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The Prevalence of Undiagnosed Hypertension in
Ambulatory Emergency Department Patients and
Lack of Adequate Referral

A Thesis Submitted to the
Yale University School of Medicine
in Partial Fulfillment of the Requirements for the
Degree of Doctor of Medicine

by

Andrew Sandor Nerlinger

2006

ABSTRACT

THE PREVALENCE OF UNDIAGNOSED HYPERTENSION IN AMBULATORY EMERGENCY DEPARTMENT PATIENTS AND LACK OF ADEQUATE REFERRAL.

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OBJECTIVES: According to a WHO estimate, 1 in every 8 deaths worldwide is due to high blood pressure (BP). The Emergency Department (ED) provides an opportunity to identify individuals with undiagnosed hypertension (HTN) and refer them for BP recheck. The study objectives were to quantify the population in need referral for BP recheck and to determine the frequency of referral from the ED.

METHODS: A retrospective, structured chart review of all patients > 18 years old seen in an urban adult ED over 5 days, excluding major trauma and pregnant pts. Patients with any systolic BP (SBP) > 140 or diastolic BP (DBP) > 90 had the following collected: demographics, all BPs, history of HTN, use of BP medication, and disposition. Patients with elevated BP, no prior diagnosis of HTN or BP medication use, and who were discharged met criteria for referral. For pts in need of referral, HTN-specific discharge instructions or physician plans were noted.

RESULTS: Of 967 pts who met inclusion criteria, 339 (35.1%; 95% CI: 35-46%) had at least one elevated BP, with a mean maximum BP of 152.4/89.7. 45.4% were male and the mean age was 52.3. 130 pts, or 13.4% (95% CI: 11-16%) had severe elevation (JNC-7 stage 2 level): SBP > 160 or DBP > 100. 85.4% would have been identified as having elevated BP by initial measurement. 137 pts (14.1%; 95% CI: 12-16%) required referral for a repeat BP measurement, and 39 (4.0% of all included pts) had a SBP > 160 or DBP > 100. Of the 137 pts in need of referral, 2 pts (1.5%, 95% CI: 0-3.5%) received computer-generated discharge instructions, and 3 (2.2%, 95% CI: 0-3.9%) had a documented plan for referral. No significant correlation existed between need for referral and age, sex, or maximum or triage BP.

CONCLUSIONS: 1 in 7 pts discharged from the adult ED has elevated BP with no prior diagnosis of HTN and should be referred for BP recheck. Few of these pts were identified as needing referral or received appropriate discharge instructions. 85% of pts in need of referral would have been identified by initial BP, which suggests that a screening and referral protocol could be initiated at triage.

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INTRODUCTION

Hypertension is a major health concern; the World Health Organization estimates that one in 8 deaths worldwide can be attributed to high blood pressure (BP). Such a statistic mandates appropriate attention to the diagnosis and treatment of hypertension in any clinical setting. Early identification and treatment of hypertension is one of the fundamentals of modern preventive medicine, as 31% of the population remains unaware of their hypertension (1). Routine BP measurement in the Emergency Department (ED) is standard of care, and many patients in the (ED) at Yale-New Haven Hospital (Connecticut) are found to have an elevated blood pressure measurement on routine BP screening. These patients often have no previous diagnosis of hypertension, and it was observed by the authors that a high number of these patients are discharged with no documentation of elevated BP or of the need to receive a follow-up BP measurement for the possible diagnosis of hypertension. It therefore seems that opportunities are being missed to identify patients with hypertension. Consequently, the initial hypothesis of this study is that ED patients with elevated BP who have no history of hypertension and who are subsequently discharged are neither frequently identified nor adequately referred for BP recheck.

Several initial questions are important in the assessment of this problem:

1. How common is elevated blood pressure in the ED?
2. How reliable are BP measurements in the ED and how frequently are patients with elevated ED measurements subsequently found to have true hypertension?

3. Are symptoms commonly associated with elevated BP (i.e. dyspnea, blurred vision, headache, epistaxis, chest pain, and dizziness) accurate predictors of the need for blood pressure evaluation and management?
4. How frequently are patients who are found to have elevated BP in the ED referred for BP recheck?
5. How frequently do patients who are referred for BP recheck from the ED actually obtain a repeat measurement?

These questions were addressed through a critical review of the literature:

1. *How common is elevated blood pressure in the ED?*

Elevated BP in the ED is a frequent occurrence, and it has long been considered an important issue for emergency physicians. As early as 1978, physicians suggested that the ED would be a potential site to screen patients for elevated blood pressure as well as to refer patients for repeat blood pressure measurements and any necessary treatment (2,3). Mamon et al. in 1987 recognized that the ED is an ideal site to screen a “hard-to-reach” population that tends not to receive regular medical care (4). In 2001, McCaig et al. found that 30% of ED visits were associated with a blood pressure greater than 140/90 mm Hg (5). The prevalence of elevated BP has consistently been in the range of 25-35% all adult ED patients, which is shown to be consistent with national prevalence data for hypertension. While a meta-analysis may be useful to further quantify this number, it is clear that numerous ED patients should obtain follow-up for elevated blood pressure.

2. *How reliable are BP measurements in the ED and how frequently are patients with elevated ED measurements subsequently found to have true hypertension?*

A potential issue surrounding the use of the ED as a site for hypertension screening is the reliability of BP measurements in the ED. Many patients are anxious or in pain in the ED, which has led many physicians to dismiss elevated BP in the ED as a transient appropriate stress response rather than a true manifestation of chronically elevated blood pressure. In 1987, Chernow et al. prospectively studied 239 patients who presented to the emergency department with BP \geq 160/95 (6). Follow-up for repeat BP measurement was achieved with 45% of patients. Of the patients who had repeat measurements, 35% had BP \geq 160/95, 33% had BP from 140-159/90-94, and 32% were normotensive ($<$ 140/90). The authors further comment that each of the above categories included patients with similar amounts of pain, and they conclude that elevated BP on discharge should mandate referral for follow-up.

This notion was challenged in 1998 by Pitts et al., who suggested that the statistical phenomenon of 'regression to the mean' may explain many of the elevated blood pressures in the ED beyond typical stressors often attributed to 'white coat hypertension' (7). In response, Backer et al. in 2003 prospectively examined BP measurements in both the ED and clinic settings before, during, and after the ED visit (8). They found that 70% of patients with initial increased BP \geq 140/90 had at least one elevated BP measurement after the initial reading. They also found a direct correlation between ED BP and repeat measurements. BP measurements from both before and after the ED measurement were not significantly different, and BP was similar for both

patients with and patients without pain as the chief complaint. The authors concluded that increased BP is common among ED and urgent care patients without a history of hypertension. These patients should be referred for repeat measurement after a single abnormal BP in the ED, as most will be ultimately diagnosed as hypertensive.

Recent authors have confirmed this conclusion. In 2005, Karras et al. screened 7238 patients from multiple urban emergency departments and found that 1396 patients had elevated BP (9). BP measurements were repeated in 61% of patients and were the same or greater in 51% of cases. Also in 2005, Fleming et al. prospectively assessed whether an ED is a suitable location for the targeted screening of hypertension (10). Of 765 patients screened, 213 (28%) had elevated BP and were invited to receive a follow-up measurement, 51 of which attended (24% of those invited). The authors found that 76% of these patients remained hypertensive, and that there was no correlation between pain score and blood pressure reduction on follow-up. They concluded that there are a substantial percentage of patients whose BP remains high on follow-up, but those with a subjective pain severity of 10/10 in the ED are less likely to have elevated BP on follow-up.

Finally, Baumann et al. in 2005 sought to examine the limitations of the triage blood pressure in screening for elevated BP in the ED (11). An abstract reported that 991 patients with $BP \geq 140/90$ had 2 additional measurements recorded upon reaching the patient care area. The additional measurements were obtained before and after a 20-minute questionnaire that was part of a separate study. The authors concluded that triage BPs demonstrate significant elevations from subsequent measurements, and that

elevations in triage blood pressure may better be utilized to guide referral rather than to diagnose hypertension.

The literature pertaining to the reliability of elevated BP in the ED has been fairly inconsistent in terms of absolute percentages, but it is clear that an elevated BP in the ED is not always accurate. However, numerous authors have determined that the number of patients who have an initial elevated BP in the ED and subsequently have another elevated measurement ranges from 50-76%. While there is variation between studies in the length of time between initial and repeat measurements, the high percentage of patients (consistently above 50%) who continue to have elevated BP suggests that these patients should be referred for BP follow up. The major contrary argument would be that such referrals could be a waste of resources. However, while referring patients for BP recheck who are subsequently found to be normotensive would have limited adverse effect on the patient's health, failing to refer truly hypertensive patients is medically irresponsible. Ignoring elevated BP measurements in the ED may cause many hypertensive patients to be missed, and referring patients with elevated BP may help to establish primary care for many patients who previously received none.

In conclusion, the substantial percentage of patients who are hypertensive on repeat measurement and the positive risk to benefit ratio of referral justify the referral of all patients with elevated BP for repeat measurement.

3. *Are symptoms commonly associated with elevated BP (i.e. dyspnea, blurred vision, headache, epistaxis, chest pain, and dizziness) accurate predictors of the need for blood pressure evaluation and management?*

Renewed attention has been given to recognizing any association between elevated blood pressure and those occult symptoms normally associated with elevated BP. In 2005, Ufberg et al. prospectively matched 298 patients with elevated BP and 709 normotensive controls (12). The authors found that there was no significant difference in the incidence of headache, blurry vision, epistaxis, chest pain, dyspnea, or dizziness. In 2005, Karras et al. prospectively found that 29% of 1908 ED patients had elevated BP (13), and unprompted complaints of hypertension-associated symptoms were observed in 26% of patients with elevated BP. Interviews of patients with elevated BP were administered to document symptoms, and 68% of 294 patients who completed the interview had at least one current hypertension-associated symptom. However, the data demonstrated no relation between symptom prevalence and BP level. The authors concluded that hypertension-associated symptoms are common but unrelated to the magnitude of BP elevation.

The data on the relationship between symptoms commonly associated with hypertension and elevated BP in the ED is limited to two recent studies performed by overlapping author groups. Both the Ufberg and Karras studies demonstrated that relying on the presence of symptoms commonly associated with elevated BP in order to identify potentially hypertensive patients would not be appropriate. Conversely, it may be suggested that patients with milder elevations in blood pressure should not be ignored. BP screening in the ED is meant to identify patients with occult BP elevation before they

develop the serious sequelae. Consequently, even asymptomatic patients with minor elevations in blood pressure should be referred for repeat BP measurement.

4. How frequently are patients who are found to have elevated BP in the ED referred for BP recheck?

While it is current practice for every patient who visits the ED to have his or her blood pressure recorded at triage, follow-up is essential for the diagnosis and proper treatment of those patients who have elevated BP. Karras et al. observed in 2005 that approximately half of urban ED patients with elevated BP had no documented history or diagnosis of hypertension at the time of their visit (9). Other authors have suggested that few patients with elevated BP are actually referred for follow-up. In 1978, Kaszuba et al. reported that less than 10% of patients with elevated BP were referred for follow up (2), and Glass et al. noted that less than 1/3 of patients with BP \geq 140/90 were sent for follow-up (3). Capriotti's 1989 analysis of 78 low-acuity patients with increased BP in the ED found that only 23% had documentation of having attention drawn to their BP or of referral for follow-up (14).

Although the need for patient referral was initially documented in the 1970s and 80s, recent studies suggest that physicians have not yet adopted an effective system of referral for follow-up of high blood pressure in the ED. A 2004 retrospective analysis by Tanabe et al. reviewed 88 low-acuity patients who presented to the ED at Northwestern University and demonstrated that 37 of 88 had BP \geq 140/90 (15). Of these 37 patients, 27% had documented rechecks, 0% were treated or admitted for BP while in the ED, and 0% had documented referral for BP recheck. However, this study is limited by a very

small sample size and a focus only on those patients with low triage acuity level. Many of the symptoms possibly associated with hypertension would present in patients of higher triage acuity, and it is possible that these patients were missed by the inclusion of only very low acuity patients. This study also does not make any conclusions about the approximate percentage of patients who are discharged and who have no previous diagnosis of hypertension. It would be useful to evaluate how frequently this occurs in an adult ED.

In 2005, Escalante et al. of the M.D. Anderson Cancer Center described clinical factors associated with increased BP in cancer patients seeking acute care (16). Of 1221 patients screened, 143 had BP \geq 140/90. The authors found that only 9% of these patients were given hypertension-specific discharge instructions. However, 19% of these patients returned to the ED with hypertension or possible hypertension-related events within 6 months. The authors appropriately concluded that documentation of elevated BP and referral for recheck are important areas in need of further study and improvement. However, the major limitation of this study is the focus on a less generalizable patient population of acutely ill cancer patients.

The most recent and relevant observations on the frequency of identification and referral of patients with elevated BP in the ED are from a 2005 abstract by Baumann et al. (17). This prospective observational single-center study sought to assess the characteristics of “newly identified hypertensives” and “known hypertensives” with respect to demographics, access to healthcare, and ED referral for BP follow-up. Subjects presenting with a triage systolic blood pressure (SBP) \geq 140 or diastolic blood pressure (DBP) \geq 90 had 2 additional BP measurements at 20 minute intervals once they

reached the patient care area. Of 2,031 patients screened, 454 (22%) subjects were eligible for repeat measurement due to elevated triage measurement. Using the mean of the 3 BP measurements, 304 (67%) of 454 patients had elevated BP with a mean SBP of 159 and a mean DBP of 89. New hypertensives were less likely to be informed of their elevated BP by ED staff (34% vs 50%, $p = 0.02$) or specifically instructed to obtain a repeat measurement by their doctor or at a clinic (14% vs 31%, $p = 0.001$). They are also more likely to be younger, smoke, and drink alcohol.

Baumann et al. make several useful observations about the population of patients in need of referral for BP recheck due to elevated BP in the ED. However, there are several limitations to this study. Specific issues not addressed in the abstract include the location and population examined and the means of obtaining data on patient information and referral. The abstract notes that patients were screened based upon initial BP measurement, but this design neglects those patients who may be found to have elevated BP at another point in time in the ED. The authors make use of the mean of all 3 measurements to determine who should receive referral for recheck, but it has been argued previously that any elevated BP in the ED should mandate informing the patient of this elevated measurement and referring for recheck. The authors seemingly make no differentiation between admitted and ambulatory patients, which is an important consideration in the evaluation of referral patterns. The classification of some patients as 'new hypertensives' and the comparison with 'known hypertensives' has limited validity, as the diagnosis of hypertension ideally should follow multiple measurements over a time period greater than that in the study. The prospective nature of this study may add several confounding factors; while it is stated that the ED staff were blinded to the study,

the fact that patients were receiving multiple BP measurements over the course of data collection by dedicated staff could raise an artificial level of awareness of such elevated blood pressure measurements. Finally, the ability of patients to be excluded based on illness, language barrier, or unwillingness to participate could induce sample bias, as patients who are willing to participate in a survey in the ED may be more likely to receive additional information concerning their healthcare.

Additional questions remain concerning the conclusions made by Baumann et al. The study was conducted at an academic emergency department (UMDNJ/RWJMC at Camden, NJ) that has previously and simultaneously produced other research on hypertension in the ED. While an awareness of hypertension in the ED and familiarity of research assistants with the research methods surely has produced more accurate and reproducible data, awareness of these studies by the faculty may inflate the percentage of patients who are identified and referred for BP recheck. Information must also be gathered to examine how frequently ambulatory patients are referred for recheck, as this is the patient population most likely to be lost to future healthcare. Additional study could examine all BP measurements in the ED, rather than screening only those patients with an initial BP elevation. Such evaluation could suggest whether screening based on triage BP would be an effective tool for general BP screening in the ED. Finally, the overall goal of this field of research is to improve the percentage of patients who actually obtain follow-up and receive a repeat BP measurement. While Baumann comments on the increased tendency of new hypertensives to be younger males who smoke and drink alcohol, additional study could suggest other means of identifying patients in need of referral for BP recheck.

5. *How frequently do patients who are referred for BP recheck from the ED actually obtain a repeat measurement?*

The final hurdle to successfully screening for elevated BP in the ED is the patient's ability to obtain follow-up for BP recheck and long term care if the diagnosis of hypertension is made. In 1984, Hamaker et al. recognized this difficulty and evaluated 3 methods of referral in 239 patients who presented to the ED with diastolic BP \geq 100 (18). They found that there was no significant difference in follow-up rates between those who received routine referral plus a reminder phone call and those who received a referral to the hospital's outpatient assessment area from a specially trained interviewer. However, there was a significant improvement in the group of patients for whom an appointment was made within three days at the hospital's outpatient assessment area. Mouton et al. in 2001 evaluated factors related to a lack of follow-up at either a routine care clinic or a special primary care intervention program (the Competitive Initiative Program, CIP) (19). The authors also conducted interviews to provide information on the barriers to successful follow-up after referral through the CIP. The authors found that patients referred through the CIP were significantly more likely to receive follow-up care through a primary care provider. The ultimate goal of any research in this area is to improve not only the identification and referral of patients in need of BP follow up but also the percentage of patients who actually receive quality follow-up. While the above authors have suggested potential means of improvement, there is a clear need for further study of the effectiveness of different referral protocols and the implementation of such protocols.

The above review of the literature demonstrates that the ED is an important site for BP screening, and that elevated BP values should be accepted as accurate and appropriately acted upon even in the asymptomatic patient. However, there is a clear need for better characterization of those patients discharged from the ED (i.e. ‘ambulatory’) after an elevated BP measurement who have no prior diagnosis of hypertension. There is also a need to further evaluate whether Emergency Physicians are appropriately documenting the elevated BP and subsequently informing the patient of this measurement and of the need for BP recheck. Finally, more investigation of the development and evaluation of protocols meant to improve the recognition and referral of such patients is clearly warranted.

STATEMENT OF PURPOSE

The hypothesis of this thesis is that emergency department patients with elevated blood pressure who have no history of HTN and who are subsequently discharged are neither frequently identified by physicians nor adequately referred for BP recheck. The specific aims of the thesis are as follows:

1. Calculate the prevalence of hypertension in adult ED patients.
2. Calculate the percentage of ambulatory ED patients found to have an elevated blood pressure measurement but no prior diagnosis of hypertension, i.e. those patients in need of referral for blood pressure recheck.
3. Evaluate the demographics of ED patients in need of referral for BP recheck, and examine whether any particular demographic group is more likely to need referral for recheck.
4. Examine the frequency with which patients in need of referral for BP recheck are found to have a charted physician plan for evaluation of the elevated BP measurement.
5. Examine the frequency with which patients in need of referral for BP recheck are presented with hypertension-specific discharge instructions.
6. Utilize the data to elucidate possible means whereby the identification and referral process of patients in need of referral for BP recheck could be improved, and suggest protocols for future study.

METHODS

Site Description

This study was a retrospective chart review of 5 full days of adult patient visits to the Emergency Department at Yale-New Haven Hospital. Yale-New Haven Hospital is an urban level 1 trauma center and the major academic medical center in the Southern Connecticut Region. The annual ED census is approximately 62,500 adult patients with a 23% admission rate (20). New Haven County has no county hospital system, and Yale-New Haven is one of only two hospitals in New Haven and the surrounding towns. Additionally, as the major academic medical center in Southern Connecticut, Yale-New Haven receives many tertiary care referrals. While a multi-center study would be ideal, the patient population at Yale-New Haven Hospital could be considered highly generalizable due to its great diversity. The Yale ED is staffed by board-certified Emergency Medicine attendings, Emergency Medicine residents, and residents from various other Yale services.

In the beginning of 2006 the Yale ED implemented an electronic system of chart generation, scanning, and storage (LYNX Medical Systems, Bellevue, WA). Charts are electronically generated according each patient's chief complaint and are subsequently filled in by hand by the nurses and physicians. Prior to discharge, each patient receives computer generated discharge instructions that are customized by the physician according to diagnosis, discharge medications, and follow-up instructions. All documents are then electronically scanned and stored immediately upon discharge from the ED. The information from each patient visit is thus immediately available electronically.

Study design

This study is a retrospective chart review. The use of a computerized records system made a retrospective chart review a very practical choice due to the ease of information access. The aims of the study, particularly as they apply to the eventual goal of developing and testing a protocol for identification and referral of patients in need of BP recheck, also make a retrospective study an appropriate choice. Establishing the prevalence of patients in need of referral is most conveniently done retrospectively. Additionally, a retrospective study could more accurately represent physician documentation and referral as it removes the possibility that physicians could be influenced by prior awareness of the study topics.

Sample size

A major limitation of earlier studies about the documentation of referrals for BP recheck is the small sample size. Data was to be collected over a three week period, and the sample size was chosen to be both practical and representative of the Yale ED population. It was determined that examining the charts from several different days well-spaced apart would enable a representative cross-section of not only attendings but also of residents who switch every four weeks. A goal of reviewing 1000 charts was practical to accomplish in three weeks. Based on a daily patient census of approximately 175-250, 5 full days of adult ED visits were reviewed. The dates were chosen one month apart to ensure a broad sampling of ED residents: April 18, May 18, June 18, July 18, and August 18, 2005.

Institutional Review

Protocol #27714 was approved by the Yale University School of Medicine's Human Investigation Committee. A waiver of HIPAA Authorization for Research Use/Disclosure of Protected Health Information was obtained prior to data collection. No personally identifiable data was recorded for any patient, and the investigators subsequently referred to patient data by the patient's medical record number (MRUN). All chart review was done solely by the author, and all primary data was available only to the author of this thesis and the faculty advisor.

Data collection

All data collection was performed by the author during a three week period in August-September 2005. Charts were reviewed of all adult ED visits from the eighteenth of each month from April through August of 2005. Each chart was initially screened to exclude all patients with major trauma (defined as either a 'full' or 'modified' trauma in which the trauma surgery service attends to the patient in the ED), pregnant women, and patients younger than 18 years old. All other patients were eligible for inclusion and subsequently were screened for any single charted elevated blood pressure measurement. Patients were defined as having an elevated BP measurement with any single measurement of systolic blood pressure (SBP) ≥ 140 or diastolic blood pressure (DBP) ≥ 90 based upon the criteria of the Joint National Commission on Hypertension-VII (21). Patients were further classified as being "Stage 2" for SBP ≥ 160 or DBP ≥ 100 and "Stage 1" for blood pressure ranges of $160 > SBP \geq 140$ or $100 > DBP \geq 90$ corresponding to the JNC-VII categories. For each included patient, the MRUN as well

as classification (none, stage 1, or stage 2) were recorded on a custom data collection instrument.

For every patient with elevated blood pressure, the complete chart was reviewed and the following information was collected on a separate custom data collection form: age, sex, location (main adult ED vs. urgent care minor complaint area), history of hypertension, use of antihypertensive medications, disposition, all BP measurements (triage note, nursing chart, resident chart, and attending chart), chief complaint, presence of any charted resident or attending plan pertaining to the patient's elevated BP, and presence of blood pressure-specific discharge instructions. Of note, the documentation of the patient's race is not typically a part of the Yale-New Haven Hospital ED chart, is more difficult to obtain, and is anecdotally noted as being frequently inaccurate when recorded by registrar personnel. As a result, race was not recorded for the study subjects.

Data was coded and entered into a Microsoft Excel spreadsheet. The definitions for specific data coding are as follows:

1. Patients were defined as having a history of hypertension if the words 'elevated BP,' 'HTN,' and 'hypertension' were written on the triage history or the resident history or circled on the computerized resident chart.
2. Patients were defined as taking antihypertensive medication based upon notation of antihypertensive medication use on the triage note or the resident chart. It was decided that documentation of antihypertensive use would be a more accurate representative of a previous diagnosis of hypertension because many triage nursing notes had 'HTN' listed as past medical history if a patient

was found to have an elevated BP measurement at triage. It was often unclear if these patients actually had a history of hypertension.

3. Patients were classified as having no resident or attending plan pertinent to elevated blood pressure if the blood pressure was not specifically listed in the differential diagnosis or noted in the space reserved for the attending or resident plan.
4. Discharge instructions at the Yale ED are computer-generated based upon physician input of diagnoses and prescriptions, and they leave space for user comments to be included. A specific set of discharge instructions for hypertension exists that enables the physician to input a patient's BP measurement. Patients were classified as having no documented discharge instructions if these instructions were not included or if there was no mention of blood pressure in the physician comments section of the discharge instructions.

Coded data was then transferred into SPSS (SPSS Inc., Chicago, IL) for analysis.

RESULTS

Notable percentages are reported as actual percent \pm error representative of the 95% confidence interval, assuming a very large patient population from which the sample size was taken (62,500 adult ED visits per year). All calculations of the mean include the standard error of measurement.

1028 patient charts were reviewed, which represents each adult ED visit from the eighteenth day of April through August, 2005. Of 1028 charts reviewed, 61 patients (5.9 \pm 1.4%) met the exclusion criteria: 27 patients (2.6%) were classified as either full or modified trauma, 28 patients (2.7%) had no noted blood pressure measurements, 2 patients (0.2%) had elevated blood pressure but were pregnant, and 4 patients (0.4%) were younger than 18 years old. 967 patients had further chart review to screen for elevated blood pressure. This inclusion/exclusion data is summarized in figure 1:

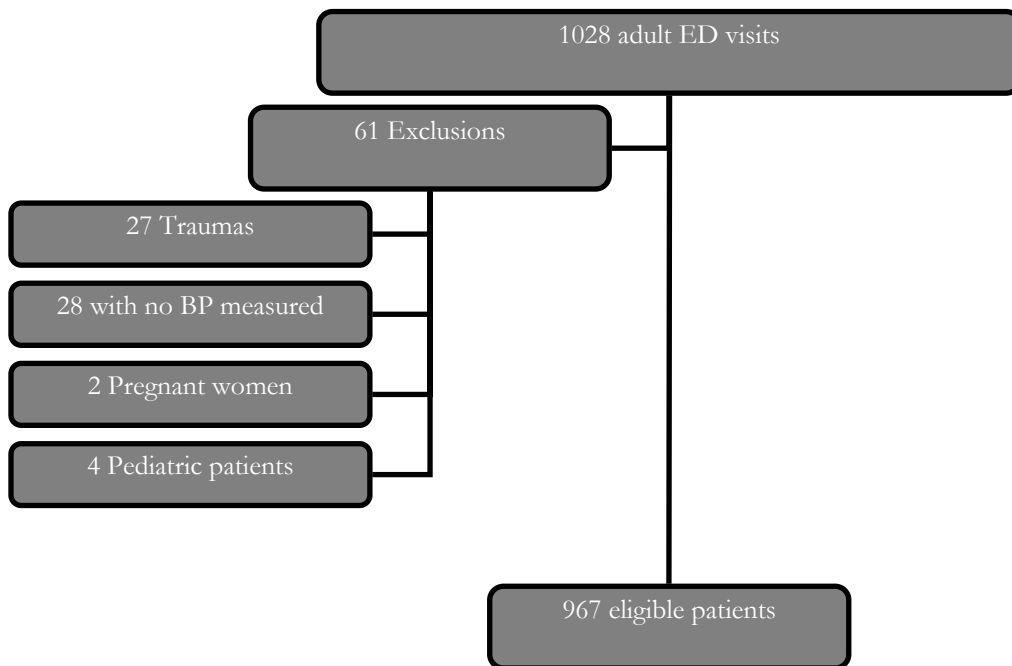


Figure 1: Inclusion and exclusion data

Of 967 patients included and therefore screened for elevated blood pressure, 339 patients (35.1 \pm 3.0%) had at least one measurement of SBP \geq 140 or DBP \geq 90. 130 of 967 patients (13.4 \pm 2.1%) had major elevation (JNC-VII Stage 2) with at least one

measurement of SBP ≥ 160 or DBP ≥ 100 . Therefore, 339 patients were determined to have elevated BP and had further review of the chart as previously described.

The 339 patients with elevated blood pressure had the following characteristics:

- Mean age of 52.3 ± 1.07 years
- 12.7% ($\pm 3.5\%$) were seen in the urgent care minor complaint area
- 45.4% ($\pm 5.3\%$) were male
- Initial systolic blood pressure of 150.6 ± 1.11 mm Hg
- Initial diastolic blood pressure of 84.0 ± 0.76 mm Hg
- Maximum systolic blood pressure of 157.2 ± 1.06 mm Hg
- Maximum diastolic blood pressure of 88.2 ± 0.66 mm Hg

Of the 339 patients with elevated blood pressure, 125 patients ($36.9 \pm 5.1\%$) had documented antihypertensive medication use. 139 patients of 339 patients with elevated BP were not discharged from the ED:

- 99 patients were admitted ($29.2 \pm 4.8\%$)
- 22 patients ($6.5 \pm 2.6\%$) were taken to the Crisis Intervention Unit (CIU), a psychiatric emergency facility in the ED. Discharge is done from the CIU by staff psychiatrists.
- 17 patients ($5.0 \pm 2.3\%$) eloped from the ED prior to receiving discharge instructions.
- 1 patient (0.3%) expired in the ED

Consequently, 137 patients were considered to be ambulatory adult ED patients with no documented antihypertensive use who therefore needed referral for BP recheck. This represents $40.4 \pm 5.2\%$ of 339 patients who were found to have elevated blood

pressure, and $14.2 \pm 2.2\%$ of 967 total included patients. 39 patients had a maximum SBP ≥ 160 or DBP ≥ 100 and were considered to need referral for recheck, which represents $4.0 \pm 1.2\%$ of 967 total included patients. This data is summarized in figure 2:

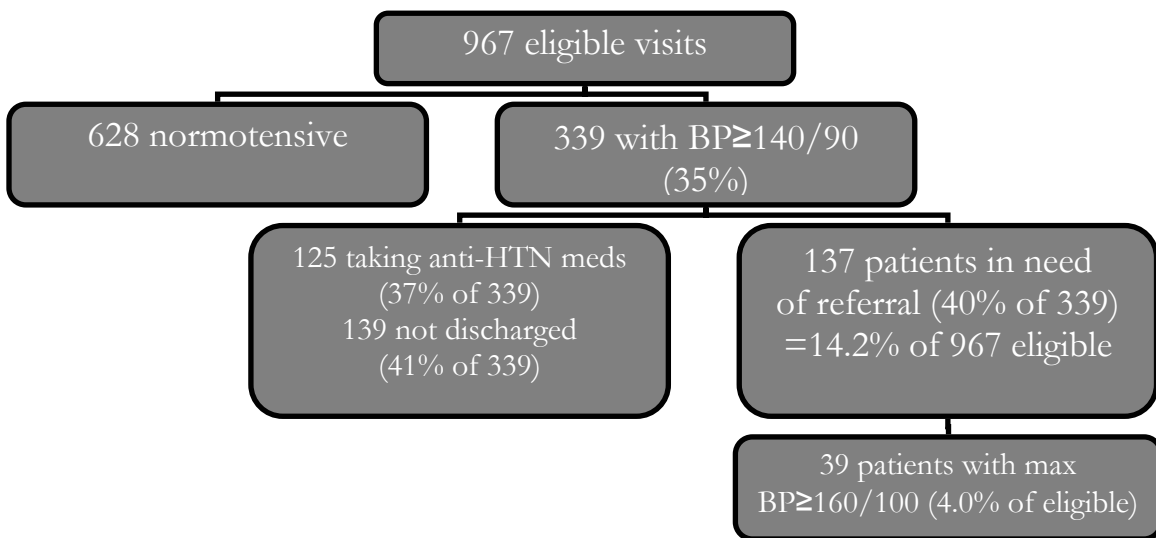


Figure 2: Data on elevated BP and the need for referral

The 137 patients considered to need referral for BP recheck had the following characteristics:

- Mean age of 42.8 ± 1.45 years
- $24.8\% (\pm 7.3\%)$ were seen in the urgent care minor complaint area
- $53.3\% (\pm 8.4\%)$ were male
- Initial systolic blood pressure of 146.3 ± 1.54 mm Hg

- Initial diastolic blood pressure of 85.8 ± 1.04 mm Hg
- Maximum systolic blood pressure of 152.1 ± 1.26 mm Hg
- Maximum diastolic blood pressure of 89.7 ± 0.86 mm Hg

Of 137 patients in need of referral for BP recheck, 3 patients had a plan related to elevated BP in either the resident or attending chart (2.2%, 95% CI = 0 to 4.7%). Two patients had appropriate discharge instructions given as described above (1.5%, 95% CI = 0 to 3.5%). A linear regression was performed to evaluate the potentially dependent variable of the need for referral for BP recheck (i.e. of inclusion as one of these 137 patients) and the effect of the independent variables age, sex, maximum SBP, maximum DBP, and location in urgent care. The linear regression analysis yielded the following p values for the independent variables: age ($p < 0.001$), sex ($p = 0.31$), maximum SBP ($p = 0.13$), maximum DBP ($p = 0.76$), and location in urgent care ($p < 0.001$). The Pearson correlation coefficient between maximum SBP and initial SBP is 0.796, $p < 0.001$.

Finally, of the 137 patients considered to need referral for recheck, 117 patients $85.4 \pm 5.9\%$ had an elevated initial blood pressure measurement.

DISCUSSION

The hypothesis of this thesis is that ED patients with elevated BP who have no history of HTN and who are subsequently discharged are neither frequently identified by physicians nor adequately referred for BP recheck. Six specific aims were stated above that were investigated with the intent of evaluating the accuracy of this hypothesis.

1. Calculate the prevalence of hypertension in adult ED patients.

The prevalence of hypertension in adult ED patients was found to be 35.1%, or 339 of 967 patients. This is consistent with the range established in numerous published reports that essentially conclude that approximately 1 of 3 adult ED patients has an elevated blood pressure in the ED. It is notable that this study found that 13.4% of ED visits are associated with a stage 2 elevation of SBP ≥ 160 or DBP ≥ 100 . This is approximately 1 in 7.5 adult ED patients. Despite increasing focus both in the ED and in the community at large, elevated blood pressure not only seems to be a major issue but also has not decreased in prevalence from estimates over the last several years.

2. Calculate the percentage of ambulatory ED patients found to have an elevated blood pressure measurement but no prior diagnosis of hypertension, i.e. those patients in need of referral for blood pressure recheck.

This study found that 137 of 967 adult ED patients evaluated were in need of referral for blood pressure recheck, or 14.2% of evaluated visits. Therefore, approximately 1 in every 7 adult ED patients is in need of referral for BP recheck for the possible diagnosis of new hypertension. If you consider a daily patient census at the Yale ED of 200 patients, this means that 28 patients daily should be referred for BP recheck! Considering an annual census of 62,500 patients, this means that almost 9000 patients per year should be referred. Furthermore, it was found that 39 of 967 patients, or 4.0%, had a stage 2 maximum BP elevation and need referral for recheck. This means that approximately 1 in 25 adult ED patients, or 8 patients per day at the Yale ED, are discharged and need of referral for recheck with JNC-VII stage 2 BP elevation. It can be

concluded that a large number of patients are seen every day at the Yale ED that are in need of follow-up for an elevated BP measurement.

3. *Evaluate the demographics of ED patients in need of referral for BP recheck, and examine whether any particular demographic group is more likely to need referral for recheck.*

The study was able to partially examine whether age, sex, and location in urgent care had any relation to the need for referral for BP recheck in *only* those patients with elevated BP. Because information on age, sex, and location was not collected for all screened patients (n=967), no statement can be made about whether these variables are useful in identifying patients in need of recheck from the population of all adult ED visits. As was noted in the results section of this thesis, only age (as a continuous variable) and location in urgent care (as a dichotomous variable) were found to have a statistically significant impact in a linear regression analysis. This analysis seems to demonstrate that an ED patient with elevated BP is more likely to need referral for recheck if he is young or if he is located in urgent care. The impact of youth on need for referral is quite intuitive, as younger patients are more likely to have been undiagnosed and less likely to routinely seek healthcare. However, the impact of location in urgent care could potentially be a useful observation. Of 137 patients in need of referral for recheck, 34 (24.8%) were seen in urgent care. Comparatively, 43 of 339 total patients (12.7%) with elevated BP were seen in urgent care, and thus 34 of 43 patients with elevated blood pressure in urgent care were in need of referral for recheck (79.1±12.5%). Again, a confounding factor could be that urgent care patients are simply less likely to be admitted. However, a substantial percentage of urgent care patients are in need of

referral for recheck. The potential impact of this observation on future studies will be discussed later.

4. *Examine the frequency with which patients in need of referral for BP recheck are found to have a charted physician plan for evaluation of the elevated BP measurement.*

Of 137 patients in need of referral for BP recheck, only 3 patients (2.2%) had a documented plan. In making a statistical conclusion concerning whether the documentation of a physician plan occurs with appropriate frequency one must consider what an appropriate frequency actually is. It could be argued that the appropriate frequency is actually 100%, in which case the result is clearly statistically significant. However, a simply subjective analysis of this result seems sufficient to make the claim that the sampled physicians are not adequately charting their patients' elevated blood pressure and developing or documenting a plan for BP recheck.

5. *Examine the frequency with which patients in need of referral for BP recheck are presented with blood pressure-specific discharge instructions.*

Of 137 patients in need of referral for BP recheck, only 2 patients (1.5%) received appropriate computerized discharge instructions. Similarly to the consideration of physician plan above, the claim can be made that the sampled patients are not receiving appropriate discharge documentation of the need to follow-up for BP recheck. It was anecdotally noted that the two patients who received appropriate discharge instructions were brought to the ED specifically due to an elevated blood pressure measurement elsewhere.

The initial hypothesis that ED patients with elevated BP who have no history of HTN and who are subsequently discharged are neither frequently identified by physicians nor adequately referred for BP recheck can consequently be confirmed by the above data. In addition, the study demonstrates that this is a very common occurrence, seen in approximately 1 of every 7 adult ED patients. This conclusion clearly supports the need to explore the final aim of this study:

6. *Utilize the data to elucidate possible means whereby the identification and referral process of patients in need of referral for BP recheck could be improved as well as to suggest a protocol that could be further studied.*

This aim is essentially the heart of the study. Hypertension is a major cause of morbidity, and a delay in diagnosis of hypertension can significantly impact this morbidity. Previous studies have demonstrated how the ED can be utilized as a valuable screening tool, not only for the population at large but in particular for a population who is less likely to have insurance, less likely to come to medical attention, and more likely to be hypertensive. Consequently, every opportunity to identify and follow these patients should be taken. However, this study demonstrates that this opportunity is frequently missed in the emergency department.

One strategy for improvement is to increase awareness of the opportunity to identify these patients and refer them for BP recheck. During any given ED visit, most patients are seen by some combination of attending, resident, physician assistant, and multiple nurses. Any strategy to improve awareness of this problem could result in improved identification and referral patterns. Such a strategy might involve the use of efficient educational measures focused upon those healthcare professionals who are most

likely to encounter these patients. The adult ED at Yale hosts a sizable rotating cast of attendings, emergency medicine residents, off-service residents, medical students, and physician assistants. In contrast, the urgent care area is staffed by a rotating group of 8-12 physician assistants. The study analysis led to the conclusion that urgent care could be a relatively high yield location to identify and refer patients in need of BP recheck, which suggests that educating the staff of urgent care could be a very efficient and fairly simple means of improvement.

Another possible strategy is the development of specific ED protocols for the identification and referral of patients in need of referral for BP recheck. While this would certainly involve far more than educating a small number of ED staff, it could potentially produce a drastic improvement in the identification and referral patterns documented in this study. The study data demonstrated that 85.4% of all patients needing referral for BP recheck would have been identified based upon their initial blood pressure measurement. This suggests that a triage-based protocol for identifying and referring these patients could drastically improve patients. While the study estimates that 15.6% of patients in need of referral for recheck would be missed by a triage-based protocol, this seems allowable as those patients missed at triage could be subsequently identified by the ED physicians (particularly if they had been educated to identify these patients).

In summary, this study demonstrates that numerous opportunities are being missed to identify and refer patients in the ED who may be subsequently diagnosed with hypertension. Because numerous staff members with different responsibilities see each patient who enters the ED, there are correspondingly numerous means wherein improvement may be sought. However, the responsibility remains with a emergency

physicians to recognize an elevated blood pressure measurement and refer that patient for BP recheck, and this thesis demonstrates that improvement is needed in this area.

Limitations

A major limitation of this study is its inability to evaluate those instances where physicians simply verbally informed patients of the need for BP follow-up. However, particularly in today's medical-legal environment, it could be argued that if something is not charted then it did not truly occur. While a physician may have verbally mentioned elevated blood pressure to a patient, this interaction must be commented on in the ED chart. Furthermore, while a physician may tell a patient to have a BP recheck, a failure to provide the patient with documentation on the discharge summary would be a major barrier to the patient actually successfully obtaining that follow-up. Additionally, a record of that elevated blood pressure would be of diagnostic importance to a primary care physician responsible for diagnosing hypertension. A study design that involved surveying patients after the ED visit could have taken verbal information into account, but it also would have consumed considerably more time and expense. It is questionable whether this additional time and expense would add very much to this thesis, for an observation that physicians are mentioning elevated blood pressure would only reinforce the conclusion that documentation needs to be improved. Such a study might best be combined with a study evaluating the effectiveness of an intervention to improve identification and referral of patients with elevated BP.

Another limitation of this study is the single hospital design. Emergency departments nationwide use a tremendous variety of systems to organize charting and

discharge instructions. While Yale New-Haven ED sees a comparatively wide variety of patients for an urban academic emergency department, it is difficult to make any statements regarding community hospitals or county medical centers. Other hospitals with electronic vital sign entry may easily implement an automated referral protocol, and medical centers with faculty who have explored this topic would be likely to have much better identification and referral rates for patients with elevated BP. Consequently, a large multicenter study with a variety of different ED demographics could have been more generalizable. However, this study highlights that elevated blood pressure measurements are being overlooked by well-trained physicians at an academic medical center, and such observations still suggest the importance of ensuring that every opportunity is taken to identify patients with elevated blood pressure and refer for recheck.

Finally, the race of patients should have been examined in a retrospective review that included demographic data collection. However, this was not possible at Yale-New Haven Hospital. Because patients are not asked to self-identify race, the ED registration personnel is responsible for recording race solely based on observation. It consequently could be highly inaccurate and is often not recorded at all.

Future Studies

The two major aims of this thesis are to emphasize that improvement is necessary in the way physicians identify and refer patients in need of BP recheck and to suggest means whereby such improvement may occur. However, the big picture is that patients with elevated blood pressure in the emergency department need more than documentation

of the need for recheck. These patients need to actually obtain the repeat blood pressure measurement and, if the BP remains elevated, they need to have good follow-up for the diagnosis and management of hypertension. The ultimate goal of any study in this area is to develop a system in the ED wherein all patients in need of BP recheck obtain successful documentation, referral, and follow-up.

Achieving this goal is clearly difficult, but the above discussion highlights that improvement could be obtained both by educating physicians in the ED and by establishing protocols that more effectively identify and refer these patients. A seemingly useful product of the data analysis is that 85% of all patients in need of BP recheck would have been identified at triage. This would suggest that a triage-based protocol might be a useful way to identify and refer a large number of people. For example, every patient with an elevated BP at triage would receive immediate information regarding the elevated BP measurement, the importance of obtaining a recheck, and how to obtain a recheck. Such an intervention could be studied prospectively by surveying patients within several weeks of the ED visit to determine if they were adequately informed of the elevated BP and whether they had successfully received a follow-up measurement and appropriate treatment. This would likely lead to a drastic improvement in the number of patients who receive appropriate documentation and referral instructions from the ED, and it would also be very easy and inexpensive to implement. While the evaluation of patient documentation would likely be confounded by the impact of physician awareness of the protocol over time, the endpoint of actually obtaining follow-up could be accurately assessed.

Another strategy is to not only inform and educate the patient about the need for BP recheck but to actually arrange for the recheck to occur. A nonscientific survey (due to incomplete documentation) of the 137 patients in need of referral for recheck demonstrated that 18 patients (13%) were recorded as receiving their primary care at the Hill Health Center, the major free health clinic in downtown New Haven. Many more of the 137 patients would likely be referred to Hill Health, and another major portion receives care at the Yale Primary Care Center. A prospective evaluation of an intervention that includes making either contact with the clinic about an elevated BP or an actual appointment for BP recheck would be a useful addition to the strategy of improving referral and patient education. An example of such an intervention is the automatic inclusion of documentation of elevated BP in a patient's chart. Hill Health patients frequently visit the clinic for both medical and non-medical reasons. A simple flag in the front of a patient's chart could inform the physician of the ED blood pressure measurement when that patient next comes to the clinic.

Finally, the physicians, nurses, physician assistants, and medical students who staff the ED must become more aware of the need to identify these patients and properly refer them for BP recheck. Any educational program would likely be beneficial, particularly one as noted above that targets the staff of urgent care. Such a strategy takes advantage of a small number of staff that could easily be informed of the need for referral, and urgent care hosts a population undistracted by major illness that may be more likely to obtain follow-up. Educational strategies meant to target attendings and residents would be more difficult to develop and examine, in part due to the large number of each and the frequent turnover of off-service residents. Developing a protocol to test

the impact of education would be difficult, as any awareness of this thesis and future studies could confound the data. However, any protocol to test an intervention could itself serve as a useful educational tool for physicians. Ideally, increased physician awareness of the need for identification and referral combined with well-developed means of ensuring that patients obtain follow-up could significantly impact the number of patients who are successfully screened for hypertension in the Emergency Department.

A related area for future study involves characterizing those patients who carry a diagnosis of hypertension and are taking antihypertensive medication but who have a major BP elevation in the emergency department. While this thesis addressed patients with no prior diagnosis of hypertension, it would be interesting to similarly examine the identification and referral of those patients who have insufficient control of previously diagnosed hypertension. Protocols similar to those intended to improve identification and referral for patients with no prior diagnosis of hypertension might also be used to improve the notification of patients of the need for better BP control. Improving blood pressure control is of great importance in minimizing morbidity from hypertension and is complementary to the goal of improving identification of patients in need of diagnosis and initiation of therapy.

Summary

One in every 7 adult ED patients has an elevated BP, no history of hypertension, and is subsequently discharged from the ED. These patients should be referred for BP recheck, but they are neither frequently identified by physicians nor adequately referred for follow-up measurement. Improvement is necessary and could involve both the

education of ED staff and the development of protocols that effectively enable patients to obtain follow-up for recheck. Approximately 85% of patients in need of recheck would have been identified at triage, and a triage based protocol for identification and referral could be a useful means of improvement.

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