Supplementary methods: Chart review validation of pharmacy records for identifying antihypertensive intensifications

We compared medications identified as intensified using pharmacy records to a gold standard of chart review documentation of medication changes using a two-stage approach.

First, as not all charts may fully document medication changes, two authors (SN and EX) reviewed a random sample of 598 charts to identify those with either a pharmacist discharge medication reconciliation or discharge summary note which included a list of medication changes, yielding 159 charts with high-fidelity documentation of medication changes. Using these 159 charts, two authors (TSA and CW) identified all antihypertensives identified as intensified on discharge (increased dose or new medication addition compared to medications taken on admission). Intensifications identified by chart review were first compared at the medication level, by comparing each antihypertensive identified in the chart review to the pharmacy records and categorizing each as either intensified or not intensified. Results of this comparison are shown in **Table A(i) and A(iii)**.

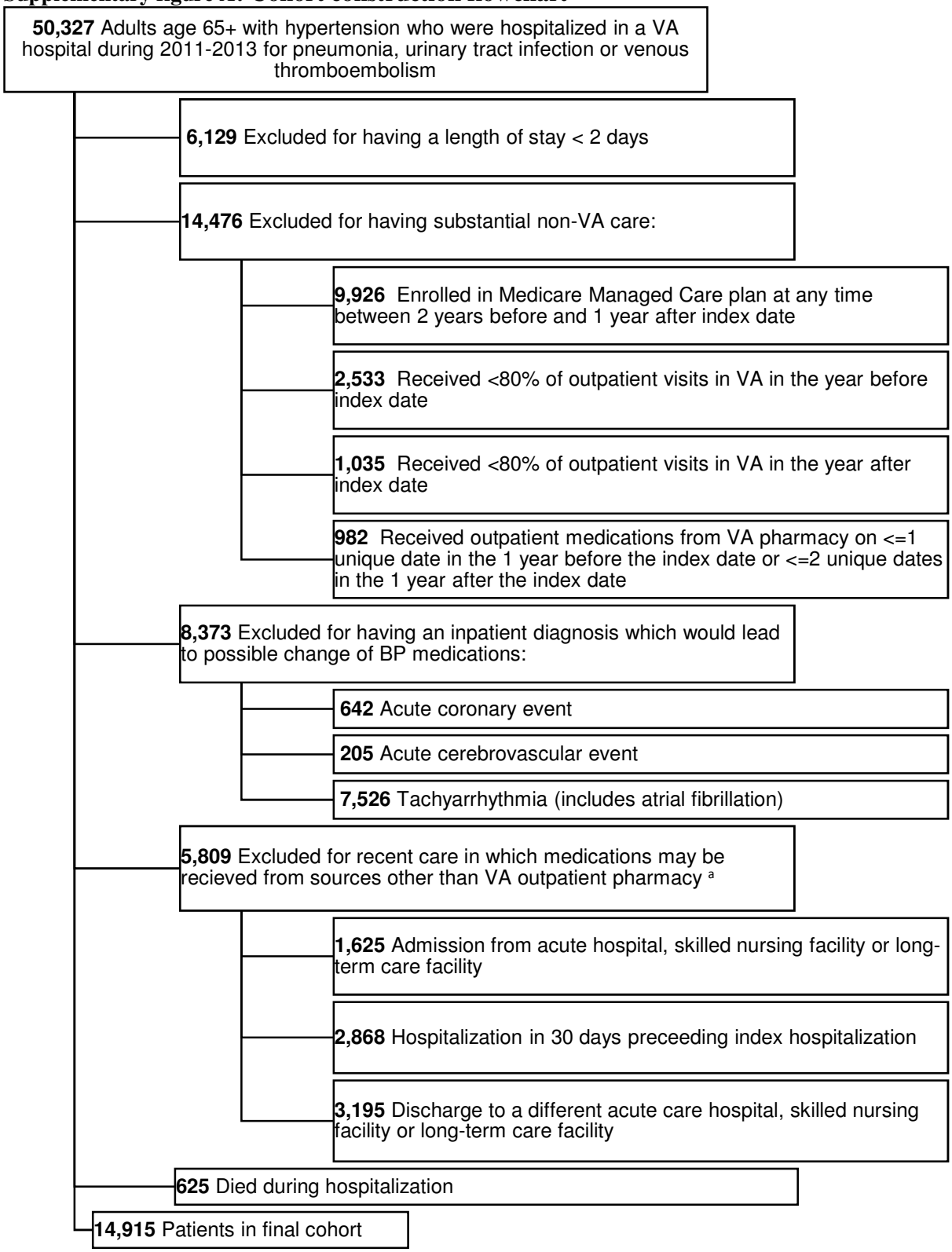
VA pharmacy records available through VA's Pharmacy Benefits Management databases include information on medication fill dates, but are unable to consistently detect when a medication is discontinued by a provider. In clinical systems, there are methods for marking a medication as discontinued. However, discontinuation instructions are often communicated verbally to patients without a formal discontinuation order entered, and even when ordered these changes are not consistently encoded in national databases. Thus, if a medication is not subsequently dispensed when a refill would typically be due, it is difficult to ascertain if that was due to clinician instructions to stop the medication or patient non-adherence. As a result, patients who received one or more antihypertensive intensifications at discharge may truly be discharged on a more intensified overall antihypertensive regimen or they may be experiencing medication substitutions if one or more antihypertensive was stopped and replaced by the intensified antihypertensive.

Thus, we compared intensifications, grouped at the patient level, to determine the accuracy of pharmacy records for identifying intensifications to patients overall antihypertensive regimen, categorizing each patient's overall antihypertensive list as either intensified or not intensified. Regimen intensification was defined as receiving a greater number of new antihypertensive medications than discontinued antihypertensive medications and/or more antihypertensive medications with dose increases than antihypertensives with dose decreases. Regimen intensification was defined as receiving a greater number of new antihypertensive medications than discontinued antihypertensive medications and/or more antihypertensive medications with dose increases than antihypertensives with dose decreases, while regimen deintensification was defined as the converse. Regimen substitutions were defined as receiving an equal number of discontinued medications and new medications and/or an equal number of dose increases and dose decreases. Unchanged regimens were defined as those with no intensifications or deintensifications. Results of this comparison are shown in **Table A(ii) and A(iii)**.

Our first-stage chart review of 159 patients identified that our pharmacy data-based measure had a positive predictive value of 74% for identifying patient-level antihypertensive intensifications, but confidence intervals were wide. To more accurately determine the positive predictive value of our pharmacy data-based measure (i.e., obtain a point estimate with narrower confidence intervals), we conducted a supplemental chart review of a random sample of patients whose antihypertensives were intensified according to our pharmacy dispensing records-based metric. Similar to our first-stage chart review, two authors (SN and EX) reviewed a random sample of charts of patients identified as receiving an antihypertensive intensification by pharmacy records to identify charts with either a pharmacist discharge medication reconciliation or discharge summary note which included a list of medication

changes. A total of 164 charts were reviewed, of which 101 charts had an available list of medication changes including the 26 identified in the first-stage chart review. Two authors (TSA and CW) reviewed these 101 charts and identified all antihypertensives prescribed or discontinued on discharge to determine whether each patient's overall antihypertensive regimen was intensified, substituted, deintensified or unchanged. The positive predictive value of receiving at least on antihypertensive intensification for having an overall antihypertensive regimen intensification was 73.0% (95% CI, 63.2-81.4). See **Table B** for the complete comparison.

Supplementary figure A: Cohort construction flowchart



[a] Patients may have multiple exclusion criteria related to recent care in hospital or skilled nursing facilities.

Supplementary table A: Comparison of chart review and pharmacy records for identifying antihypertensive intensifications

(i) Two by two comparison table of medication-level intensifications

	Chart Review	
Pharmacy Records	Intensification	No intensification
Intensification	30	4
No Intensification	5	323

(ii) Two by two comparison table of patient-level intensifications

	Chart Review	
Pharmacy Records	Intensification	No intensification
Intensification	17	6
No Intensification	4	129

(iii) Test characteristics of pharmacy records compared to chart review

		Comparison of Chart Review and Pharmacy Records, % (95% CI)				
	No.	**Prevalence**	**Sensitivity**	**Specificity**	**Positive Predictive Value**	**Negative Predictive Value**
Medication-level Intensification	362	9.7 (6.8 – 13.2)	85.7 (69.7 – 95.2)	98.8 (96.9 –99.7)	88.2 (72.5 – 96.7)	98.5 (96.5 –99.5)
Patient-level Intensification	159	13.2 (8.4 – 19.5)	81.0 (58.1 – 94.6)	95.7 (90.8 – 98.4)	73.9 (51.6 – 89.9)	97.1 (92.6 – 99.2)

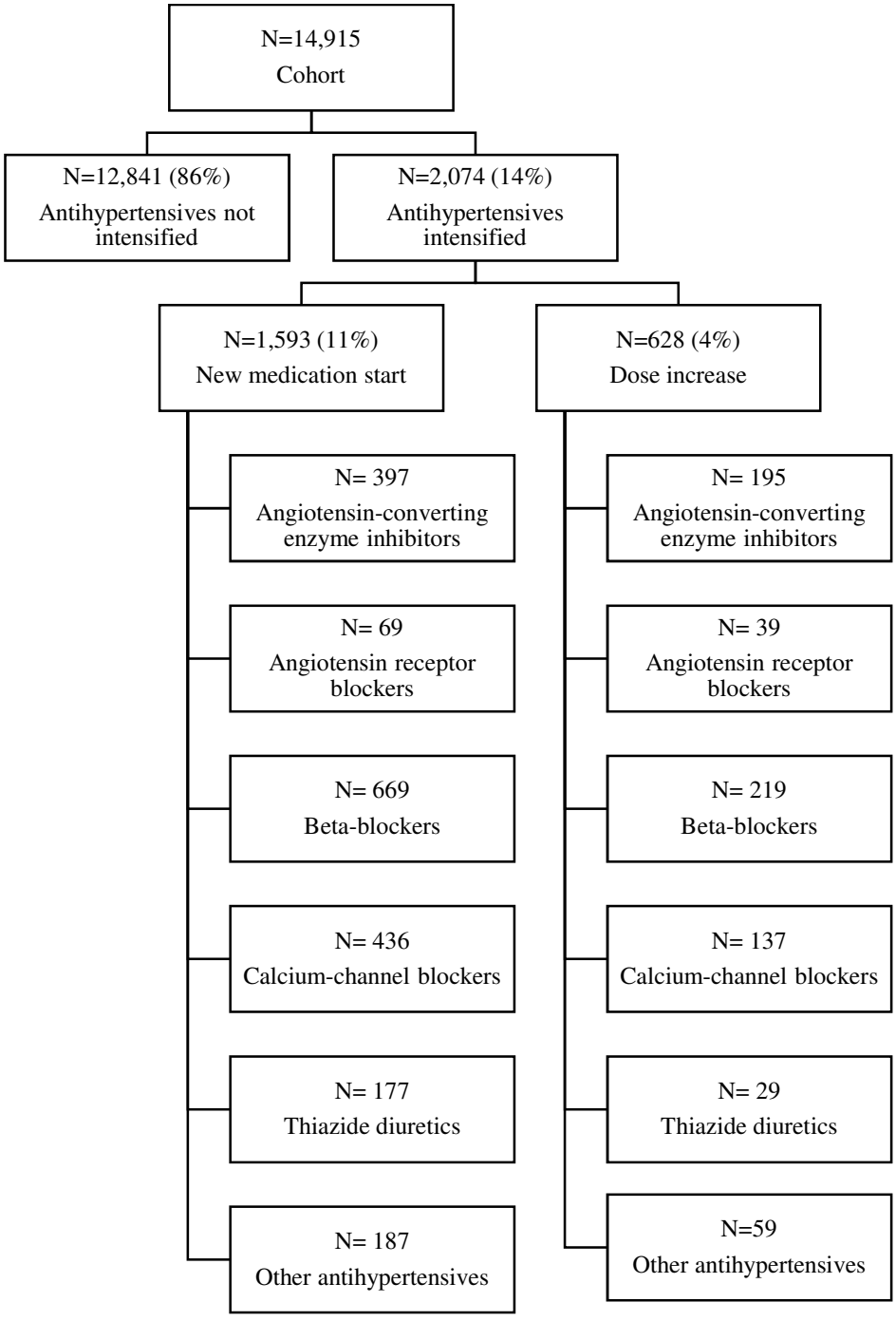
Note: Review of random sample of clinical charts containing either a discharge pharmacist medication reconciliation note or discharge summary note containing a list of medication changes, as described in the supplementary methods.

Supplementary table B: Chart review comparison of antihypertensive intensifications identified from pharmacy records and overall antihypertensive regimen intensifications

Antihypertensive Regimen	N	>=1 medication intensifications	>=1 medication deintensifications
Regimen intensified	74	76	12
Regimen substituted	9	9	9
Regimen deintensified	8	7	8
No change to regimen	8	0	0
Total	101	93	29

Note: Review of random sample of clinical charts of patients identified as having an antihypertensive intensification by pharmacy records. Chart review was restricted to charts containing either a discharge pharmacist medication reconciliation note or discharge summary note containing a list of medication changes, as detailed in the supplementary methods.

Supplementary figure B: Antihypertensive intensifications by drug class



Note: 459 patients received multiple intensifications, thus sub-categories of intensifications do not sum to 2,074