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# Outline

The purpose of our study is to assess physicians’ behavior to refer patients with hypertension for further evaluation. Towards that end, we tried to find out the variables that have significant relationship with our target variable (Y-variable), which is a binary variable that indicates whether physicians referred the patient with hypertension (values 0 for “yes” and 1 for “no”). We had 11 suspected variables and 293 patients. The variables include types of pain, administration of analgesic medication, administration of antihypertensives, age, gender, ethnicity, documented history of substance abuse, documented history of chronic pain, prescriber level, whether the patient was discharged from emergency department, referral to PCP for follow-up.

# Summary Statistics

Here are summary statistics of the variables that we analyzed.

## % Pain Type

| Pain Type | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Dorsalgia | 123 | 10 | 45.3% |
| Lumbar Back Pain | 70 | 2 | 24.5% |
| Thoracic Spine Pain | 16 | 0 | 5.4% |
| Cervical Spine Pain | 70 | 2 | 24.5% |

## % Gender

| Gender | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Female | 135 | 7 | 48.4% |
| Male | 144 | 7 | 51.5% |

## % Age

Mean: 52.05 & Standard Deviation: 15.18

Mean +/ SD = [36.86, 67.23]

## % Ethnicity

| Ethnicity | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| White | 68 | 2 | 23.8% |
| African | 20 | 1 | 7.1% |
| Hispanic | 188 | 11 | 67.9% |
| Asian | 0 | 0 | 0% |
| Other | 1 | 0 | 0.3% |
| Intermediate | 2 | 0 | 0.6% |

## % Received Analgesics (Column F)

| Hx Analgesics | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Yes | 178 | 12 | 64.8% |
| No | 101 | 2 | 35.2% |

## % Received Antihypertensives (Column G)

| Hx Antihypertensives | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Yes | 5 | 1 | 2.0% |
| No | 274 | 13 | 98.0% |

## % History of Substance abuse (Column K)

| Hx Substance Abuse | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Yes | 45 | 5 | 17.1% |
| No | 234 | 9 | 82.9% |

## % History of Chronic Pain (Column L)

| Hx Chronic Pain | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Yes | 59 | 3 | 21.2% |
| No | 219 | 11 | 78.5% |
| N/A | 1 | 0 | 0.3% |

## % Prescriber level by grouping (Column M)

| Prescriber Level | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Attending | 17 | 0 | 5.8% |
| Resident | 104 | 1 | 35.8% |
| APP | 158 | 13 | 58.4% |

## % referred to PCP for follow up (Column O)

| Is Referred to PCP | Not Referred HTN | Referred HTN | Referral PCP Ratio |
| --- | --- | --- | --- |
| Yes | 185 | 13 | 67.6% |
| No | 94 | 1 | 32.4% |

## % Received HTN goal directed DC instructions (Column P)

|  | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Value | 279 | 14 | 4.8% |

# Bivariate Analysis

We applied bivariate analysis on these 11 variables, and we picked out 3 variables that seemed to have (at least almost) significant relationship. For each variable, we have a contingency table, the last column of which represents the ratio of patients being referred to address hypertension in each group (row).

## 1. Prescriber’s level

* There were 3 possible levels: 1) attending, 2) resident, 3) APP. Out of 293 patients, there were 17 attending (5.8%), 105 residents (35.8%), 171 APP (58.3%).
* The chi-square test comparing prescriber’s level and Y-variable showed **p-value=0.0269371**.

### Contingency Table

| Doctor Level | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Attending | 17 | 0 | 0% |
| Resident | 104 | 1 | 0.9% |
| APP | 158 | 13 | 7.6% |

### Implications

It was evident that more experienced prescriber tended to make referrals less frequently (attending < resident < APP).

## 2. History of Substance Abuse

* There were 2 possible levels: 1) without substance abuse history and 2) with substance abuse history. Out of 293 patients, there were 243 without substance abuse history (82.93%), 50 with substance abuse history (17.07%).
* The chi-square test comparing prescriber’s level and Y-variable showed **p-value=0.0573.**

### Contingency Table

| Substance Abuse | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Yes | 45 | 5 | 10% |
| No | 234 | 9 | 3.7% |

### Implications

According to the rule of thumb (threshold of p-value=5%), this variable should not be regarded as significant. However, since p-value was very close to 5%, we included this variable. Patients with substance-abuse history were more likely to be referred.

## 3. Referral to PCP

* There were 2 possible levels: 1) not referred to PCP and 2) referred to PCP. Out of 293 patients, there were 95 not referred to PCP (32.42%), 198 referred to PCP (67.58%).
* The chi-square test comparing prescriber’s level and Y-variable showed **p-value=0.0384**.

### Contingency Table

| Referred PCP | Not Referred HTN | Referred HTN | Referral Ratio |
| --- | --- | --- | --- |
| Yes | 185 | 13 | 6.6% |
| No | 94 | 1 | 1.1% |

### Implications

Patients who were referred to their PCP’s were more likely to be referred to address hypertension.

# Multivariate Analysis

Now that we have picked out 3 variables that seemed to have significant association with referral to hypertension, we will conduct a multivariate analysis via logistic regression. We considered the prescriber's level (the first explanatory variable covered in bivariate analysis) as a categorical variable having values 1, 2, and 3, each value representing attending (1), resident (2), and APP (3), with attending (1) being the reference level. For the other binary variables, we used 0 (No) and 1 (Yes).

|  | Estimate | Standard Error | P-value |
| --- | --- | --- | --- |
| Intercept | -0.05169 | 0.05307 | 0.33082 |
| Prescriber’s level (Resident) | -0.01411 | 0.05497 | 0.79763 |
| Prescriber’s level (APP) | 0.07397 | 0.05302 | 0.16401 |
| Substance abuse | 0.05558 | 0.03244 | 0.08772 |
| Referral to PCP | 0.07676 | 0.02722 | 0.00514 |

It aligned with the bivariate analysis in that substance the last two variables showed almost significant (substance to abuse) and significant (referral to PCP) significance in a positive way. On the other hand, since the logistic regression model automatically separates prescriber’s level into two separate variables (Resident vs attending & APP vs attending), we could not exactly determine the significance of prescriber’s level.

In order to verify the significance of prescriber’s level, we compared two models, the model that includes the variable and excludes the variable. By Chi-square test, we found that the two models are significantly different with p-value=0.0025. This explains that the prescriber’s level has a significant explanation on the referral for hypertension.