hypertension control status to their observation period hypertension control status?
    - If better, this participant is identified as having "Improved Hypertension Control Status." Calculate as proportion of denominator.
    - If same, this participant is identified as having "No Change in Hypertension Control." Calculate as proportion of denominator.
    - If worse, this participant is identified as having "Degraded Hypertension Control Status." Calculate as proportion of denominator.

5 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.
    - Diastolic and systolic blood pressure values may be reversed or manually entered with incorrect values (e.g., entering 310 or 1300 rather than 130).
    - 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 Control Algorithms

ID	Title	Summary	Hypertension Control Measurement	Inclusion and Exclusion Criteria
1	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	This 2017 article provides the current clinical practice guidelines for hypertension detection and control and defines diagnostic criteria for essential hypertension and recommends goals for BP control by hypertension type.	Population: Patients 18 years of age and above who have established [diagnosed] hypertension.. Criteria: For adults with diagnosed hypertension, a BP target of less than 130/80 mm Hg is recommended.	Excluded patients under 18 years of age.

ID	Title	Summary	Hypertension Control Measurement	Inclusion and Exclusion Criteria
2	NCQA[25] 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 BP 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: Percentage of patients whose most recent blood pressure was adequately controlled (<140/90 mmHg) during the measurement 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
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 BP in 2018 or 2019. Criteria: Hypertension control status for patients with hypertension was assigned according to the patient's most recent blood pressure value starting with the day of diagnosis.	Excluded: • patients with 0 clinical encounters with measure BP in the previous two years • patients under 18 years of age • patients lacking diagnosis codes for hypertension

[25] 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.

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.[26] 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

[26] 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.	1237894	Primary Key
PATID	Char	None	Arbitrary person-level identifier used to link across tables.	MRAG8308	Foreign Key
REPORT_DATE	Date	None	Date condition was noted, which may be the date when it was recorded by a provider or nurse, or the date on which the patient reported it. Please note that this date may not correspond to onset date.	1/10/2025	Determine if evidence of hypertension diagnosis is within defined measurement period.
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.	789101112	Primary Key
PATID	Char	None	Arbitrary person-level identifier used to link across tables.	MRAG8308	Foreign Key
ADMIT_DATE	Date	None	Encounter or admission date. This is a field replicated from the ENCOUNTER table.	01/24/25	Determine if evidence of hypertension diagnosis is within defined measurement period.
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

The VITAL table contains one record for each measurement of vital signs. Vital signs (such as height, weight, and blood pressure) directly measure an individual's current state of attributes. The following attributes provide blood pressure observations to assess hypertension control.

Table B-5. VITAL Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use
VITALID	ID	None	A primary key that uniquely identifies a row in the table.	123456789	Primary Key
PATID	ID	None	Arbitrary person-level identifier. Used to link across tables.	MRAG8308	Foreign Key
MEASURE_DATE	DATE	None	Date of vitals measure.	01/24/2025	Determine if BP is within defined measurement period, look-back period, or observation period.
MEASURE_TIME	TIME	None	Time of vitals measure.	13:47	Differentiate multiple BPs taken on same day to aid in BP selection or calculation
DIASTOLIC	NUMERIC(X)	None	Diastolic blood pressure (in mmHg). Only populated if measure was taken on this date. If missing, this value should be null.	80	Denominator (all): Evidence of valid BP result; Numerators (all): Valid BP results used to calculate control categories and change in control
SYSTOLIC	NUMERIC(X)	None	Systolic blood pressure (in mmHg). Only populated if measure was taken on this date. If missing, this value should be null.	120	Denominator (all): Evidence of valid BP result; Numerators (all): Valid BP results used to calculate control categories and change in control

The ORGANIZATION table contains information for each organization sending or receiving referrals, collecting patient-reported outcomes, offering programs (e.g., diabetes prevention program) or assets (e.g., home-delivered meals). The attributes below can help define the population of interest based on participation in a particular organization's intervention.

Table B-6. ORGANIZATION Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
ORGANIZATIONID	Char	None	A primary key that uniquely identifies a row in the table.	CBO1	Primary Key
ORGANIZATION_NAME	Char	None	Name of organization.	MAC	May help define population of interest (all)

The PROGRAM table contains information for each distinct program. A program comprises a collection of interventions intended to produce a particular outcome. The attributes below can help define the population of interest based on participation in a particular program.

Table B-7. PROGRAM Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
PROGRAMID	Char	None	A primary key that uniquely identifies a row in the table.	EBP1	Primary Key
PROGRAM_NAME	Char	None	A name of the program (e.g., Congregate meal program).	Chronic Disease Management	May help define population of interest (all)
PROGRAM_ ORGANIZATIONID	Char	None	A link back to the organization that is offering the program.	MAC	Foreign Key

The PROGRAM_ENROLLMENT table contains one record for each person who enrolls in a program. The following attributes may provide evidence of intervention start date.

Table B-8. PROGRAM_ENROLLMENT Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
PROGRAM_ENROLLMENT_ID	Char	None	A primary key that uniquely identifies a row in the table.	4567	Primary Key
PATID	Char	None	Arbitrary person-level identifier. Used to link across tables.	MRAG8308	Foreign Key
PROGRAMID	Char	None	A link back to the program this enrollment belongs to.	CTC	Foreign Key
ORGANIZATIONID	Char	None	A link back to the non-clinical organization that this enrollment belongs to.	MAC	Foreign Key
ENROLLMENT_DATE	MM/DD/YYYY	None	A date on which the enrollment was performed.	01/03/2024	May be used as Intervention Start Date (pre/post metric)

The SESSION contains one record for each session of a program attended by an individual. In a community setting, a session corresponds to one engagement of a program such that the PROGRAMID field is required for programs delivered by community-based-organizations. The following attributes may provide evidence of intervention start date.

Table B-9. SESSION Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
SESSIONID	Char	None	A primary key that uniquely identifies a row in the table.	12345	Primary Key
PATID	Char	None	Arbitrary person-level identifier. Used to link across tables.	MRAG8308	Foreign Key
PROGRAMID	Char	None	A link back to the program this session belongs to (if any).	EBP1	Foreign Key
PROGRAM_ ENROLLMENT_ID	Char	None	A link back to the enrollment event this session belongs to (if any).	7890	Foreign Key
SESSION_DATE	Date	None	A date on which the session was conducted.	12/01/2024	May be used as Intervention Start Date (pre/post metric)

The ASSET_ENROLLMENT table contains information for each unique asset enrollment for a person. The following attributes may provide evidence of intervention start date.

Table B-10. ASSET_ENROLLMENT Table Data Elements for Measure Calculations

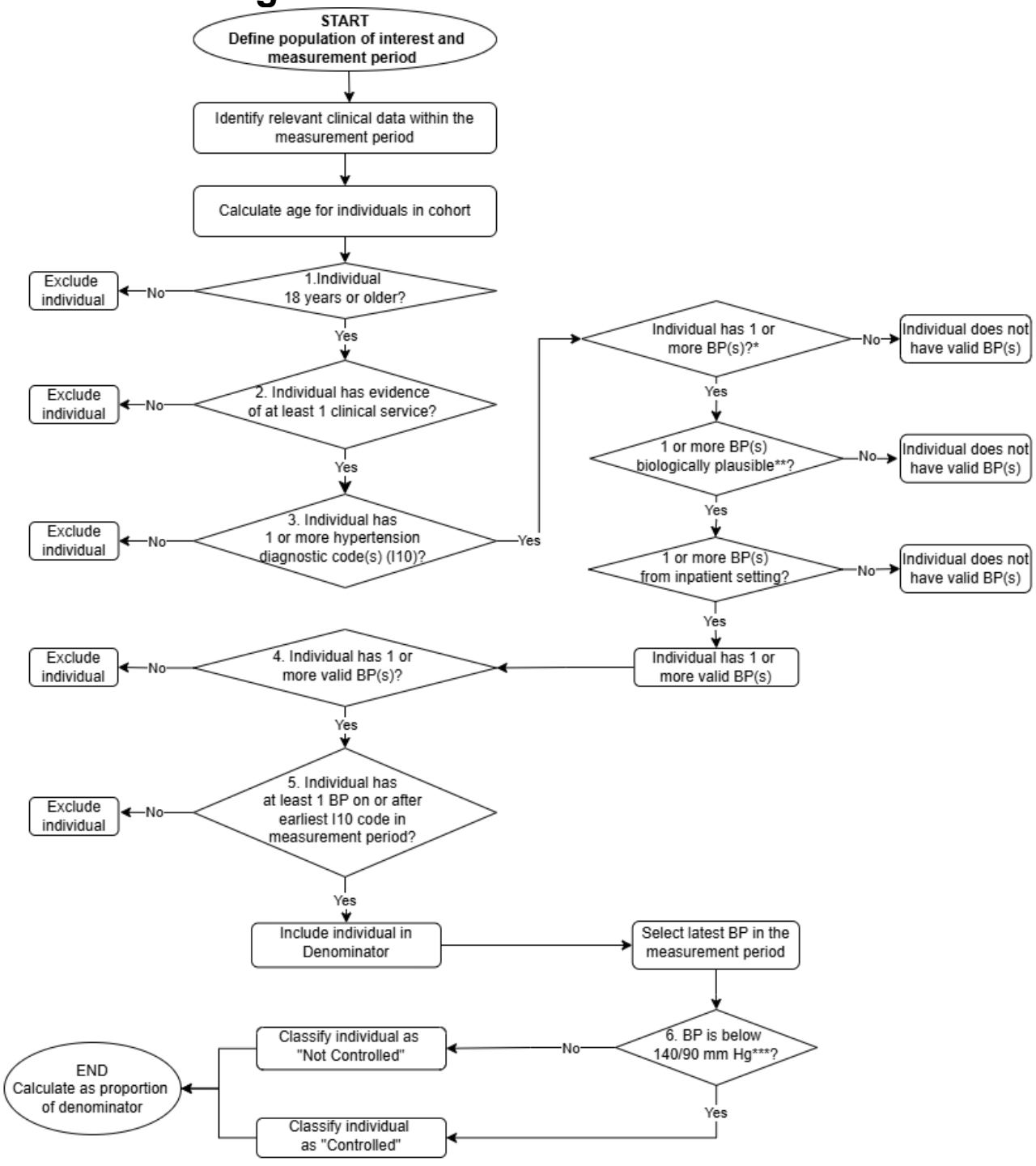
Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
ASSET_ENROLLMENT_ID	Char	None	A primary key that uniquely identifies a row in the table.	7890	Primary Key
PATID	Char	None	A link back to the demographic table.	MRAG8308	Foreign Key
ENROLLMENT_DATE	MM/DD/YYYY	None	A date on which the enrollment was performed.	01/03/2024	May be used as Intervention Start Date (pre/post metric)
DELIVERY_START_DATE	MM/DD/YYYY	None	A date on which the individual who enrolled will start receiving asset. (ACL CODI note: CRISP prefers MM/DD/YYYY format)	01/03/2024	May be used as Intervention Start Date (pre/post metric)
DELIVERY_END_DATE	MM/DD/YYYY	None	A date on which the individual who enrolled will stop receiving asset. This field may be blank if there is not a planned end to the service.	05/03/2024	
ASSET_ORANIZATIONID	Char	None	A link back to the organization that enrolled a person to receive assets	MAC	Foreign Key

The ASSET_DELIVERY table contains information about the delivery of assets associated with an asset enrollment; assets are resources transferred to an individual, like home-delivered meals. The following attributes may provide evidence of intervention start date.

Table B-11. ASSET_DELIVERY Table Data Elements for Measure Calculations

Attribute Name	Format	Value Set	Definition	Example Inputs	Measure Calculation Use (Metric)
ASSET_DELIVERY_ID	Char	None	A primary key that uniquely identifies a row in the table.	12345	Primary Key
PATID	Char	None	Arbitrary person-level identifier. Used to link across tables.	MRAG8308	Foreign Key
PROGRAM_ENROLLMENT_ ID	Char	None	A link back to the program enrollment that this asset delivery belongs to. An asset delivery should be linked to either a program or asset enrollment.	CTC	Foreign Key
ASSET_ENROLLMENT_ID	Char	None	A link back to the asset enrollment that this asset delivery belongs to. An asset delivery should be linked to either a program or asset enrollment.	7890	Foreign Key
DELIVERY_START_ DATE	date	None	The first date the asset(s) was delivered.	01/03/2024	May be used as Intervention Start Date (pre/post metric)
DELIVERY_END_ DATE	date	None	The end date the asset(s) was delivered. For a single day, the entry may populate the same date for start and end.	05/03/2024	May be used as Intervention Start Date (pre/post metric)

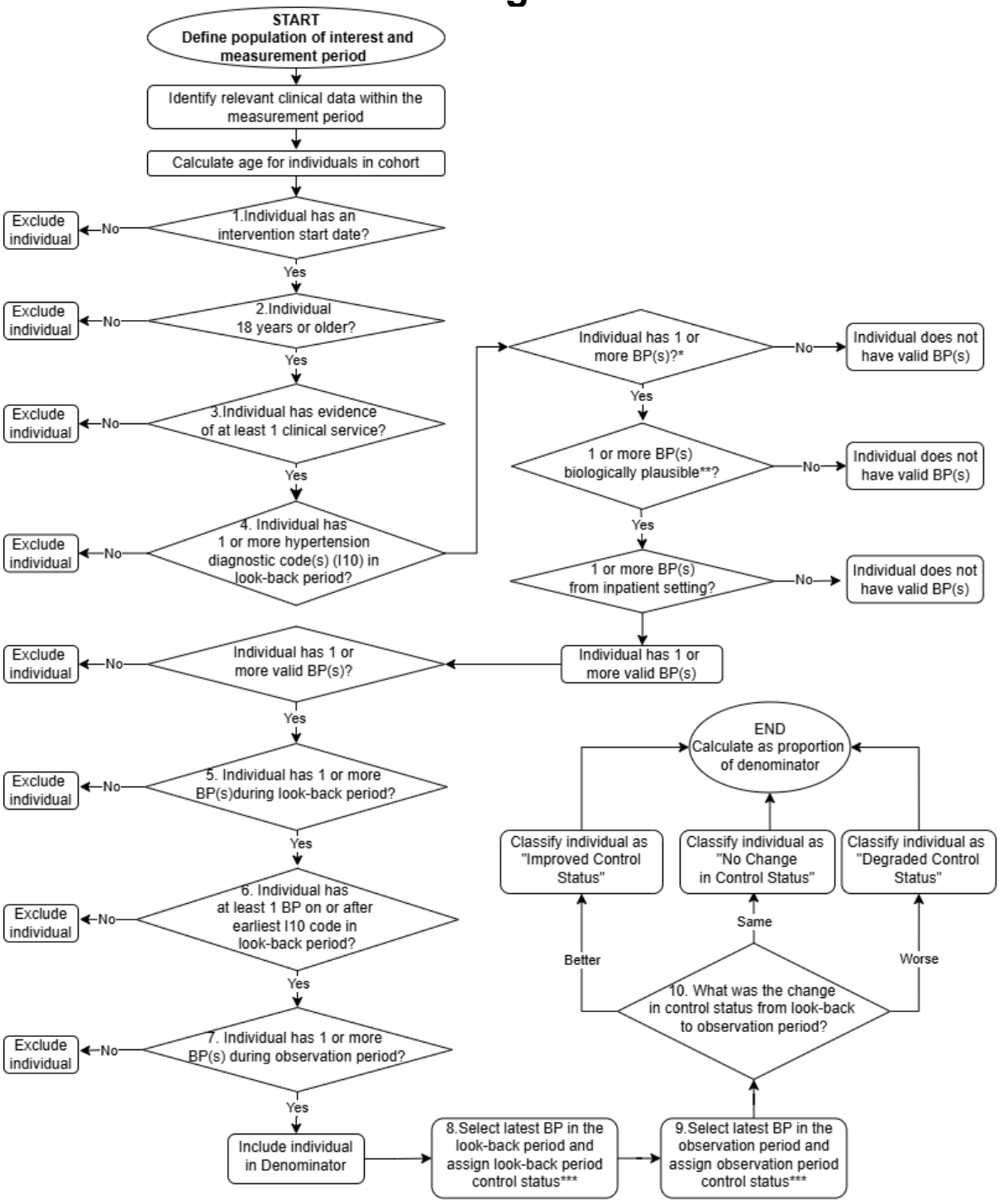
Appendix C Hypertension Control Surveillance Metric Calculation Logic Flow Chart



*Blood pressure observations (BPs) identified by the following LOINC codes (Systolic: 8459-0, 8480-6, 11378-7, and 8460-8; Diastolic: 8453-3, 8454-1, 8462-4). Only BPs that contain both a systolic and diastolic value from the same day during the measurement period are included.
**Biologically plausible BPs defined as: systolic ≥ 30 mm Hg and ≤ 300 mm Hg; diastolic ≥ 20 mm Hg and ≤ 150 mm Hg.
*** Below 140/90 mm Hg implemented as systolic BP below 140 mm Hg and diastolic BP below 90 mm Hg.

Figure C-1. Hypertension Control Surveillance Calculation Flow Chart

Appendix D Pre/Post Change in Hypertension Control Status Metric Calculation Logic Flow Chart



*Blood pressure observations (BPs) identified by the following LOINC codes (Systolic: 8459-0, 8480-6, 11378-7, and 8460-8; Diastolic: 8453-3, 8454-1, 8462-4). Only BPs that contain both a systolic and diastolic value from the same day during the measurement period are included.
**Biologically plausible BPs defined as: systolic ≥ 30 mm Hg and ≤ 300 mm Hg; diastolic ≥ 20 mm Hg and ≤ 150 mm Hg.
*** If the systolic BP was <140 mm Hg and the diastolic BP value was <90 mm Hg, then hypertension control status is classified as "Controlled." If the systolic BP value was ≥140 mm Hg or the diastolic BP value was ≥90 mm Hg, then hypertension control status is classified as "Not Controlled."

Figure D-1. Pre/Post Change in Hypertension Control Status Calculation Flow Chart

Appendix E Acronyms and Abbreviations

Term	Definition
ACL	Administration for Community Living
BP	Blood Pressure
CCD	Continuity of Care Document
CBO	Community Based Organization
CODI	Community and Clinical Data Initiative
CRISP	Chesapeake Regional Information System for our Patients
DBP	Diastolic Blood Pressure
ESRD	End Stage Renal Disease
HIE	Health Information Exchange
ICD-10	International Classification of Disease revision 10
LOINC	Logical Observation Identifiers, Names, and Codes
MAP	Mean Arterial Pressure
mm Hg	millimeters of mercury
NCQA	National Committee for Quality Assurance
SBP	Systolic Blood Pressure