**Supplemental Materials:**

**Effect of IV Antihypertensives on Outcomes of Severe Hypertension in Hospitalized Patients without Acute Target Organ Damage**
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Table S1: Common IV antihypertensives given over 3 hours from time of severe HTN development in the non-weighted population

|  |  |
| --- | --- |
| **Within 3 hours of severe HTN development** |  |
| **IV medications (n=1,056)** |
| Hydralazine | 667 |
| Labetalol | 390 |
| Metoprolol | 534 |
| Nicardipine | 79 |
| Number of IV meds among those who received IV meds  | 2 [1, 4] |

Numbers do not add up to 1,056 because some patients received more than 1 IV antihypertensive during 3 hours.

Table S2: Inpatient outcomes for treated vs. untreated Patients by CVD admission status and treatment route

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated | Events in Untreated | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| CVD admissions (Total:6,525, 472 treated and 6,053 did not receive any treatment within 3 hours of severe inpatient hypertension) |
| **Myocardial Injury**  |
| IV vs. no treatment  | 42 (8.9%) | 417 (6.9%) | 1.31 [0.95, 1.80] | 1.27 [0.84, 1.90] |
| **Stroke** |
| IV vs. no treatment | 7 (1.5%) | 107 (1.8%) | 0.84 [0.39, 1.80] | 0.52 [0.21, 1.28] |
| **AKI** |
| IV vs. no treatment | 138 (29.2%) | 1,436 (23.7%) | 0.98 [0.82, 1.17] | 0.92 [0.73, 1.16] |
| **Death** |
| IV vs. no treatment | 24 (5.1%) | 121 (2.0%) | 1.08 [0.69, 1.67] | 0.91 [0.54, 1.53 |
|  | Events in Treated | Events in Untreated | HR [95% CI] |  |
| Non- CVD admissions (Total:10,738, 587 treated and 10,151 did not receive any treatment within 3 hours of severe inpatient hypertension) |
| **Myocardial Injury**  |
| IV vs. no treatment  | 20 (3.4%) | 174 (1.7%) | 2.01 [1.26, 3.19] | 1.75 [0.94, 3.26] |
| **Stroke** |
| IV vs. no treatment | ----- | ----- | ----- | ----- |
| **AKI** |
| IV vs. no treatment | 107 (18.2%) | 1,440 (14.2%) | 1.17 [0.96, 1.42] | 1.06 [0.79, 1.42] |
| **Death** |
| IV vs. no treatment | 4 (0.7%) | 87 (0.9%) | 1.18 [0.43, 3.26] | 0.92 [0.49, 1.74] |

HR (Hazard Ratio) calculated while accounting for overlap propensity weights
95%CI: 95% confidence interval, CVD: cardiovascular disease
CVD admissions included patients who were admitted with cerebrovascular events, myocardial infarction, heart failure or abdominal aortic aneurysm. These are based on whether a new, not historical, ICD-10 code for any of these events during hospitalization was coded.
No stroke events following severe inpatient hypertension development in patients admitted for non-cardiovascular disease reasons

Table S3: Inpatient outcomes for treated vs. untreated patients by ward on admission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated | Events in Untreated | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Medical ward (Total: 13,949, 750 treated and 13,199 did not receive any treatment within 3 hours of developing severe inpatient hypertension) |
| **Myocardial Injury**  |
| IV vs. no treatment  | 50 (6.7%) | 491 (3.7%) | 1.83 [1.37, 2.44] | 1.74 [1.17, 2.59] |
| **Stroke** |
| IV vs. no treatment | 3 (0.4%) | 79 (0.6%) | 0.67 [0.21, 2.12] | 0.42 [0.12, 1.43] |
| **AKI** |
| IV vs. no treatment | 179 (23.9%) | 2,326 (17.6%) | 1.09 [0.93, 1.26] | 0.99 [0.81, 1.22] |
| **Death** |
| IV vs. no treatment | 21 (2.8%) | 179 (1.4%) | 0.98 [0.62, 1.54] | 0.79 [0.41, 1.50] |
|  | Events in Treated | Events in Untreated | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Surgical ward (Total; 3,314, 309 treated and 3,005 did not receive any treatment within 3 hours of developing severe inpatient hypertension) |
| **Myocardial Injury**  |
| IV vs. no treatment  | 12 (3.9%) | 10 (3.3%) | 1.17 [0.64, 2.13] | 0.87 [0.44, 1.72] |
| **Stroke** |
| IV vs. no treatment | 4 (1.3%) | 28 (0.9%) | 1.39 [0.49, 3.96] | 1.14 [0.33, 3.95] |
| **AKI** |
| IV vs. no treatment | 66 (21.4%) | 550 (18.3%) | 0.99 [0.76, 1.28] | 0.92 [0.64, 1.33] |
| **Death** |
| IV vs. no treatment | 7 (2.3%) | 29 (1.0%) | 1.45 [0.63, 3.38] | 1.58 [0.80, 3.09] |

HR (Hazard Ratio) calculated while accounting for overlap propensity weights
95%CI: 95% confidence interval, CVD: cardiovascular disease

Table S4: Inpatient outcomes for treated vs. untreated patients by treatment route\*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated | Events in Untreated | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| **Myocardial Injury** |
| IV vs. no treatment or oral treatment  | 62 (5.9%) | 693 (3.6%) | 1.66 ]1.27, 2.15] | 1.59 [1.13, 2.24] |
| **Stroke** |
| IV vs. no treatment or oral treatment | 7 (0.7%) | 126 (0.7%) | 1.01 [0.47, 2.17] | 0.69 [0.29, 1.61] |
| **Acute Kidney Injury** |
| IV vs. no treatment or oral treatment | 245 (23%) | 3,450 (17.9%) | 1.05 [0.92, 1.19] | 0.98 [0.82, 1.17] |
| **Stroke** |
| IV vs. no treatment or no treatment | 28 (2.6%) | 237 (1.2%) | 1.09 [0.74, 1.63] | 0.87 [0.49, 1.53] |

HR (Hazard Ratio) calculated while accounting for overlap propensity weights
95%CI: 95% confidence interval, CVD: cardiovascular disease

\*We compare events in patients treated with IV antihypertensives over 3 hours vs. those treated with oral only antihypertensives (no IV) or those who did not treatment over 3 hours. 1,059 were treated vs. 19,324 were not treated.

Table S5. Inpatient Outcomes for Treated with IV Antihypertensives vs. Treated with Oral Antihypertensives

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated with IV Antihypertensives Only  | Events in Treated with Oral Antihypertensives Only  | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| **Myocardial Injury** |
| IV vs. oral  | 46 (5.1%) | 102 (3.3%) | 1.57 [1.11, 2.22] | 1.91 [1.16, 3.16] |
| **Stroke** |
| IV vs. oral | 4 (0.4%) | 19 (0.6%) | 0.72 [0.25, 2.13] | 0.29 [0.09, 0.92] |
| **Acute Kidney Injury** |
| IV vs. oral | 189 (20.8%) | 574 (18.4%) | 0.95 [0.80, 1.12] | 0.91 [0.74, 1.10] |
| **Death** |
| IV vs. oral | 25 (2.8%) | 29 (0.9%) | 1.20 [0.69, 2.09] | 0.94 [0.48, 1.85] |

IV: intravenous
Hazard Ratio (HR) calculated while accounting for overlap propensity weights
95%CI: 95% confidence interval

We compare events in patients treated with IV antihypertensives (only) over 3 hours vs. those treated with oral only antihypertensives (no IV) over 3 hours. 908 were treated with IV antihypertensives vs. 3,120 were treated with oral only antihypertensives.

Table S6. Admission diagnosis groupings in the overall cohort and by treatment group

|  |  |  |  |
| --- | --- | --- | --- |
| **Diagnosis Grouping** | **Overalln=17,623** | **Treated with IVn=1,081** | **Untreatedn=16,542** |
| Acquired absence of limb or organ | 9 (0.1) | 0 (0) | 9 (0.1) |
| Cardiovascular and cerebrovascular | 2,427 (13.8) | 250 (23.1) | 2,177 (13.2) |
| Dermatological | 158 (0.9) | 7 (0.6) | 151 (0.9) |
| Endocrine | 628 (3.6) | 39 (3.6) | 589 (3.6) |
| External exposure | 60 (0.3) | 1 (0.1) | 59 (0.4) |
| Fracture or injury | 960 (5.4) | 55 (5.1) | 905 (5.5) |
| Gastrointestinal and genitourinary | 2,150 (12.2) | 138 (12.8) | 2,012 (12.2) |
| HEENT | 66 (0.4) | 3 (0.3) | 63 (0.4) |
| Hematologic | 536 (3) | 27 (2.5) | 509 (3.1) |
| Infection | 2,537 (14.4) | 130 (12) | 2,407 (14.6) |
| Kidney related | 1,594 (9) | 87 (8) | 1,507 (9.1) |
| Miscellaneous | 1,217 (6.9) | 66 (6.1) | 1,151 (7) |
| Musculoskeletal and rheumatological disorders | 428 (2.4) | 16 (1.5) | 412 (2.5) |
| Neoplasms | 574 (3.3) | 43 (4) | 531 (3.2) |
| Neurological | 1,479 (8.4) | 110 (10.2) | 1,369 (8.3) |
| Pain | 254 (1.4) | 11 (1) | 243 (1.5) |
| Post procedure complications | 267 (1.5) | 15 (1.4) | 252 (1.5) |
| Psychological | 296 (1.7) | 3 (0.3) | 293 (1.8) |
| Respiratory | 1,386 (7.9) | 57 (5.3) | 1,329 (8) |
| Substance abuse | 485 (2.8) | 13 (1.2) | 472 (2.9) |
| *Missing* | *112 (0.6)* | *10 (0.9)* | *102 (0.6)* |

Table S7.A. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for cardiovascular and cerebrovascular disease based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=250) | Events in Untreated (untreated n=2,177) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Cardiovascular and cerebrovascular |
| **Myocardial Injury** |
| IV vs. no treatment | 24 (9.6%) | 161 (7.4%) | 1.32 [0.86, 2.03] | 1.43 [0.81, 2.53] |
| **Stroke** |
| IV vs. no treatment | 1 (0.4%) | 25 (1.1%) | 0.35 [0.05, 2.56] | 0.11 [0.02, 0.85] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 64 (25.6%) | 435 (20%) | 0.87 [0.67, 1.14] | 0.84 [0.61, 1.14] |
| **Death** |
| IV vs. no treatment | 10 (4%) | 30 (1.4%) | 1.08 [0.52, 2.24] | 1.26 [0.68, 2.34] |

Table S7.B. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for fractures or injuries based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=55) | Events in Untreated (untreated n=905) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Fracture or injury |
| **Myocardial Injury** |
| IV vs. no treatment | 2 (4%) | 32 (3.5%) | 1.04 [0.25, 4.33] | 0.47 [0.09, 2.57] |
| **Stroke** |
| IV vs. no treatment | 3 (0.3%) | 0 (0%) | --------- | --------- |
| **Acute Kidney Injury** |
| IV vs. no treatment | 10 (18.2%) | 152 (16.8%) | 0.70 [0.37, 1.34] | 0.64 [0.38, 1.06] |
| **Death** |
| IV vs. no treatment | 1 (1.8%) | 5 (0.6%) | 0.59 [0.06, 5.66] | 0.29 [0.04, 1.91] |

Table S7.C. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for gastrointestinal and genitourinary disease based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=138) | Events in Untreated (untreated n=2,012) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Gastrointestinal and genitourinary |
| **Myocardial Injury** |
| IV vs. no treatment | 55 (2.7%) | 4 (2.9%) | 1.06 [0.39, 2.94] | 0.82 [0.29, 2.35] |
| **Stroke** |
| IV vs. no treatment | 1 (0.7%) | 14 (0.7%) | 1.04 [0.14, 7.93] | 0.39 [0.06, 2.99] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 25 (18.1%) | 376 (18.7%) | 1.46 [0.94, 2.26] | 1.69 [1.06, 2.69] |
| **Death** |
| IV vs. no treatment | 1 (0.7%) | 16 (0.8%) | 0.59 [0.08, 4.57] | 0.39 [0.16, 0.99] |

Table S7.D. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for infection based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=130) | Events in Untreated (untreated n=2,407) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Infection |
| **Myocardial Injury** |
| IV vs. no treatment | 8 (6.2%) | 66 (2.7%) | 2.27 [1.09, 4.73] | 2.05 [0.75, 5.61] |
| **Stroke** |
| IV vs. no treatment | 1 (0.8%) | 11 (0.5%) | 1.69 [0.22, 13.1] | 1.59 [0.21, 12.32] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 28 (21.5%) | 383 (15.9%) | 0.96 [0.67, 1.36] | 0.90 [0.57, 1.41] |
| **Death** |
| IV vs. no treatment | 7 (5.4%) | 35 (1.5%) | 1.29 [0.62, 2.65] | 1.03 [0.49, 2.12] |

Table S7.E. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for kidney related disease based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=87) | Events in Untreated (untreated n=1,507) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Kidney related |
| **Myocardial Injury** |
| IV vs. no treatment  | 2 (2.3%) | 52 (3.5%) | 0.67 [0.16, 2.75] | 0.43 [0.08, 2.21] |
| **Stroke** |
| IV vs. no treatment | 1 (1.1%) | 12 (0.8%) | 1.44 [0.19, 11.08] | 0.83 [0.11, 6.39] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 29 (33.3%) | 350 (23.2%) | 1.55 [1.06, 2.27] | 1.57 [1.03, 2.39] |
| **Death** |
| IV vs. no treatment | 3 (3.4%) | 27 (1.8%) | 0.97 [0.29, 3.31] | 0.87 [0.39, 1.90] |

Table S7.F. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for neurological disease based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=110) | Events in Untreated (untreated n=1,369) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Neurological |
| **Myocardial Injury** |
| IV vs. no treatment | 9 (8.2%) | 39 (2.8%) | 2.95 [1.35, 6.44] | 3.13 [1.32, 7.48] |
| **Stroke** |
| IV vs. no treatment | 1 (0.9%) | 9 (0.7%) | 1.39 [0.18, 10.98] | 2.15 [0.28, 16.83] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 22 (20%) | 184 (13.4%) | 0.79 [0.46, 1.37] | 0.68 [0.39, 1.18] |
| **Death** |
| IV vs. no treatment | 0 (0%) | 22 (1.6%) | --------- | --------- |

Table S7.G. Inpatient outcomes for treated vs. untreated patients by treatment route in patients admitted for respiratory disease based on admission ICD-10 codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Events in Treated (treated n=110) | Events in Untreated Only (untreated n=1,369) | Unweighted crude HR [95% CI] | Overlap propensity weighted HR [95% CI] |
| Respiratory |
| **Myocardial Injury** |
| IV vs. no treatment | 9 (8.2%) | 39 (2.8%) | 2.95 [1.35, 6.44] | 3.14 [1.32, 7.48] |
| **Stroke** |
| IV vs. no treatment | 9 (0.7%) | 1 (0.9%) | 1.39 [0.18, 10.98] | 2.15 [0.28, 16.83] |
| **Acute Kidney Injury** |
| IV vs. no treatment | 22 (20.0%) | 184 (13.4%) | 0.79 [0.46, 1.37] | 0.68 [0.39, 1.18] |
| **Death** |
| IV vs. no treatment | 0 (0%) | 22 (1.6%) | --------- | --------- |

Figure S1: Propensity score distribution in treated and untreated groups


 Estimated propensity score

Dark grey shading refers to untreated severe hypertension patients
Light grey shading refers to treated severe hypertension patients

Figure S2. Systolic blood pressure over 12 hours from time of severe inpatient hypertension development


Time: 0 refers to time of severe hypertension development.
Treated: “No” refers to NOT being treated with IV antihypertensives within 3 hours of developing severe hypertension (in orange) and “Yes” refers to being treated with IV antihypertensives within 3 hours of developing severe hypertension (in blue)

Figure S3. Diastolic blood pressure over 12 hours from time of severe inpatient hypertension development



Time: 0 refers to time of severe hypertension development.
Treated: “No” refers to NOT being treated with IV antihypertensives within 3 hours of developing severe hypertension (in orange) and “Yes” refers to being treated with IV antihypertensives within 3 hours of developing severe hypertension (in blue)