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ARTICLE

# Referrals to, and characteristics of patients attending a specialist hypertension clinic

Cormac Kennedy[1,2] · Richard Farnan[1] · John Stinson[2,3] · Mary Hall[2] · Linda Hemeryck[2] · Patricia O'Connor[1,2] · Martina Hennessy[1,2] · Michael Barry[1,2]

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## Abstract

The management of hypertension is suboptimal in Ireland and internationally. The role of a specialist hypertension clinic is not always defined but an analysis of the reasons for referral are likely informative. Also, a description of the clinical characteristics of patients with hypertension will inform requirements for comprehensive hypertension management in the community and secondary care. Patients were recruited at consecutive hypertension clinics at St James Hospital, Dublin from July to September 2019. Reasons for referral, clinical characteristics of patients, their investigations and treatment were analyzed. 236 patients were included in the study. The majority of patients, 83%, were obese or overweight. A family history of hypertension was a frequent finding with 70.8% of patients reporting same. 26.7% of patients were under the age of 40. 78% of referrals were from primary care and the most referrals were to investigate secondary causes of hypertension or because the patient was ≤40 years of age. Calcium channel blockers were the treatment most frequently prescribed (51.7%). Clinic blood pressure for the cohort was 137/81 mmHg and this was replicated by their ambulatory BP. This insight into the contemporary management of hypertension highlights the frequency of obesity and a positive family history in those with hypertension. Most referrals were consistent with international guidance though deviations were evident. Findings suggest a national program for hypertension with greater focus on public health interventions and better resourcing of primary care is required.

## Introduction

The management of hypertension in Ireland is suboptimal and international comparisons are unfavorable. In a report of recent trends in hypertension awareness, treatment and control, Ireland was worst in all categories among the 12 countries included [1]. The hypertension prevalence in adults over 50 years of age reported in a Irish population based prospective cohort study was 63.7% (The Irish Longitudinal Study on Aging – TILDA) [2]. Another study estimated a hypertension prevalence of 60% in Ireland in those aged 45 years and older [3]. Evidence from TILDA suggested only 54.5% of those with hypertension were aware of the diagnosis. This compared to a known diagnosis of hypertension in 64% of hypertensive individuals in England and 86% in the USA [4]. Improvements in the detection of hypertension are necessary, for example, a national hypertension screening program as well as primary care and community focused strategies.

While the adequate detection of hypertension remains a significant challenge, so too does the management of hypertensive patients. However, the importance of high-quality hypertension treatment cannot be overstated and small changes in blood pressure (BP) can result in large improvements in outcomes at a population level. For example, analysis of the Framingham Heart Study reported that a 2 mmHg reduction in mean diastolic BP would produce a 17% reduction in overall hypertension prevalence among the 35–64 year old age cohort [5]. This BP reduction would then result in a 14% reduction in stroke and transient ischemic attacks (TIAs) as well as a 6% decrease in the risk of coronary heart disease.

✉ Cormac Kennedy
cormackennedy1@gmail.com

[1] Department of Pharmacology and Therapeutics, Trinity College, Dublin 8, Ireland

[2] St James Hospital, Dublin 8, Ireland

[3] LEO Pharma, Dublin, Ireland

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Evidence-based hypertension guidelines are available for practitioners, however, in reality practice can vary from these [6, 7]. A global survey of primary care physicians suggested a gap existed between clinical practice and guideline directed hypertension management [8]. The majority of survey respondents reporting hypertension management as difficult due to unachievable BP goals for some patients. This in turn was due to adverse effects of anti-hypertensives medications, too many titration steps and patient complexity. Clinical inertia is reported as a significant issue in blood pressure control along with patient factors such as poor medication adherence [9, 10]. A key component in addressing the issue of suboptimal hypertension treatment is the access to a specialist hypertension clinic as a vital resource to augment management of hypertension in primary care.

Reviewing patients referred to, and attending, a specialist hypertension clinic will provide insights into the contemporary management of hypertension and highlight issues in primary and secondary care. The findings may inform future national guidelines and potential novel pathways of care.

The aims of this study include:

- determining the clinical characteristics of patients attending a hypertension clinic,
- elucidating the reasons for referral to this specialist service, and
- describing the current treatment of hypertensive patients.

## Patients and methods

### Setting and study design

This study was initiated in July 2019 and involved patient recruitment at the Hypertension Clinic at St James's Hospital, Dublin 8, Ireland. The clinic has over 1300 attendances per annum. A pragmatic observational study design was used, integrating the study with the workflow of the clinic. Patient recruitment was prospective, while the data collected was both prospective; for all attendees with results pertaining to the study visit and for first time attendees followed up one year after the study visit, and retrospective; results from previous attendances for repeat attendees. Patient were included if they met the following criteria: adult (18 years or older), hypertension as the primary reason for attendance, consented to inclusion in the study.

### Consent process and pseudonymisation

Consent for inclusion in the study was requested from all patients attending the specialist hypertension clinic at St James's hospital whose primary issue was hypertension. The consent was requested by members of the clinical team at the time of the study visit. The patients were provided with a patient information leaflet and a study consent form. The only patient identifier recorded was their Medical Record Number (MRN). The dataset was pseudonymised to allow follow-up of the patients in line with the study protocol. Compliance with the European Union General Data Protection Regulations was reviewed by the hospital's data protection office. Ethical approval for this study was granted by Tallaght University Hospital Research Ethics Committee.

### Data collection and extraction

The main data points recorded in the study dataset are given in Table 1. Clinical, sociodemographic and referrals details were extracted from the patient's medical chart at the time of patient enrollment. Details were recorded for the current visit to the clinic as well as from the first attendance to the clinic. Diagnoses documented in the patients' charts were included in the analyses e.g. Type 2 Diabetes, Obstructive Sleep Apnoea (OSA), Hypercholesterolemia. A diagnosis of cardiovascular disease (CVD) was taken as a diagnosis affecting the cardiac or vasculature systems e.g. ischemic

**Table 1** Study data points.

| | |
|---|---|
| Demographics | Age, Gender, Area of origin, Height, Weight |
| Referral information | Referring institution, reason for referral |
| Comorbidities | Cardiovascular disease, hypercholesterolemia, type 2 diabetes mellitus, obstructive sleep apnoea, mental health illness |
| Lifestyle factors | Smoking status, excessive alcohol intake, illicit drug use |
| Cardiovascular medications | Generic name, dose, frequency |
| Blood pressure measurements | Clinic blood pressure, ambulatory blood pressure |
| Laboratory investigations | Lipid profile, renal profile, hemoglobin, thyroid function tests, corrected calcium, HbA1c, urinary metanephrines, aldosterone level, renin level. |
| Imaging | Echocardiogram, magnetic resonance angiogram renal arteries, magnetic resonance imaging of the adrenal glands. |

heart disease, coronary artery disease, peripheral vascular disease, stroke, transient ischemic attack, cardiac arrhythmias, valvular heart disease and congestive heart failure [11]. The presence of a family history of hypertension or CVD was determined from the consultation notes, as this question is a component of the patient's initial assessment. A mental illness diagnosis was considered to be one of the following: depression, generalized anxiety, bipolar affective disorder, schizophrenia. Clinic blood pressure was measured in line with current recommendations so that the patient was sitting with their back and arm supported and the appropriate cuff size was chosen from the range available at the clinic [12]. Measurement used a wall mounted mercury sphygmomanometer (checked and calibrated on a biennial basis). It was taken following five minutes of sitting, initially measured in both arms, and the average of three measurements was taken. Ambulatory blood pressure monitor (ABPM) measurements were taken every 30 min during daytime (07.00–22.00 h) and every hour at night (23.00–07.00 h) with a SpaceLabs MDL 90217A monitor (SpaceLabs Healthcare Inc, Hertford, UK). The software used for ABPM reports was SpaceLabs Sentinel 11 information management system. An ABPM was required to have at least 70% of the expected measurements reported to be considered a valid investigation [12]. If ABPM was not performed for the clinical review at the study visit, an ABPM report within the last year was accepted. A similar approach was used for other investigations. Patient weight was routinely recorded at every clinic visit unless the patient refused or could not be weighed e.g. wheelchair bound, frail. Patient height was measured at the first study visit. For diagnostic tests, a previous confirmatory result at any point in time was included in the dataset, for example, renal artery stenosis as reported by a Consultant Radiologist following a renal angiogram (the angiogram is requested based on findings of a magnetic resonance angiography). A diagnosis of moderate/severe chronic kidney disease was made if the patients estimated glomerular filtration rate (calculated using the Modification of Diet in Renal Disease formula) was <60 mL/min on two occasions three months apart. Blood tests for aldosterone and renin levels were taken in the morning with the patient in an erect position for at least fifteen minutes. Patients were advised not to salt restrict and interfering medications were held for four weeks prior to the test, if feasible. Further details of laboratory test ranges and procedures are available at the St James Hospital website [13].

### Data analysis

Data were coded and organized to enable analysis. Body mass index (BMI) was calculated from measured weight and height. The patients were then divided into normal, overweight and obese categories. Those with resistant hypertension were identified as being on three anti-hypertensive drugs, including at least one diuretic, and having a BP not less than 140/90 mmHg OR those on four or more anti-hypertensive drugs (adapted from European Society of Hypertension Guidelines) [12]. Clinic blood pressure was compared to recommended targets in the European Society of Hypertension and America Heart Association guidelines [12, 14]. Between group differences were analyzed for those attending the clinic for their first clinical review and those attending for their second or subsequent review. Statistical analysis included standard two tailed $t$ test for continuous variables and the Chi-squared test for differences in proportions. As standard, the minimum level of statistical significance was 5% ($p < 0.05$). Analyses were performed using Microsoft Excel and SPSS software version 25 (IBM Corp, Armonk, NY, USA).

## Results

### Characteristics of study participants

A total of 236 participants were enrolled in this study between July and September 2019. 19% of patients ($n = 44$) were attending for their first clinical review. The average age of participants was 52.9 years (range 18–85). Those attending the clinic for the first time were younger, mean 45.3 years, compared with those attending for a repeat visit, mean 54.6 years (difference 9.3 years, 95% confidence interval 4.4–14.2; $p < 0.001$). Approximately, a quarter of the cohort was either 65 years or older (27.5%) or under 40 years of age (26.7%). The sample had a female predominance (Table 2). 30.9% of patients had a personal history of cardiovascular disease, most frequently ischemic heart disease, and 42% had a diagnosis or were being treated for hypercholesterolemia. Left ventricular hypertrophy was detected in almost 10% of the cohort (27% of those with an echocardiogram).

The average BMI of the measured participants was 31.1 kg/m² ($n = 171$) with a range extending from 18.9 kg/m² to 56.0 kg/m². 36% of the cohort were obese (≥30 kg/m²), this was 49.7% of those with a BMI available, while one third of the cohort were overweight (25 to <30 kg/m²) and only 17% of the patients were of normal weight. The BMI was equivalent for those attending for the first time compared to those repeating attendance (31.0 kg/m² vs 31.1 kg/m²) and the proportion of obese patients was also comparable ($\chi 2 = 2.426$, $p = 0.622$). A condition frequently associated with both obesity and hypertension, obstructive sleep apnoea, was identified as a comorbidity in 6.4% of patients. 15.5% of patients had a diagnosis of moderate or severe chronic kidney disease, while only 2.2.% had a diagnosis of renal artery

**Table 2** Study patient characteristics including investigations ($n = 236$).

| Characteristic | % of total cohort | % of cohort tested | Test results (± SD) |
|---|---|---|---|
| Female | **55.5** | | |
| First Attendance | **18.6** | | |
| Elderly (>=65 years) | **27.5** | | |
| Young (<40 years) | **26.7** | | |
| Current smoker | **15.3** | | |
| Cardiovascular disease[ad] | **30.9** | | |
| Ischemic heart disease | 9.3 | 35.2 | |
| Chronic heart failure | 4.2 | | |
| Cerebrovascular disease | 4.7 | | |
| Peripheral vascular disease | 5.1 | | |
| Arrhythmias | 8.5 | | |
| Valvopathy | 1.7 | | |
| LVH on echocardiogram | **9.3** | | |
| Hypercholesterolemia[b] | **42.0** | | |
| On lipid lowering treatment | 33.5 | 87.7 | |
| Total cholesterol | | | 4.72 ± 0.98 mmol/L |
| LDL cholesterol | | | 2.63 ± 0.84 mmol/L |
| Type 2 diabetes[a] | **11.9** | | |
| HbA1c | | 76.7 | 39.3 ± 8.8 mmol/mol |
| Mental health illness[ae] | **17.4** | | |
| Obesity[c] | **36.0** | | |
| Body Mass Index | | 72.5 | 31.1 ± 6.7 kg/m$^2$ |
| Obstructive sleep apnoea[a] | **6.4** | | |
| CKD (moderate/severe)[c] | **15.5** | | |
| Renal artery stenosis[b] | **2.2** | | |
| MR renal angiogram | | 13.6 | |
| Thyroid disease[a] | **5.1** | | |
| TSH | | 79.7 | 2.18 ± 1.77 mU/L |
| Primary aldosteronism[b] | **1.1** | | |
| ARR | | 43.2 | |
| MR adrenal glands | | 10.2 | |
| Hyperparathyroidism[a] | **0.4** | 51.3 | |
| Corrected calcium | | | 2.36 ± 0.10 mmol/L |
| Phaeochromocytoma[b] | **0** | 13.1 | |
| Resistant hypertension[b] | **19.5** | | |
| Family history of hypertension | **70.8** | | |
| Family history of CVD | **49.6** | | |

*SD* standard deviation, *LVH* left ventricular hypertrophy, *ARR* aldosterone renin ration, *CKD* chronic kidney disease, *MR* magnetic resonance, *CVD* cardiovascular disease.

[a]Diagnosis from medical chart.

[b]Diagnosis from medical chart and/or investigations.

[c]Diagnosis from measurement/investigations.

[d]A patient may have multiple diagnoses.

[e]Includes diagnosis of depression, generalized anxiety, bipolar affective disorder, schizophrenia.

stenosis and 1.1% had primary aldosteronism identified. 19.5% of the cohort were being treated for resistant hypertension. Interestingly, 70.8% of the cohort had a family history of hypertension. The significant numbers with a family history of cardiovascular disease is also notable at 49.6%.

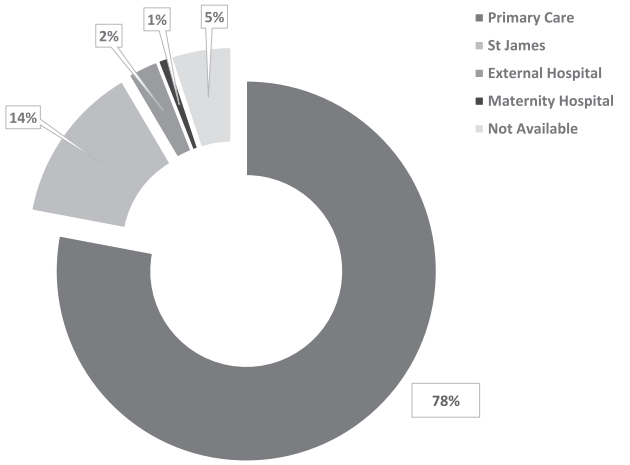


**Fig. 1 Source of referral to the hypertension clinic.** Primary Care refers to referrals from general practitioners, St James refers to the hospital in which the clinic is situated, External Hospital refers to all other adult hospitals except maternity hospitals, Maternity Hospitals referes to those hospitals providing mainly/wholly obstetric services.

## Referrals

Of the participants, 84.3% resided in Dublin area. Most referrals (78%) were received from primary care (Fig. 1). Relatively few referrals were from other hospitals, suggesting that hospitals manage their hypertensive patients in a local unit or devolve this to the primary care setting. While there are few dedicated hypertension clinics in operation in Ireland, hypertension is often managed by other specialties including cardiologists, endocrinologists, geriatricians and nephrologists.

In terms of the reasons for referral, one of the objectives of the hypertension clinic is to investigate patients for secondary cases of hypertension. In keeping with this, the most common reason for referral (29.2%), was to investigate the possibility of secondary hypertension (Fig. 2). A diagnosis of hypertension at a young age (less than 40 years) was the second most common reason for referral at 16.5%. The proportion of patients attending for their first review for these reasons was comparable to those repeating attendance (secondary hypertension, $\chi2 = 2.016$, $p = 0.155$; young patients ($\chi2 = 1.508$, $p = 0.219$). Other frequent referral reasons included a request for input into hypertension treatment optimization, resistant hypertension and concerning family history of hypertension with a personal diagnosis of hypertension. Referring physicians may consider a hypertensive patient with a high cardiovascular risk profile warrants specialist input and this was the referral

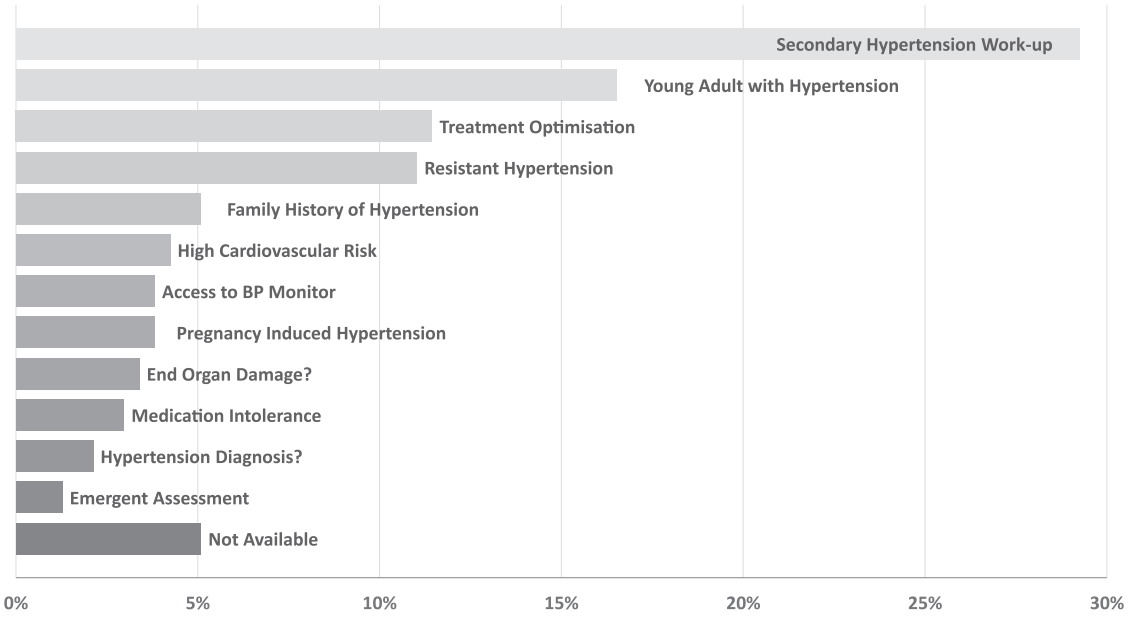


**Fig. 2** Reason for referral to the hypertension clinic at St James Hospital, Dublin.

reason for a small number of patients (4.2%). Access to ABPMs was rarely an indication for referral in this study (3.8%). Those with pregnancy induced hypertension (PIH) may be monitored in the community/obstetric services, though a referral for specialist input may also be warranted, for example, those requiring ongoing treatment with multiple medications. Referrals querying a diagnosis of hypertension were small in number and possibly related to a lack of access to ABPMs for example.

## Anti-hypertensive treatment

Figure 3 illustrates the number of anti-hypertensives medicines prescribed for the study cohort. As the clinic aims to see more complex patients with hypertension for work-up and optimization of blood pressure, many patients are likely to undergo multiple changes to their treatment while attending the clinic. In keeping with this, those attending the clinic for their first review were on significantly less anti-hypertensive medications (difference 1 medication, 95% CI 0.6–1.4; $p < 0.001$). The majority of patients were treated with one or two agents at the time of the study (53%). More than a third, 33.9%, were prescribed three or more medications with a small percentage on six or more (0.8%) suggesting these patients had refractory hypertension [15]. Interestingly, thirty-one patients (13%) were not on any anti-hypertensive treatment. The mean age of these patients was 42 years, considerably younger than that for the study cohort, and 45% were attending for the first time. Of those not yet on anti-hypertensive treatment, most had a clinic blood pressure not at target – 77% of the non-treated

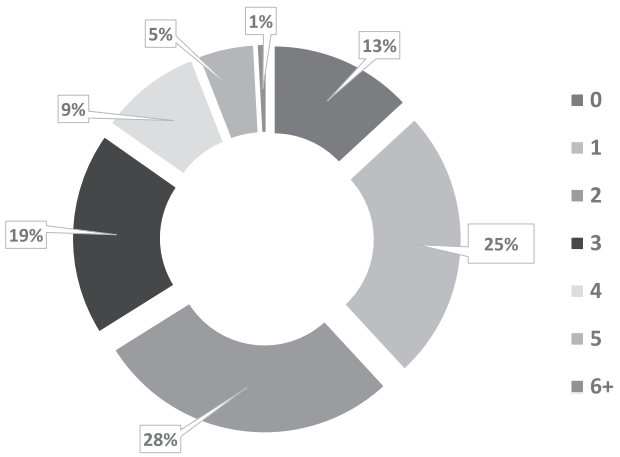


**Fig. 3** The number of anti-hypertensive medications patients attending the clinic were prescribed.

patients did not achieve current European Society of Hypertension guideline targets.

In terms of specific treatments detailed in Table 3, nearly three-quarters of patients were on either an angiotensin converting enzyme inhibitor (ACEI) or an angiotensin receptor blocker (ARB). Also, 81.4% of patients were on either an ACEI, ARB or a calcium channel blocker (CCB). A CCB with either an ACEI or ARB, a standard combination treatment, was the regimen for 42.8% of patients. Almost half of these patients were also on a diuretic so that 17.8% of the cohort were on at least this triple anti-hypertensive regimen. A considerable percentage of patients (24.2%) were on a beta-adrenergic receptor blocker therapy

**Table 3** Anti-hypertensive agents used for treatment of study patients.

| Medication class | Patients ($n$) | Percentage of cohort |
|---|---|---|
| Calcium channel blocker | 122 | 51.7 |
| Angiotensin converting enzyme inhibitor | 91 | 38.6 |
| Angiotensin receptor blocker | 85 | 36.0 |
| Thiazide diuretic | 45 | 19.1 |
| Thiazide-like diuretic | 10 | 4.2 |
| Loop diuretic | 17 | 7.2 |
| Mineralocorticoid receptor antagonist | 8 | 3.4 |
| Beta-adrenergic receptor blocker | 57 | 24.2 |
| Alpha-adrenergic receptor blocker | 42 | 17.8 |
| Nitrate | 5 | 2.1 |

**Table 4** Blood pressure (BP) measurements of the study cohort.

| Mean blood pressure ± standard deviation | Systolic BP | Diastolic BP |
|---|---|---|
| Clinic blood pressure ($n = 224$) | 137.2 ± 17.9 | 81.3 ± 10.8 |
| Clinic BP, 1st clinical review ($n = 44$) | 139.3 ± 17.7 | 85.0 ± 12.0 |
| Clinic BP, 2nd or subsequent review ($n = 180$) | 136.7 ± 18.0 | 80.4 ± 10.3 |
| Clinic BP, patients with an ambulatory BP ($n = 120$) | 137.3 ± 16.4 | 82.9 ± 10.5 |
| Average ambulatory BP ($n = 120$) | 138.6 ± 16.4 | 83.9 ± 10.7 |
| Day ambulatory BP ($n = 120$) | 141.7 ± 16.0 | 86.7 ± 11.3 |
| Night ambulatory BP ($n = 120$) | 130.0 ± 18.4 | 76.0 ± 11.6 |

(BB), with the majority of these patients having a background of CVD (55%) and most were on at least three medications (84%). Of these patients 55% were also classified as having resistant hypertension. Similarly, 53% on alpha-adrenergic blocker therapy were in the resistant hypertension group. Of those on loop diuretics, most had moderate to severe CKD (77%). Mineralocorticoid receptor antagonists were seldomly used (3.4%).

### Blood pressure measurements

The clinic blood pressure of the cohort on average was 137/81 mmHg (Table 4). Clinic blood pressure was higher for those attending for the first time at 139/85 mmHg. Interestingly, the clinic systolic BP (138.6 mmHg) was similar to the average measured with an ambulatory BP monitor (137.3 mmHg). In terms of BP control, 55% of patients had a clinic BP less than 140/90 mmHg. 45% for those at their first attendance were below this target compared to 58% for those repeating attendance ($\chi2 = 2.142$, $p = 0.143$). Using BP targets in the ESH guidelines, 28% of patients were at target which divided into 14% first attenders and 31% of repeat attenders ($\chi2 = 4.898$, $p = 0.027$). Applying the AHA guideline threshold of 130/80 mmHg, 17% of the cohort had controlled blood pressure in clinic. This was 10% for first attenders and 19% for those for repeat review ($\chi2 = 2.032$, $p = 0.154$). When a cut-off 130/80 mmHg is applied to the average 24-h ABPM readings ($n = 120$), only 17.5% of patients had a controlled BP.

## Discussion

This pragmatic observational study found that half of the patients attending our hypertension clinic with a recorded BMI were obese and that the majority of patients had a family history of hypertension. Most patients were referred either due to the possibility of secondary hypertension or due to their young age at diagnosis. As expected, most patients were referred from primary care, they lived in the hospital's catchment area and the most frequently prescribed anti-hypertensives were CCB's, ARB's and ACEI's. Those attending for the first time had higher blood pressure readings suggesting progressive treatment of their hypertension while attending the clinic.

The topic of obesity is highly relevant in the context of hypertension. The mean BMI for the study cohort was 31.1 kg/m² and almost half of those with a BMI available were classified as obese. A study using Framingham Heart study data reported that obesity is responsible for 78% and 65% of essential hypertension cases in men and women respectively [16]. Hypertension is associated with excessive weight and reductions in weight can reduce blood pressure measurements [17, 18]. Multiple potential factors involved in this association including lifestyle, diet and pathophysiological alterations. Elevated blood pressure in obesity has been related to extracellular fluid volume expansion and increased cardiac output which mediated activation of the renin-angiotensin-aldosterone and the sympathetic nervous systems [17].

The approach to combatting obesity is multi-faceted and begins with lifestyle intervention. A meta-analysis of randomized controlled trials assessing weight loss as an intervention to reduce BP showed that a reduction of 1.05/0.92 mmHg resulted from each kilogram of weight lost [18]. The blood pressure reducing effects of a low sodium diet such as DASH (Dietary Approaches to Stop Hypertension) is well described and its effectiveness is improved when combined with calorie restriction and weight loss [19, 20]. As well as weight loss, exercise appears to be moderately beneficial to reduce blood pressure in hypertensive patients, with an effect comparable to a typical anti-hypertensive drug [21].

Essential hypertension is due to a complex interplay of genetic and environmental factors. While rare monogenic

causes of hypertension exist, such as Liddle's syndrome, most commonly the genetic disturbances involved are polygenic in nature. Few gene loci have been identified to explain exact genetic basis of hypertension. Studies, such as those involving twins, suggest that heritability is between 30% and 50% [22, 23]. Data from the Framingham Heart Study has been used to show that a diagnosis of hypertension before the age of 55 years represents the strongest risk factor for high blood pressure in their offspring [24]. It is now also hypothesized that environmental influences can result in epigenetic changes which could be transmitted across generations [23]. That a significant majority of patients had a family history of hypertension in our study is informative for detection or screening interventions to identify new cases.

The objective of many healthcare systems is to treat patients in a primary care setting, particularly chronic diseases, to improve efficiency and effectiveness of healthcare provision. Hypertension was an archetypal condition as part of this movement away from the predominance of hospital-based care. Guidelines have been developed and modified to clarify the care of hypertensive patients in a community setting and when a referral to secondary care is required. The ESH guidelines from 2018 suggest that circumstances for referral will vary between healthcare organizations but the following should be considered as reasons to refer for a hospital based evaluation [12]:

- suspicion of secondary hypertension,
- a young adult (<40 years) with grade 2 or more severe hypertension,
- patients with treatment resistant hypertension,
- to assess for hypertension mediated organ damage (HMOD) if findings will influence management,
- sudden onset hypertension, and
- other clinical circumstances based on the opinion of the referring doctor.

Recent guidelines from the National Institute of Health and Care Excellence (NICE) outline similar reasons to refer to a specialist and include those with clinic BP 180/120 mmHg or more with signs of end organ damage [25].

This study demonstrated that most referrals come from primary care and when a concern for a secondary cause of hypertension exists. Given the multiple etiologies of secondary hypertension and the numerous investigations required to screen a patient, a validated multi-component screening tool would be useful to guide secondary hypertension referrals based on the patients age, family history, BMI, clinical signs and symptoms. Of note, a quarter of this cohort had a diagnosis suggestive of a secondary cause of their hypertension [12]. The number of patients with primary aldosteronism is lower than expected, likely because patients with a positive screening test are subsequently investigated by our endocrinology colleagues.

In keeping with ESH guidance 61% of the referral to our service were for potential secondary hypertension, hypertension in young adults (also likely a referral to review the patient for secondary causes), resistant hypertension, investigation of end organ damage and emergent assessment. Other referral reasons identified are less clearly aligned to guidance, for example, a family history of hypertension. A considerable number of cases were referred for treatment optimization. This term may suggest appropriate referrals for difficult to treat (resistant) hypertension or a requirement for improved support to manage these patients in primary care. Given that the control of hypertension in Ireland is substandard relative to other developed countries, national guidance on the management of hypertension and increased resources for primary care physicians, for example complex case conferences, should be considered [1].

Current guidance on hypertension management suggests that optimal initial medical treatment of hypertension involves the use of combination treatments at low doses [12]. Doing so aims to promptly attain blood pressure control while limiting adverse effects. Medical treatment may follow a trial of lifestyle interventions in certain patients and those with mild hypertension may be treated with a single agent. It therefore interesting to note that 38% of our cohort were on one anti-hypertensive drug or none at all. Of note, the study did not assess patients for medication intolerance, which may explain the lack of drug treatment in some cases. Also, patients often choose to address lifestyle issues in the first instance. Those attending for the first time were on significantly less anti-hypertensive treatment. These findings, along with reasons for referral discussed above, may suggest that in many cases hypertension treatment could be optimized in primary care setting if adequate resources, guidance and performance-based incentives were available.

Most patients were treated with ACEI, ARB or CCB as expected. This is in line with current guidance. A recent comparative effectiveness and safety study using real-world evidence suggested that thiazide diuretics as an initial treatment may improve cardiovascular outcomes as well as having an improved safety profile when compared to ACEI [26]. Chlorthalidone replaced hydrochlorothiazide in AHA 2017 guidance on hypertension and thiazide-like diuretics have been recommended above thiazide diuretics in recent NICE guidance [14, 25]. In this cohort thiazide diuretics were more frequently prescribed than thiazide-like diuretics. This may be due to a number of factors. Chlorthalidone is not available in Ireland except in a combination with atenolol, there is likely a legacy prescribing effect given the NICE guidance was released during the study period and

hydrochlorothiazide is most commonly available in convenient combination pills. Beta-adrenergic receptor blockers were frequently used in the study cohort, but mostly in patients who had a background of CVD and who were on at least three medications indicating their use in cases of resistant hypertension. Mineralocorticoid receptor antagonists (MRAs) are not frequently used despite evidence from the PATHWAY studies [27]. More recently, a review of the comparative effectiveness of fourth line anti-hypertensive agents has suggested MRAs as the agent of choice [28]. This evidence has been reflected in the most up-to-date European guidelines on hypertension which recommends MRAs as the optimal fourth line agent [12]. The relevance of this finding is unclear and will require further assessment of MRA prescribing at the clinic.

Blood pressure control at the clinic improved in those after their first attendance with clear evidence of progression with specialist input. The most appropriate indicator of blood pressure control at the clinic would be the blood pressure at discharge which was outside the scope of this work. It is interesting to note the variation in patients with controlled hypertension when ESH and AHA targets are applied. The influence of the SPRINT study on these targets has been subject to much debate and has implications for patient treatment, blood pressure measurement as well as population research findings based on new targets [29–32]. Of interest also is the similarity between the clinic blood pressure and that measured using ABPM on the same patients. The measurements were not necessarily taken at the same time-point, limiting the inferences from this information. Also, it should be noted that the diagnostic thresholds and treatment goals are lower for ABPM measurements [12]. Therefore, the clinic and ambulatory BP means should not be considered as comparable. It is notable that the percentage with controlled BP based on the based on their clinic BP was much greater than that based on the 24-h average on ABPM. The latter is line with the percentage controlled when the stringent AHA criteria for controlled BP are applied. The ready availability of ABPMs at a specialist clinic may be advantageous in capturing more patients with uncontrolled hypertension. This may lead to improved treatment intensification and aid adherence monitoring.

This study presents several considerations for those treating patients with hypertension. Firstly, while hypertension research is most often at a population level now, there are key insights available from collecting data on a selected hypertensive cohort. The review of reasons for referral is novel and other results provide a contemporary viewpoint which readers may find useful as a comparison for their practice. The results suggest greater implementation of international guidelines, the creation of national guidance and greater support for those in primary care to diagnose and adequately management hypertension are necessary. Unfortunately, these suggestions are not new but have not been acted upon in the past [33–35]. This, again, reflects the conventional wisdom that the appropriate application of current evidence may provide greater improvements in health outcomes than new technologies [36]. The role of quality improvement in healthcare cannot be understated. Secondly, the identification of obesity as a major comorbidity in this cohort requires much more attention. This finding highlights the lifestyle component of hypertension and other non-communicable conditions. A requirement for effective public health interventions is obvious to combat the obesity epidemic, both to improve health outcomes and to alleviate stresses on healthcare systems. Patients attending the clinic are provided verbal and written advice (leaflets) to optimize their lifestyle e.g. information on the DASH diet. Unfortunately, the clinic does not have access to a clinical nutrition service and referral pathways to publicly funded community-based weight loss programs have yet to be developed. Thirdly, the percentage of patients attending with a family history of hypertension should guide population screening efforts. Fourthly, the presence of a specialist hypertension clinic is essential to investigate and manage complex patients with hypertension. However, community-based initiatives to identify and optimize treatment of blood pressure are required. Hypertension could be screened for in an opportunistic manner in a familiar setting such as seen in the use of barbershops in the USA [37]. Treatment could be improved by greater use of pharmacy services such as free provision of ABPM's and prescribing rights for pharmacists to titrate anti-hypertensive medications [38, 39].

Strengths of this study include its prospective, pragmatic design thus providing a snapshot of contemporary hypertension treatment in a hospital outpatient setting. Limitations include its observational nature, thus omitting important information such as the patient's medication intolerance, the patient's medication adherence, as well as resulting in incomplete data points, e.g. BMI, ABPM outputs.

## Conclusion

This observational study of patients attending a specialist hypertension clinic provides insights into the contemporary management of hypertensive patients. It highlights the association of a hypertension diagnosis with obesity and a family history of hypertension. The results suggest issues of hypertension management persist in Ireland which is likely reflected internationally. These issues are amenable to public health, quality improvement and community-based initiatives given adequate resource provision. In the absence

of a national program, suboptimal identification and control of hypertension will continue as will the uncertainty regarding the role of specialist hypertension clinics.

## Summary

### What is known about this topic

- Hypertension in Ireland and elsewhere is managed in the absence of a national program resulting in deficits in care.
- International guidance on the management of hypertension outlines reasons for referral from primary care to specialist hypertension clinics.
- Significant gaps have been identified between the management of hypertension in the community and international guidance.

### What this study adds

- The majority of referrals to our specialist hypertension clinic were consistent with international guidance.
- Referrals for treatment optimization, ambulatory monitoring and confirmation of a hypertension diagnosis suggest improved resourcing of hypertension management may facilitate management in primary care and reduce referrals.
- Public health and community-based lifestyle interventions are required as a component of national hypertension programs given that >80% of patients were obese or overweight.

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## Compliance with ethical standards

**Conflict of interest** The authors declare no competing interests.

**Ethical approval** Ethical approval was granted by the Tallaght Hospital Research Ethics Committee.

**Informed consent** Informed consent was sought and provided by all study participants.

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