Chapter 10: Blood Pressure in Prevalent RRT Patients

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Summary

- Many centres still failed to collect blood pressure data in a format that could be sent to the UK Renal Registry (UKRR).
- In England, Northern Ireland and Wales, 44% of patients achieved the combined blood pressure standard pre-dialysis (<140/90 mmHg) (inter-unit range 17–65%) and 48% post-dialysis (<130/80) (inter-unit range 16–62%). On average 30% (17–48%) of PD patients and 25% (13–39%) of renal transplant recipients achieved the standard of <130/80.
- Over the last nine years there has been no significant change in systolic or diastolic blood pressure achievement. This suggests poorly achieving centres have failed to adopt a systematic approach to blood pressure control.
- Co-morbidity data is needed for each patient on the UKRR database to perform blood pressure survival analyses.

Introduction

National and international organisations recommend a target blood pressure <130/80 mmHg for patients with chronic kidney disease (CKD) to reduce cardiovascular risk and progression to renal failure. There is extensive evidence that shows a linear relationship between systolic blood pressure (SBP) or diastolic blood pressure (DBP) and cardiovascular death in the general population. A meta-analysis including over one million individuals in hypertension trials showed the benefit is evident down to 120/75 mmHg[1]. By contrast, the relationship between blood pressure and one year all cause mortality in incident haemodialysis (HD) patients is U-shaped, with both high and low blood pressure associated with increased risk of death[2,3]. The Irbesartan Diabetic Nephropathy Trial also showed an increase in all cause mortality for SBP below 120 mmHg[4]. Recent community based studies showed an increased risk of stroke for individuals with CKD stages 3 to 4 and SBP below 120 mmHg (hazard ratio 2.51) compared to individuals with CKD and SBP 120 to 129 mmHg[5]. These observations raise concern that low blood pressure may be harmful to some patients with renal failure. The crucial question is whether low blood pressure is of itself harmful even in fit individuals without established cardiac disease. A study of 16,959 incident HD patients went some way to address this. It showed a baseline SBP below 120 mmHg was associated with a higher risk of death initially but increased survival after three years[6]. Cardiac failure was the most likely explanation for the early deaths but again the study lacked co-morbidity data to prove causal association.

In renal transplant (Tx) recipients low blood pressure is associated with increased survival, as seen in the general population[7–10]. A recent landmark study of peritoneal dialysis (PD) patients in England and Wales explained this observation[11]. The authors used activation on the renal transplant waiting list in the first year on dialysis as a surrogate marker for low co-morbidity. They showed both high and low SBP was associated with an increased risk of death for the entire cohort. However, for patients activated on the renal transplant waiting list, low blood pressure (SBP and DBP) was associated with increased survival. Cardiovascular disease was the main reason patients were not listed for renal transplant in the UK. This study showed for the first time higher mortality is linked to cardiac disease rather than low blood pressure per se.

Many factors influence blood pressure in dialysis patients. The recently revised UK Renal Association blood pressure guidelines acknowledge the key role of sodium balance. They promote control of extracellular volume by

dietary salt restriction, ultrafiltration to dry weight and lower dialysate sodium for HD patients. A study of 52 prevalent HD patients showed reducing dialysate sodium from 141 to 138 mmol/L reduced SBP by 5–10 mmHg after 8 months[12]. The largest reduction occurred in patients with higher initial blood pressure. An audit of 469 prevalent HD patients dialysing in seven centres showed significantly lower pre- and post-SBP for patients on a low dialysate sodium (137–139 mmol/L) and restricted salt intake (5 g/day)[13]. Neither study reported an increased frequency of symptomatic intradialytic hypotension using low sodium dialysate. UK centres that adopt a strict salt balance approach consistently report higher achievement of the blood pressure standard. To date little attention has been paid to sodium restriction in hypertensive renal transplant recipients. A small study of 32 transplant recipients suggested this was an effective intervention. Patients were randomly assigned to sodium restriction (80–100 mmol/day) or normal diet in addition to their usual antihypertensive medication. After 3 months SBP fell from 146+/−21 to 116+/−11 mmHg and DBP from 89+/−8 to 72+/−10 mmHg in the salt restricted group[14].

Each year UKRR data shows the prevalence of hypertension varies in a predictable fashion according to the underlying renal disease. Hypertension is more common in patients with vascular diseases (diabetes, renovascular disease or hypertension) than in those with glomerulonephritis and is even less frequent in patients with tubular disorders. The same pattern was observed in the PRESDIAL study of 387 prevalent HD patients[15]. In this study the percentage of patients achieving the pre-HD standard with vascular, glomerular and tubular disorders were 19%, 39% and 48% respectively. Patients in the PRESDIAL study with the highest blood pressure readings were prescribed the largest number of different antihypertensive drugs. This was also the case for other HD cohorts where drug information was available. If the same is true of dialysis patients in the UK (UKRR does not collect drug data) then hypertension in these groups reflects a state of salt and water overload. Patients with diabetes and renovascular disease tend to be much sicker than other patients on dialysis, have more cardiac comorbidity and substantially higher mortality (5-year survival rate 18% for age group >65 years)[16,17]. Even young diabetics (18–54 years) have double the risk of death compared with non-diabetics despite adjusting for known comorbidities. Fluid overload may contribute to this poor prognosis as hospitalisation for emergency treatment is associated with a 5-year survival rate of only 20%[18]. Salt restriction and ultrafiltration to dry weight should improve blood pressure control in these two groups but non-conventional dialysis schedules may be required to achieve this safely. It is not clear whether this approach would definitely improve survival but certainly warrants further study.

Blood pressure standard

The UK Renal Association revised its Clinical Practice Guidelines in 2007 (www.renal.org/guidelines). The blood pressure guideline does not set a target blood pressure for HD patients either pre- or post-dialysis but is otherwise unchanged. Blood pressure standards from 2002 apply to data collected in 2006 so these have been used for the statistical analyses in this blood pressure audit:

Pre-haemodialysis blood pressure <140/90 mmHg.

Post-haemodialysis, peritoneal dialysis and renal transplant blood pressure <130/80 mmHg.

Methods

The UKRR extracted quarterly blood pressure data electronically from 58 centres in England, Northern Ireland and Wales. A single blood pressure reading was taken for each patient – the last blood pressure recorded in quarter 4. If this was not available the last reading from quarter 3 was taken. Patients with no blood pressure data for the last two quarters of 2006 were excluded. All patients with data were included in the statistical analysis. Centres with sparse data for a given treatment modality (data for less than 50% of patients or less than 20 patients) were omitted from the figures. Several analyses were performed each year and the methodology has been described in detail[19]. This report presents data for the prevalent cohort on RRT during 2006.

Results

Data returns

Blood pressure data were extracted from 58 centres in England, Northern Ireland and Wales (Table 10.1). Poor returns were obtained from 17 of 58 centres for pre-HD data, from 20 of 58 centres for post-HD data, from 31 of 55 centres for PD data and from 37 of 54 centres for transplant data. These centres need to ensure blood pressure data is entered on their IT systems for extraction by the UKRR.

The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

Distribution of blood pressure by modality

Figure 10.1 shows systolic, diastolic and pulse pressure distributions for HD, PD and transplant (post-HD data is shown). Median blood pressure for HD, PD and transplant is 129/69, 135/79 and 136/80 mmHg respectively. Median pulse pressure for each group was 59, 56 and 57 mmHg respectively. The HD population had the widest spread for blood pressure. Standard deviations (SBP/DBP) pre-HD, post-HD, PD and transplant were 25/15, 25/14, 23/13 and 19/11 respectively (compared with 18/10 for a hypertensive population). The UKRR does not collect drug data to assess whether the wider blood pressure distributions for dialysis

Table 10.1: Percentage of patients with complete returns of blood pressure values by modality

	% completed data					% completed data			
	Pre-HD	Post-HD	PD	Tx		Pre-HD	Post-HD	PD	Tx
Antrim	73	59	4	30	Leic	99	96	98	25
B Heart	93	93	0	1	Liv Ain	2	1	n/a	n/a
B QEH	64	0	0	0	Liv RI	13	2	35	78
Bangor	95	94	97	n/a	ManWst	0	0	0	0
Basldn	99	99	96	7	Middlbr	97	95	96	50
Belfast	93	92	29	17	Newc	0	0	0	0
Bradfd	1	0	100	89	Newry	99	98	0	2
Brightn	0	0	0	94	Norwch	96	96	0	1
Bristol	100	99	97	70	Nottm	99	98	100	90
Camb	61	61	0	1	Oxford	81	80	71	8
Cardff	19	0	3	95	Plymth	94	0	3	0
Carlis	95	94	0	0	Ports	0	99	0	0
Carsh	64	64	1	0	Prestn	0	0	0	0
Chelms	100	100	93	73	Redng	97	36	98	95
Chestr	2	0	n/a	n/a	Sheff	99	97	99	95
Clwyd	0	2	75	86	Shrew	100	98	33	16
Covnt	99	98	86	56	Stevng	99	99	0	0
Derby	99	99	96	7	Sthend	96	96	6	0
Derry	100	100	n/a	0	Sund	96	96	0	0
Dorset	98	98	100	4	Swanse	92	92	18	6
Dudley	80	80	96	78	Truro	98	97	45	46
Exeter	96	95	95	33	Tyrone	95	95	29	3
Glouc	97	0	0	0	Ulster	98	98	100	33
Hull	96	96	82	0	Wirral	53	0	52	n/a
Ipswi	97	97	85	93	Wolve	3	97	98	94
L Barts	1	0	2	0	Wrexm	0	0	0	0
L Guys	61	59	1	0	York	99	99	95	95
L Kings	0	0	0	0	**England**	**57**	**54**	**46**	**28**
L Rfree	0	0	0	0	**N Ireland**	**91**	**87**	**21**	**15**
L West	0	0	0	0	**Wales**	**42**	**33**	**19**	**80**
Leeds	96	95	97	70	**E, W & NI**	**58**	**54**	**43**	**31**

n/a not applicable

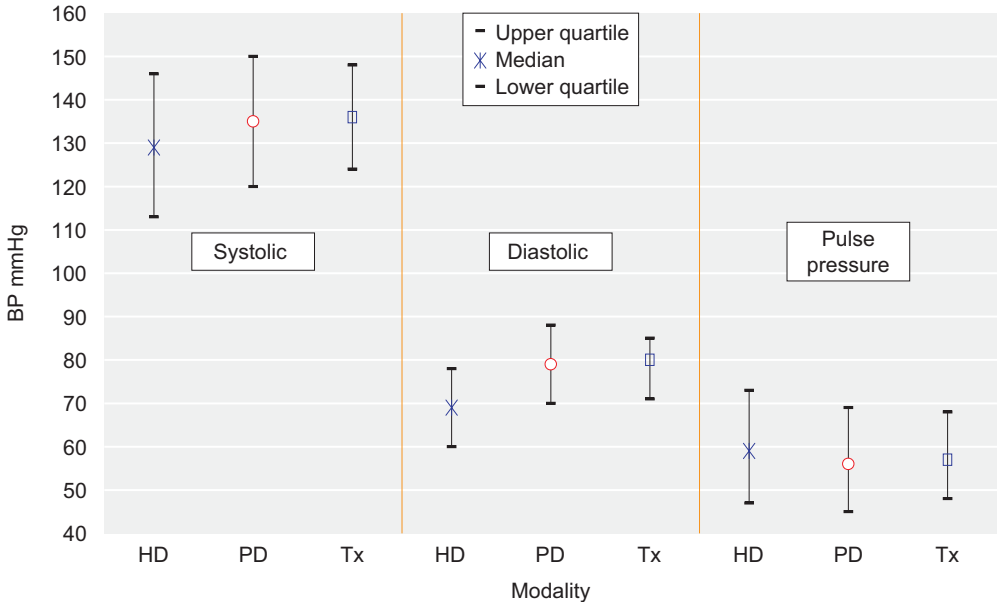

Figure 10.1: Summary of BP achievements

patients are caused by saline overload or inadequate drug therapy. The data is similar to last year which does suggest poorly achieving centres have not adopted a systematic approach to improve blood pressure control during 2006.

Achievement of combined systolic and diastolic standard

Figures 10.2 to 10.5 show a wide variation between centres achieving the combined blood pressure standard for each modality. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 44% (inter-unit range 17–65%) and post-dialysis averaged 48% (range 16–62%). Only 30% of PD patients achieved the standard (range 17–48%) and 25% of transplant patients (range 13–39%). Chi-squared testing indicated the variation between centres for achieving the combined standard was significant for HD and transplant ($p \leqslant 0.001$) but not for PD. The variation between nations was also significant ($p \leqslant 0.045$) except for pre-HD. The results showed hypertension control was inadequate across all treatment modalities but particularly for PD and transplant patients. Centres with consistently poor results need to review their protocols for hypertension control.

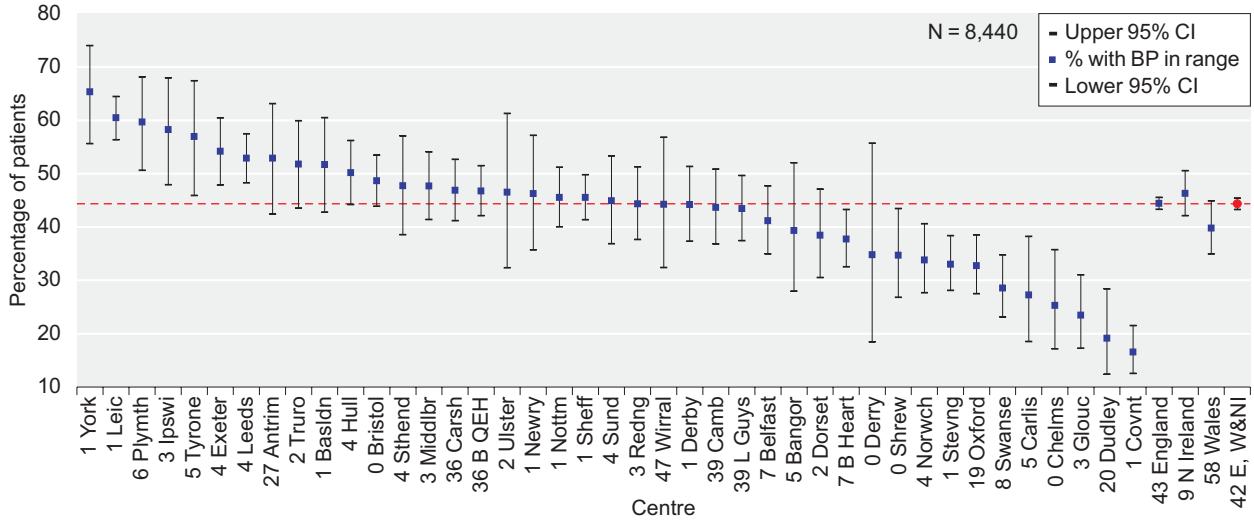

Figure 10.2: Percentage of patients with BP <140/90 mmHg: pre-HD

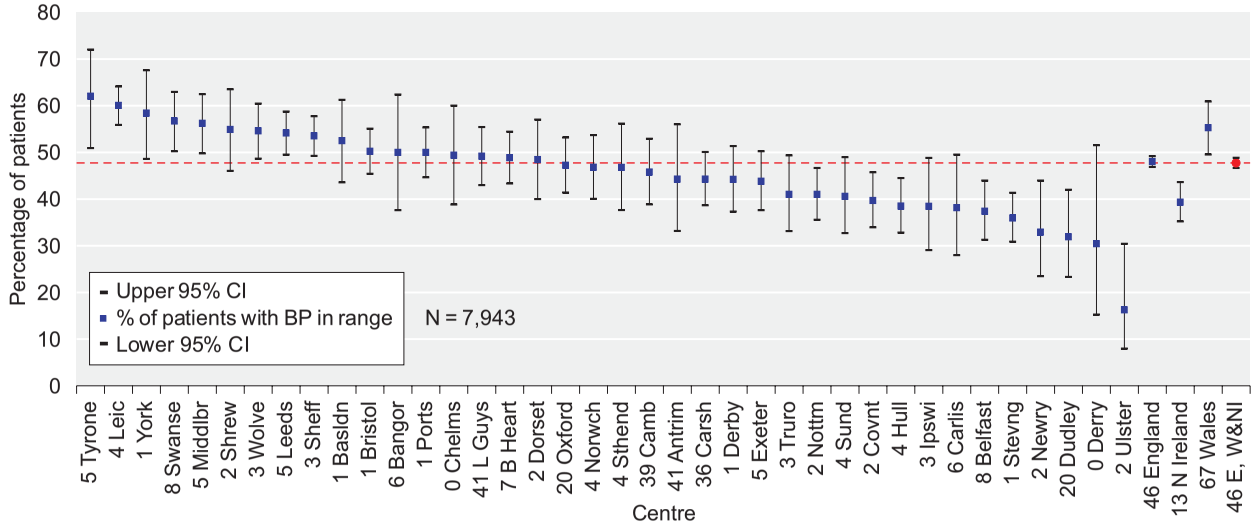

Figure 10.3: Percentage of patients with BP <130/80 mmHg: post-HD

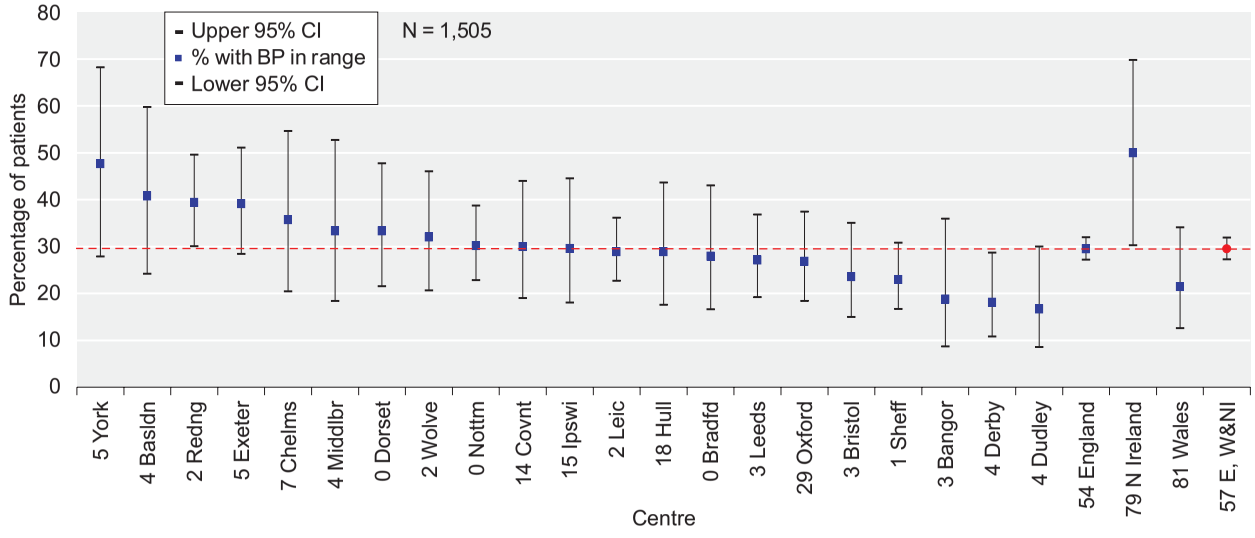

Figure 10.4: Percentage of patients with BP <130/80 mmHg: PD

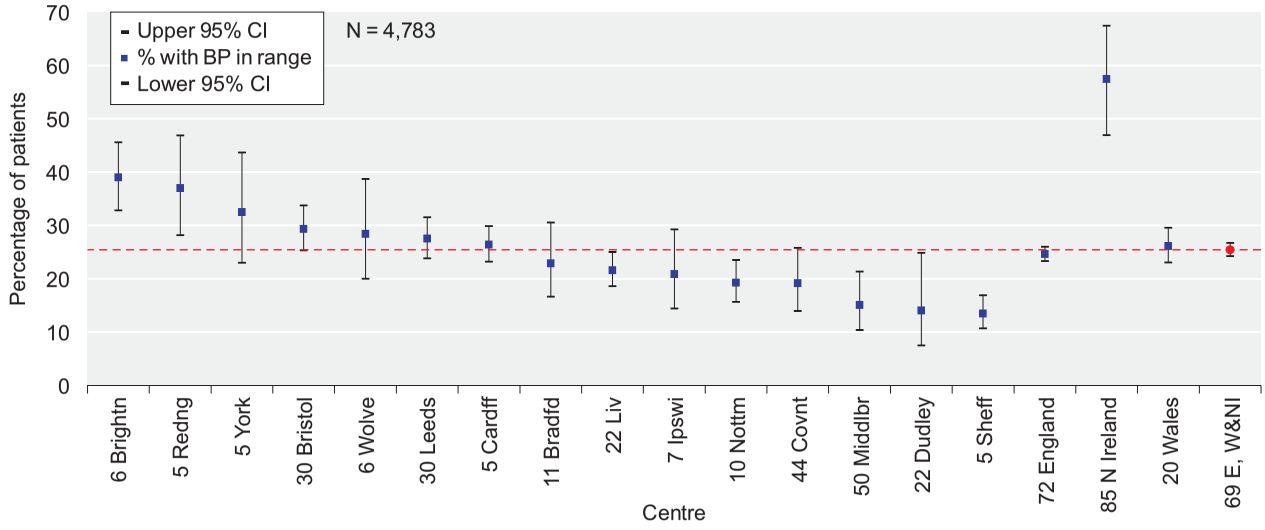

Figure 10.5: Percentage of patients with BP <130/80 mmHg: Tx

Systolic pressure alone

Figures 10.6 to 10.13 show a wide variation between centres achieving the systolic blood pressure standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 46% (range 17–66%) and post-dialysis 51% (range 21–65%). On average, 39% of PD patients achieved the standard (range 19–76%) and 35% of transplant patients (range 18–55%). Chi-squared testing indicated the variation between centres was significant for each treatment modality ($p \leqslant 0.001$). The variation between nations was significant for post-HD and transplant ($p < 0.001$) but not for pre-HD or PD. Median SBP for pre-HD, post-HD, PD and transplant was 142, 129, 135 and 136 mmHg respectively.

Diastolic pressure alone

Figures 10.14 to 10.21 show wide variation between centres achieving the diastolic blood pressure standard. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 85% (range 62–97%) and post-dialysis 77% (range 57–92%). On average 51% of PD patients achieved the standard (range 38–68%) and 50% of transplant patients (range 30–70%). Chi-squared testing indicated the variation between centres was significant for each treatment modality ($p \leqslant 0.025$). The variation

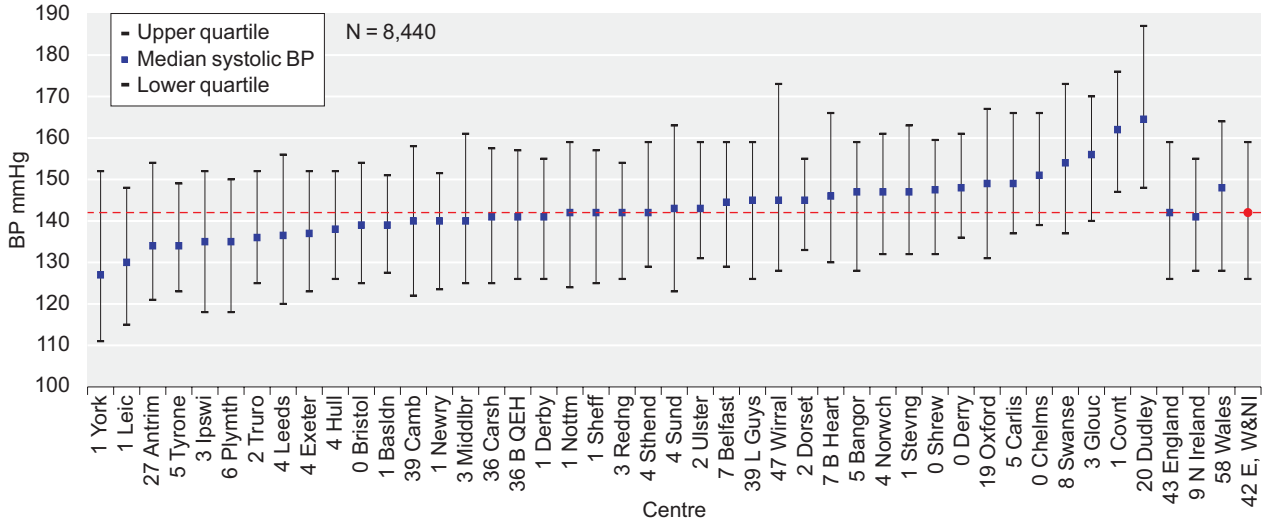

Figure 10.6: Median systolic BP: pre-HD

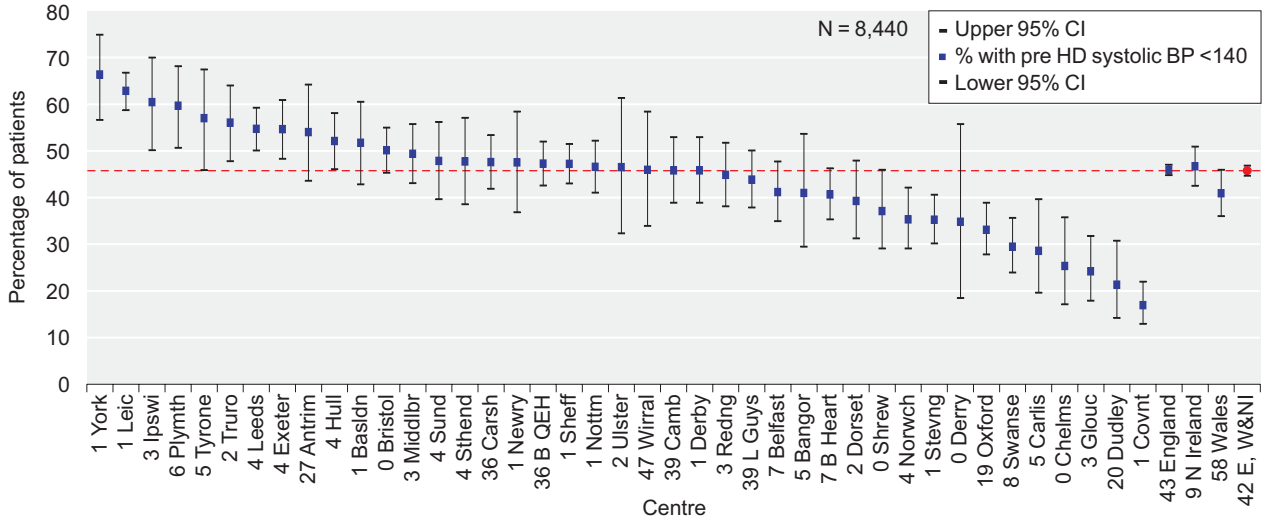

Figure 10.7: Percentage of patients with systolic BP <140 mmHg: pre-HD

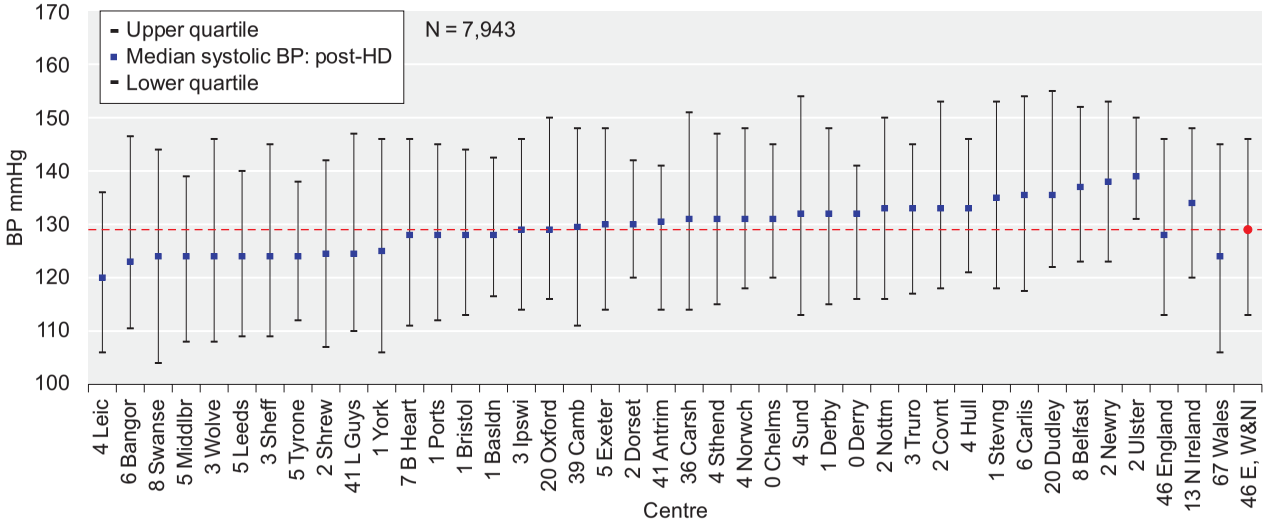

Figure 10.8: Median systolic BP <130 mmHg: post-HD

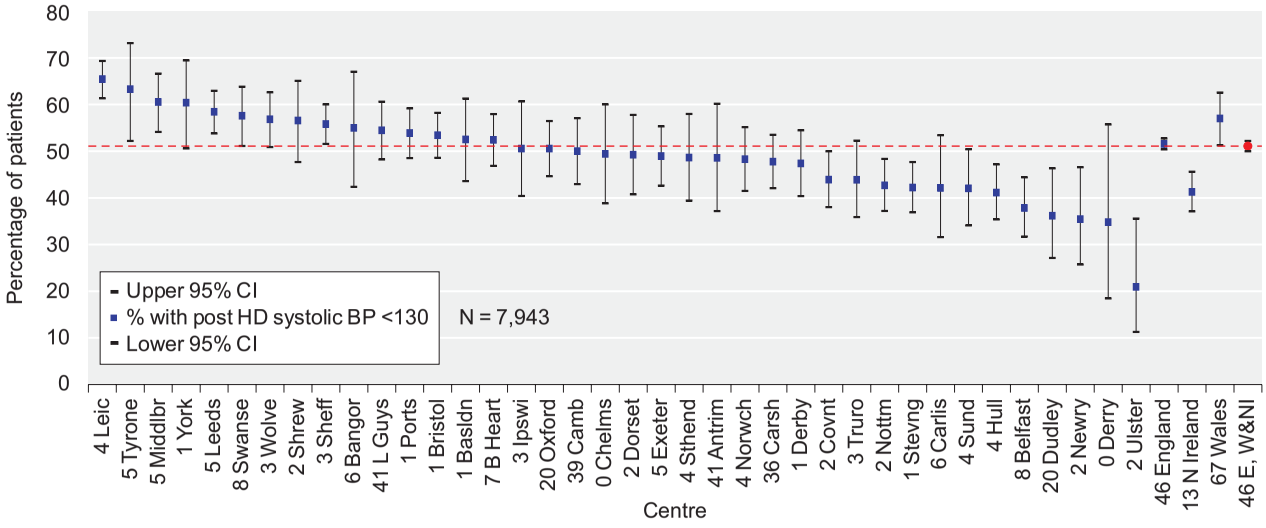

Figure 10.9: Percentage of patients with systolic BP <130 mmHg: post-HD

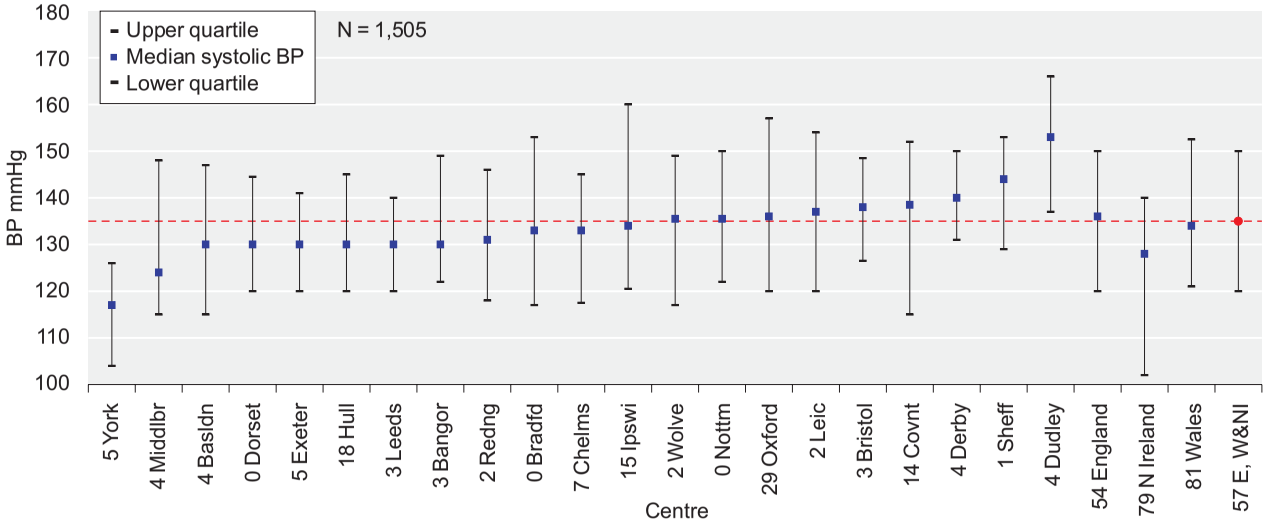

Figure 10.10: Median systolic BP: PD

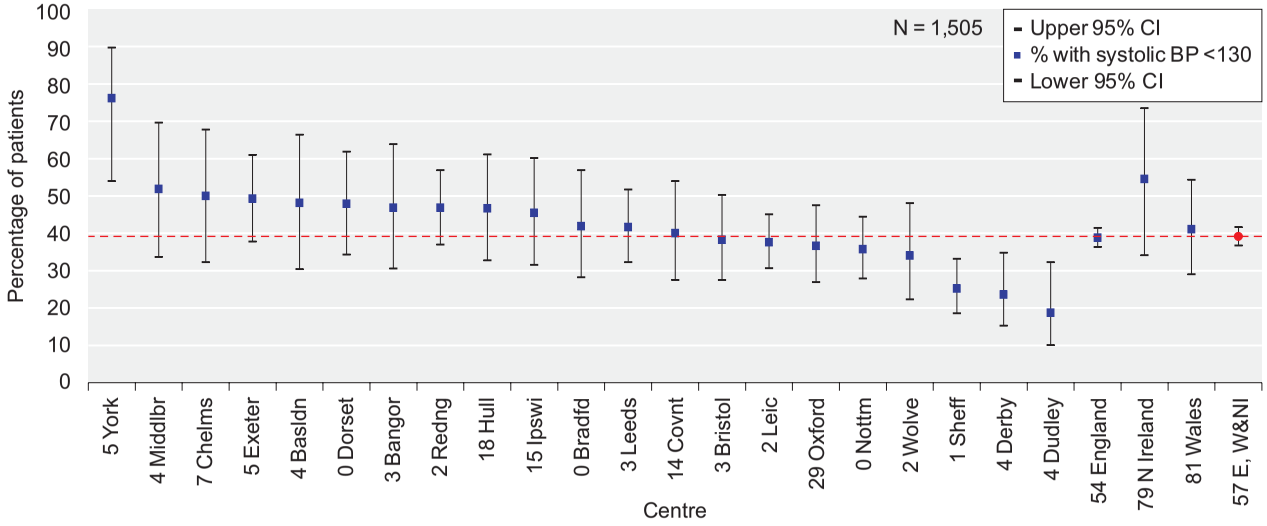

Figure 10.11: Percentage of patients with systolic BP <130 mmHg: PD

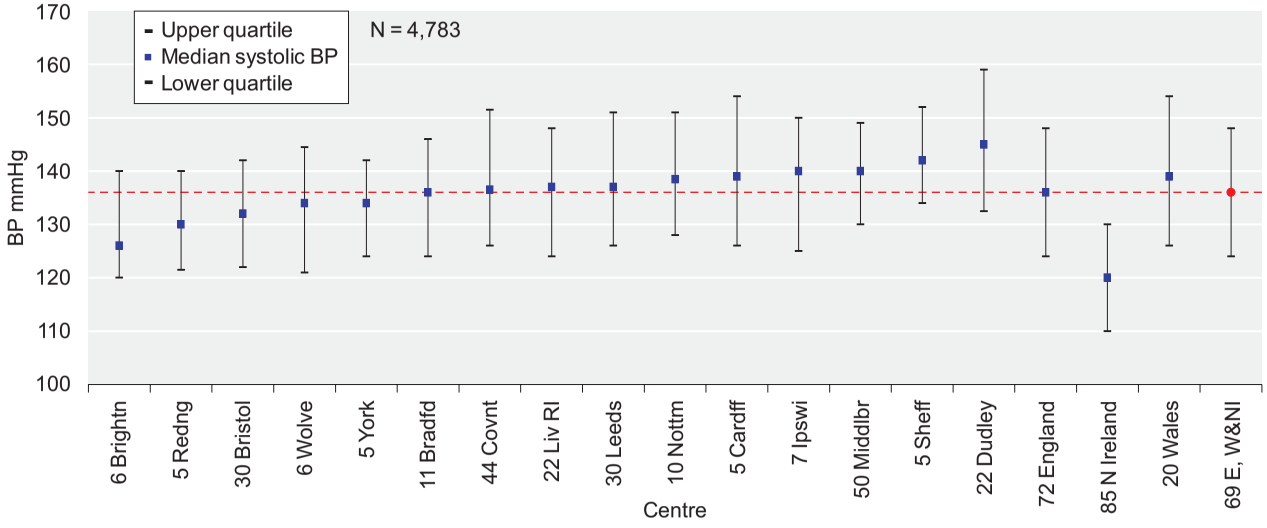

Figure 10.12: Median systolic BP: Tx

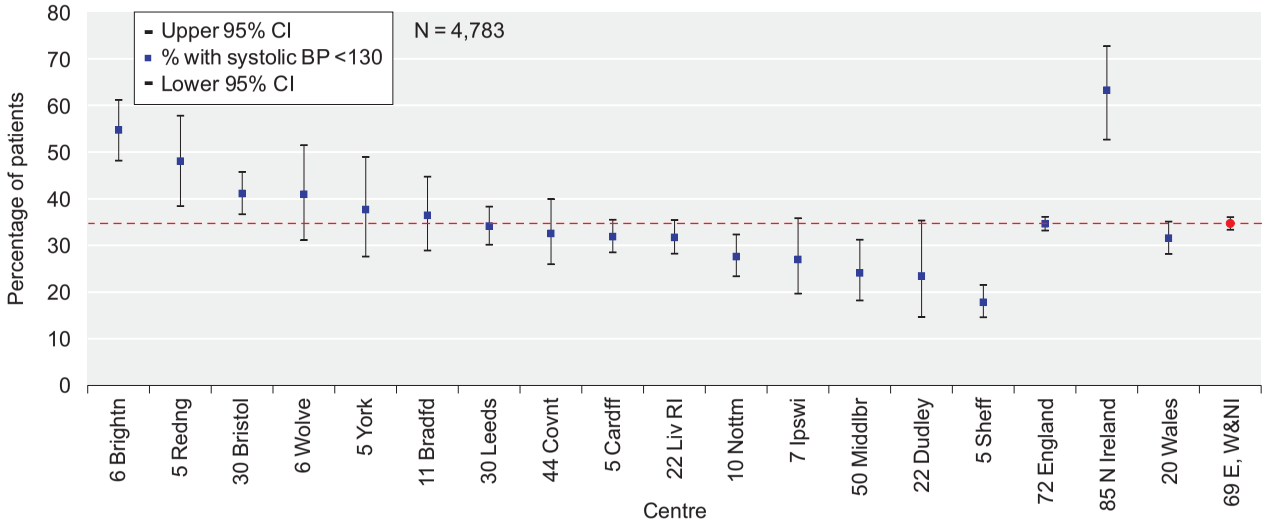

Figure 10.13: Percentage of patients with systolic BP <130 mmHg: Tx

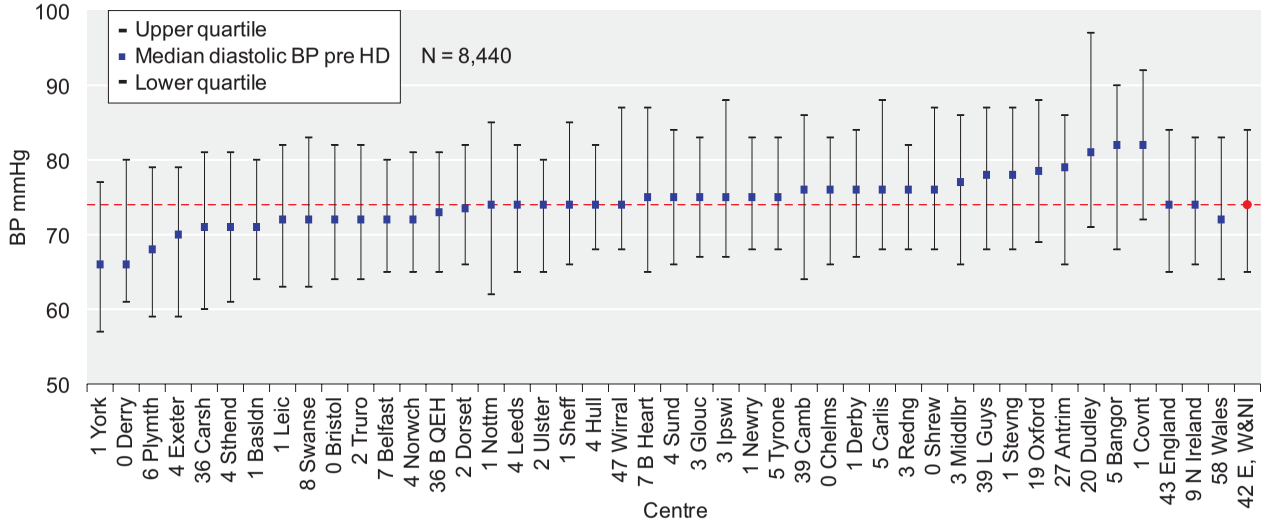

Figure 10.14: Median diastolic BP: pre-HD

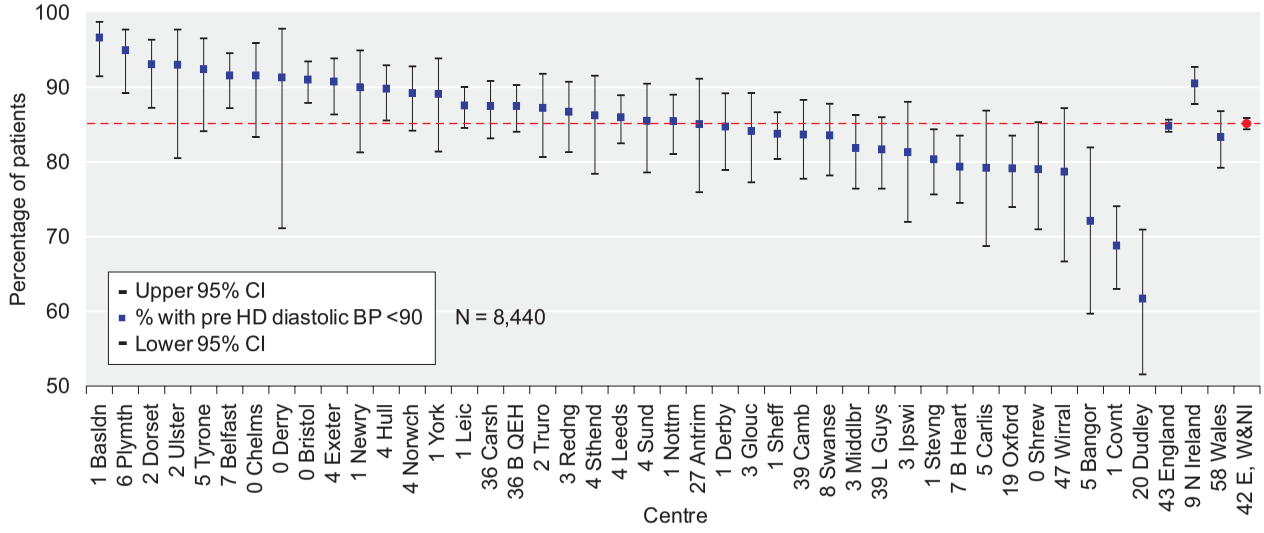

Figure 10.15: Percentage of patients with diastolic BP <90 mmHg: pre-HD

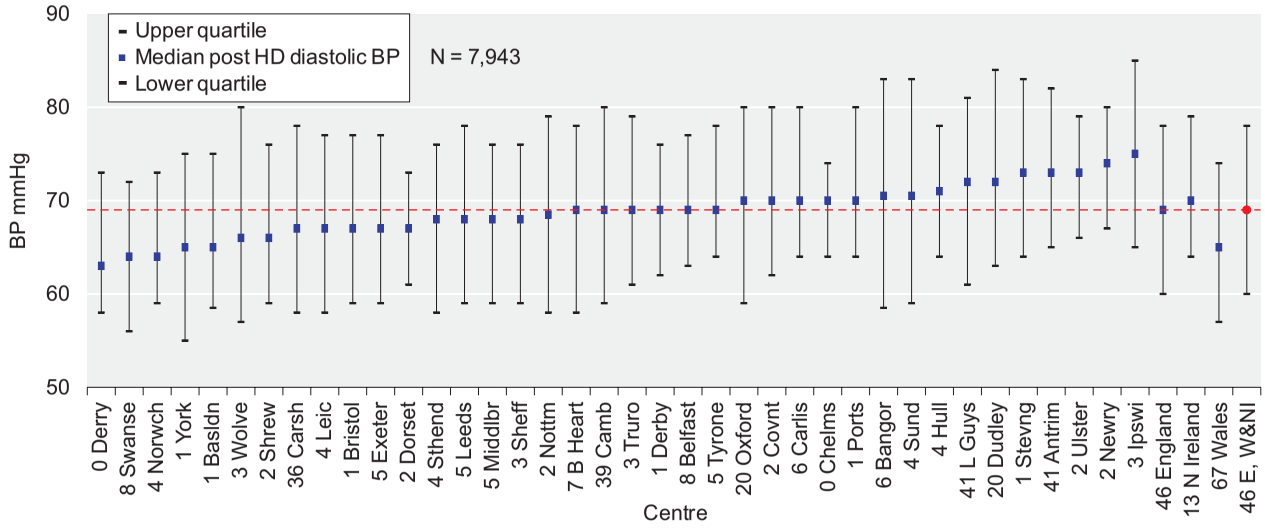

Figure 10.16: Median diastolic BP: post-HD

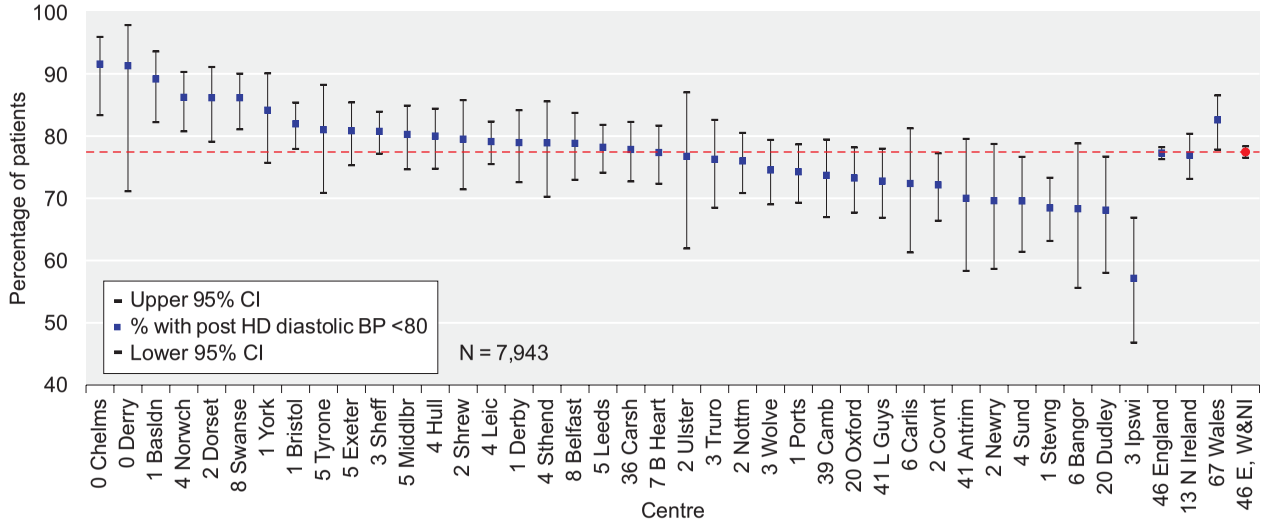

Figure 10.17: Percentage of patients with diastolic BP <80 mmHg: post-HD

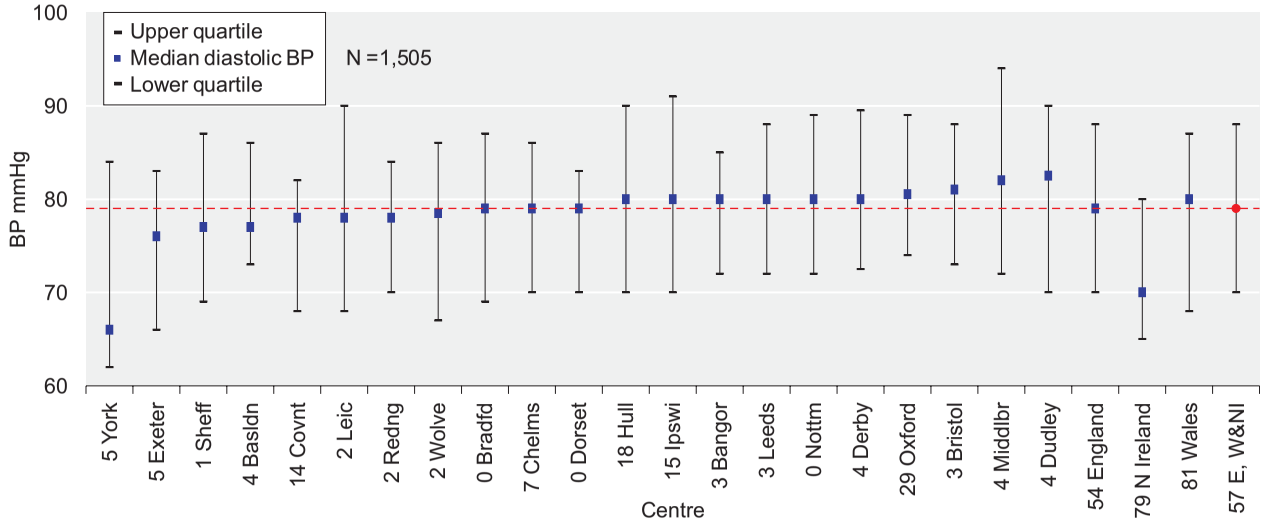

Figure 10.18: Median diastolic BP: PD

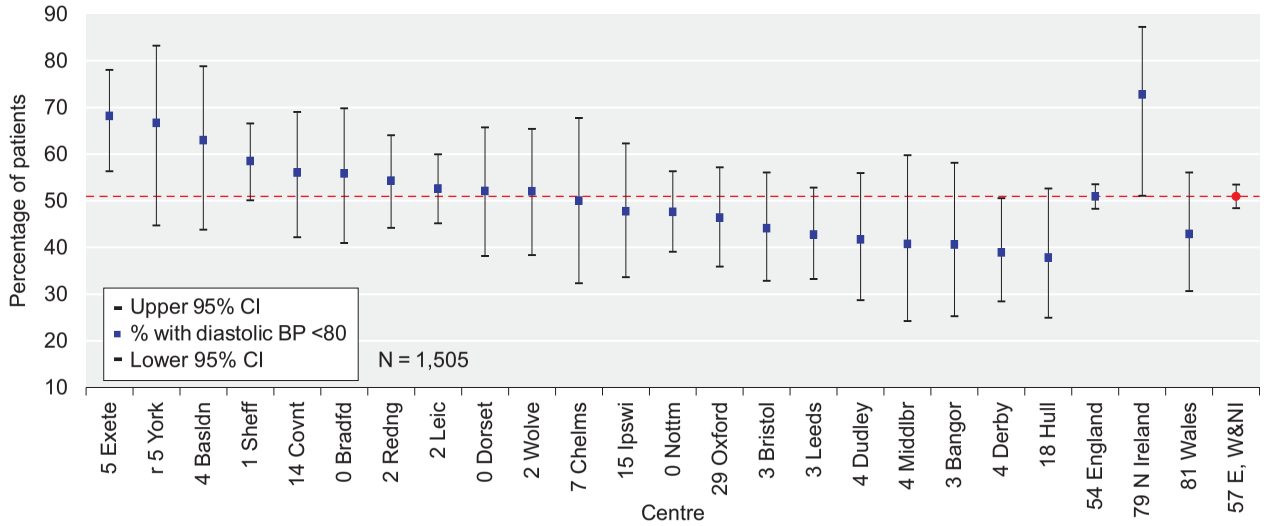

Figure 10.19: Percentage of patients with diastolic BP <80 mmHg: PD

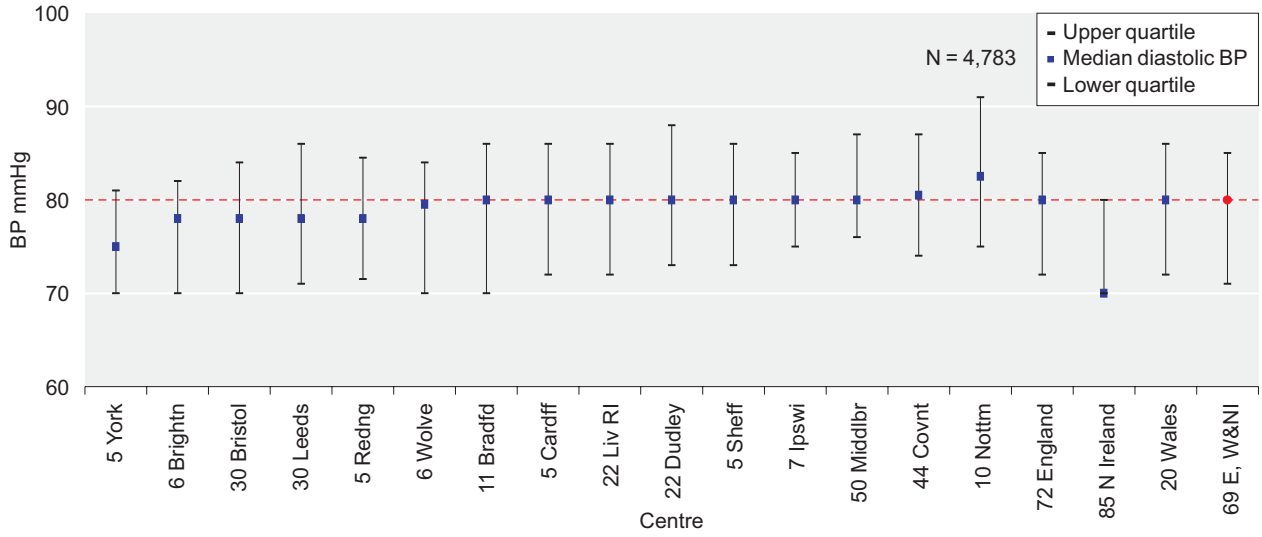

Figure 10.20: Median diastolic BP: Tx

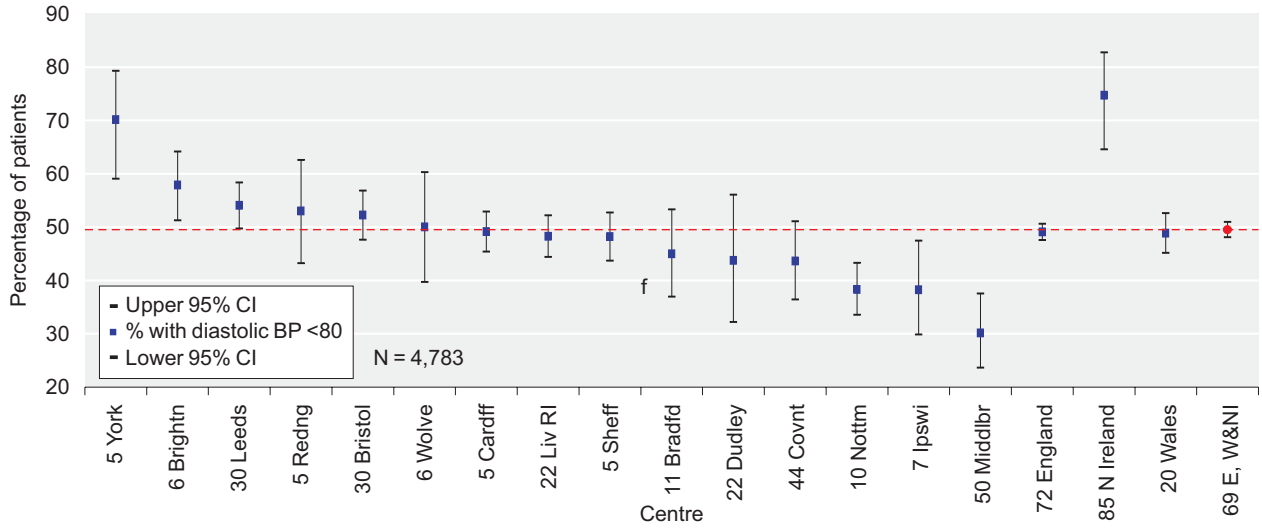

Figure 10.21: Percentage of patients with diastolic BP <80 mmHg: Tx

between nations was significant for pre-HD and transplant ($p < 0.0001$) but not for post-HD or PD. The median DBP for pre-HD, post-HD, PD and transplant was 74, 69, 79 and 80 mmHg respectively. The lower DBP recorded post-HD may reflect hypovolaemia in older patients with stiff arteries (DBP falls after 60 years of age in the general population).

Mean arterial pressure

Figures 10.22 to 10.29 show wide variation between centres achieving the desired mean arterial pressure (MAP). MAP was calculated as DBP plus one third of the pulse pressure. In England, Northern Ireland and Wales, the percentage of HD patients achieving the standard pre-dialysis averaged 74% (range 45–89%) and post-dialysis 69% (range 48–78%). On average 50% of PD patients achieved the standard (range 31–86%) and 47% of transplant patients (range 28–65%). Chi-squared testing indicated the variation between centres for each treatment modality was significant ($p < 0.001$). The variation between nations was also significant ($p \leqslant 0.015$) except for pre-HD. The median MAP for pre-HD, post-HD, PD and transplant was 97, 89, 97 and 98 mmHg respectively.

Pulse pressure

Figures 10.30 to 10.33 show the variation between centres for pulse pressure (PP). PP was calculated as SBP minus DBP. The median

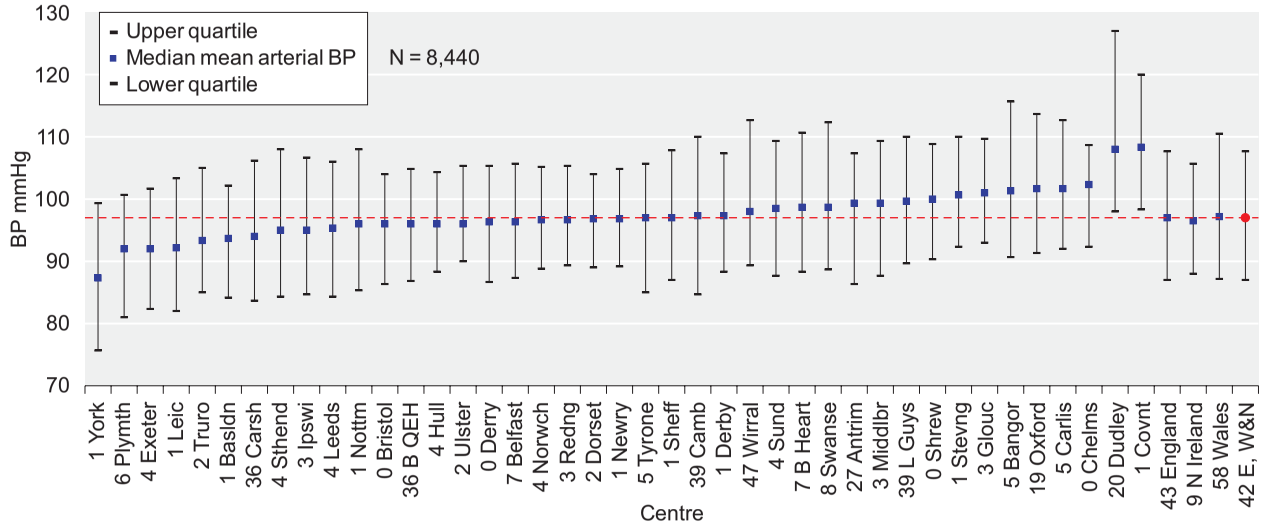

Figure 10.22: Median MAP: pre-HD

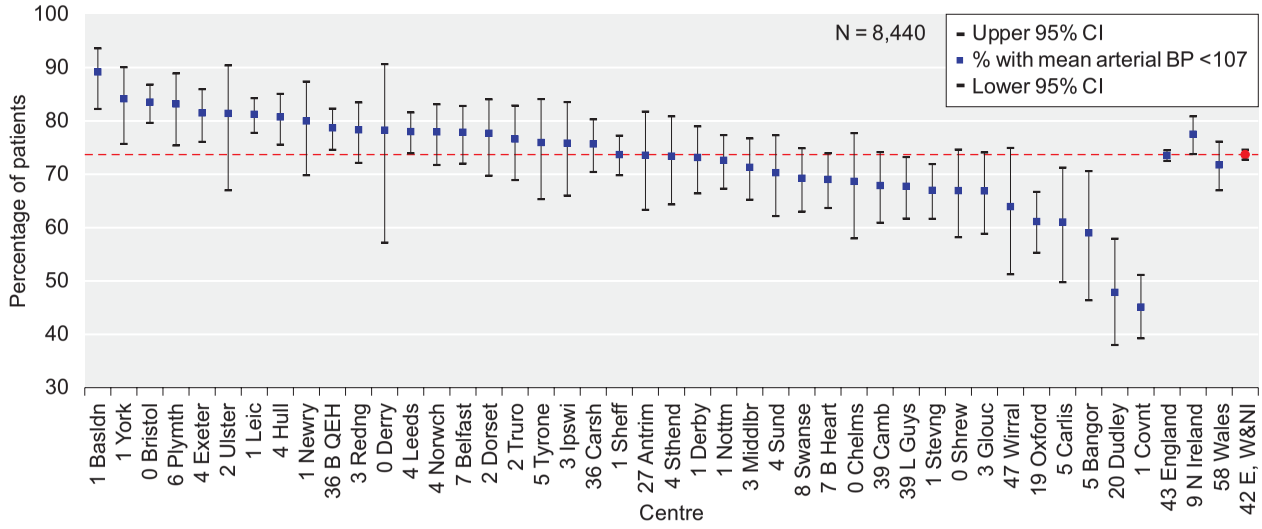

Figure 10.23: Percentage of patients with MAP <107 mmHg: pre-HD

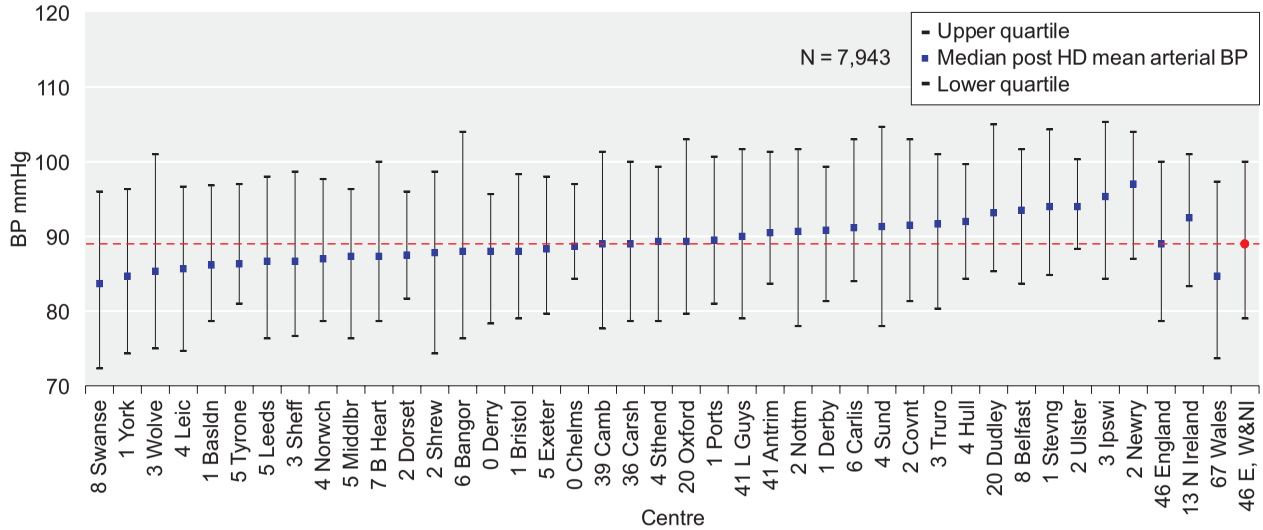

Figure 10.24: Median MAP: post-HD

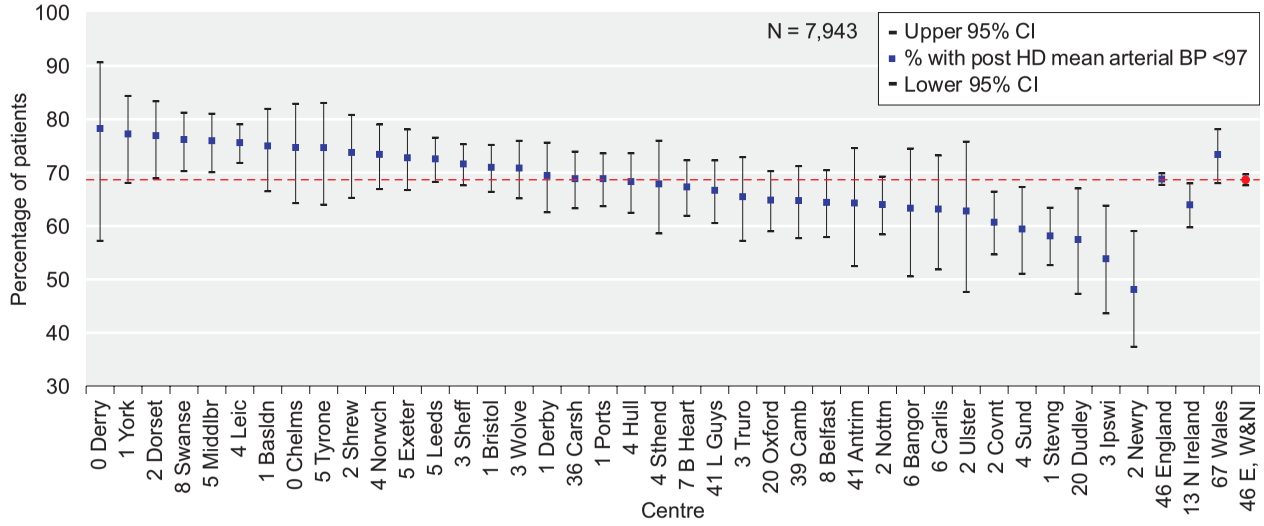

Figure 10.25: Percentage of patients with MAP <97 mmHg: post-HD

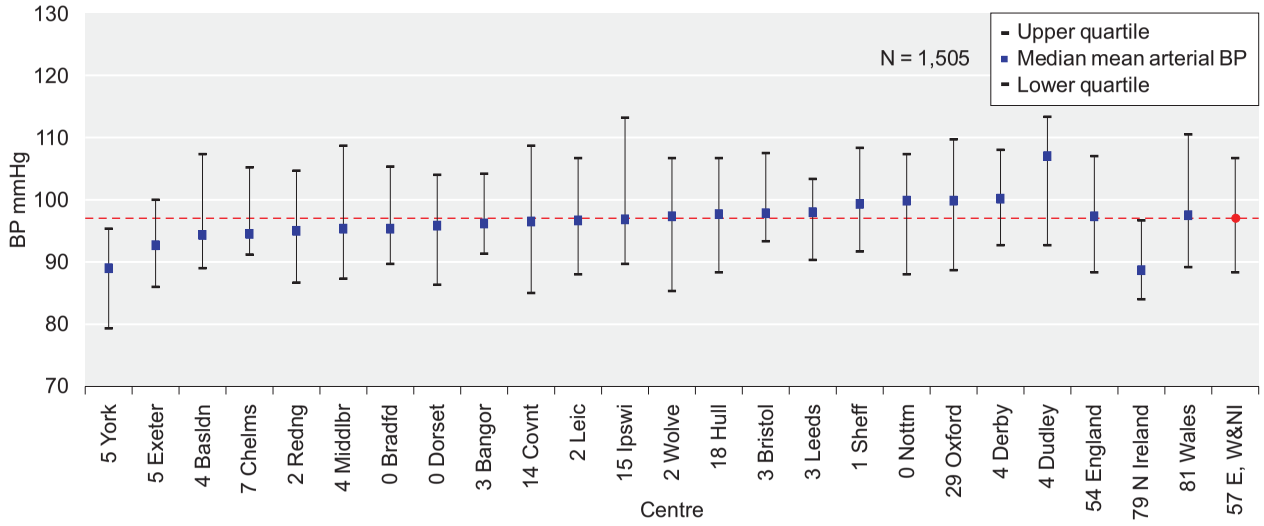

Figure 10.26: Median MAP: PD

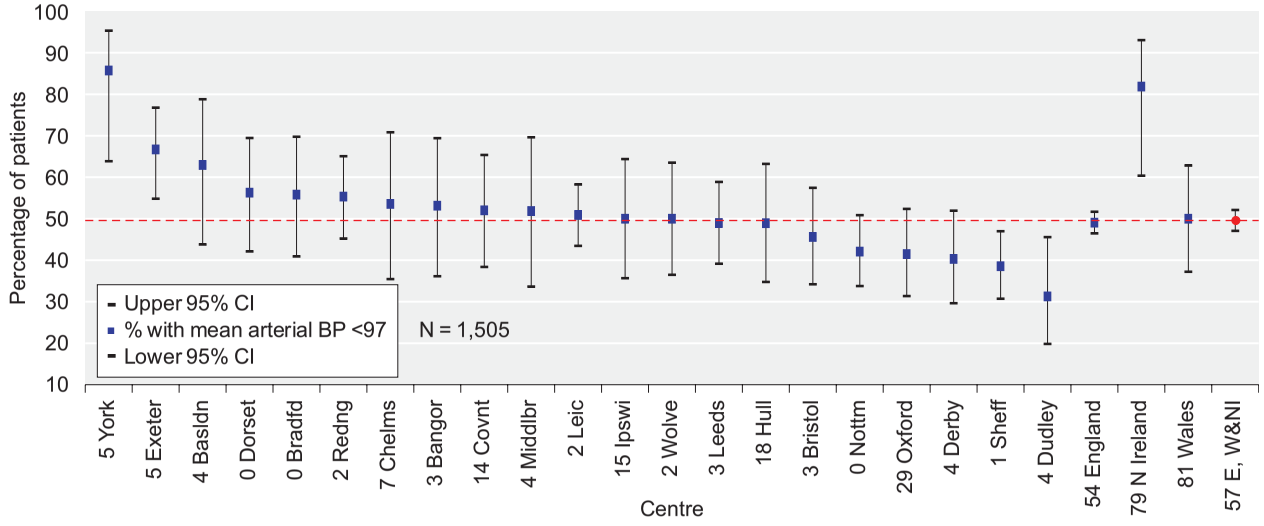

Figure 10.27: Percentage of patients with MAP <97 mmHg: PD

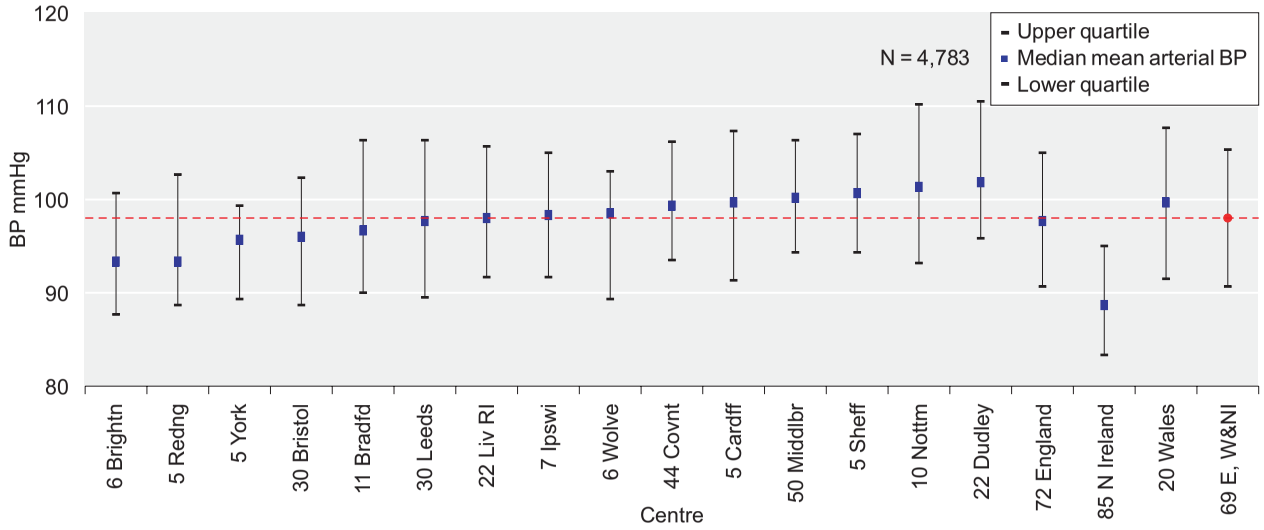

Figure 10.28: Median MAP: Tx

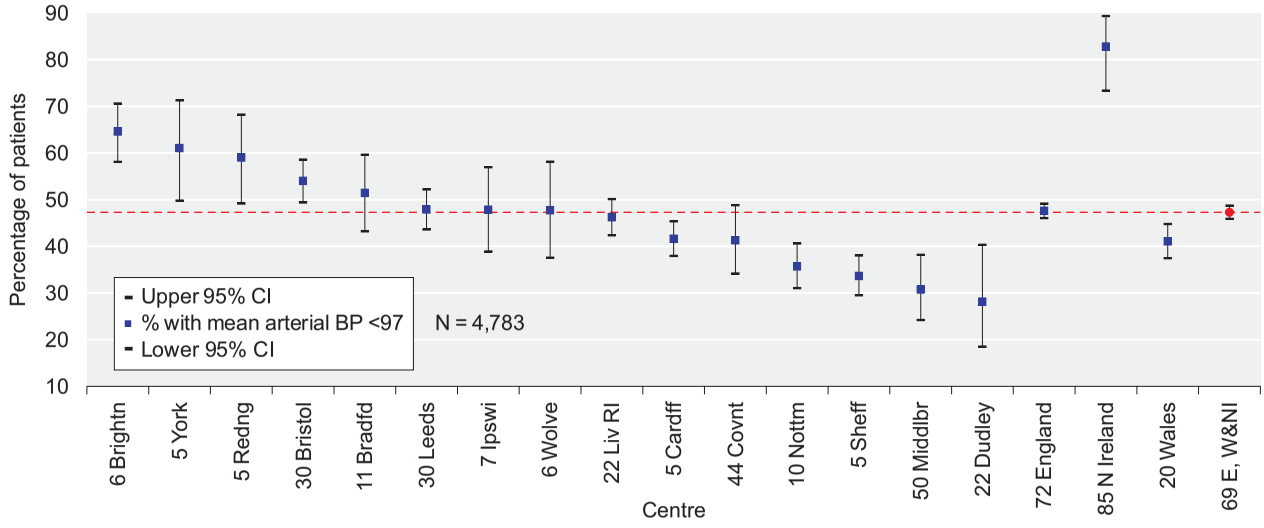

Figure 10.29: Percentage of patients with MAP <97 mmHg: Tx

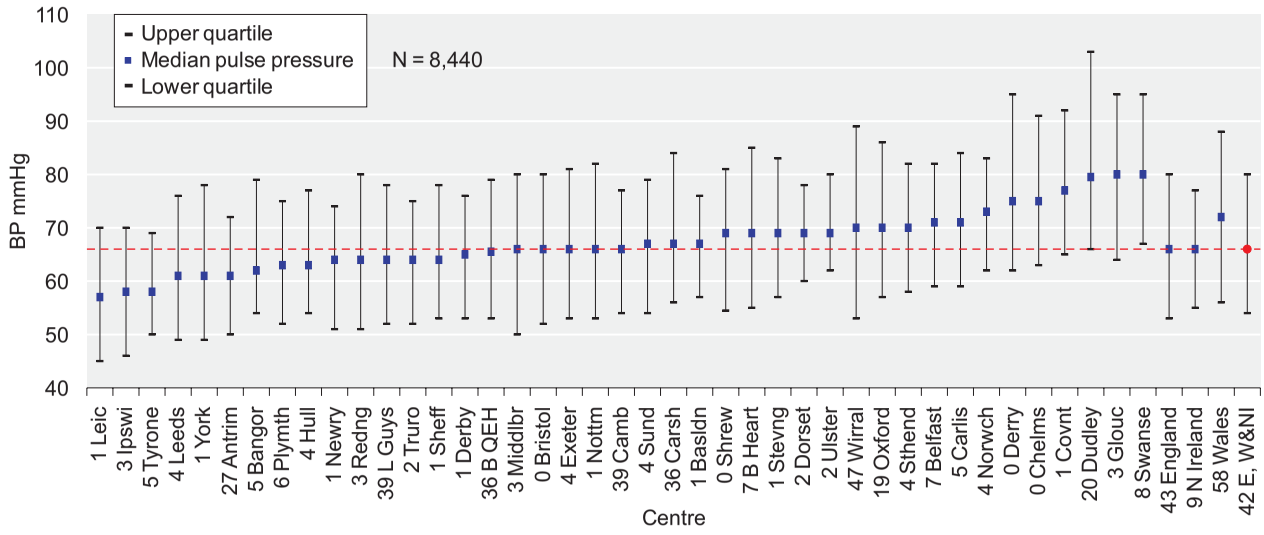

Figure 10.30: Median PP: pre-HD

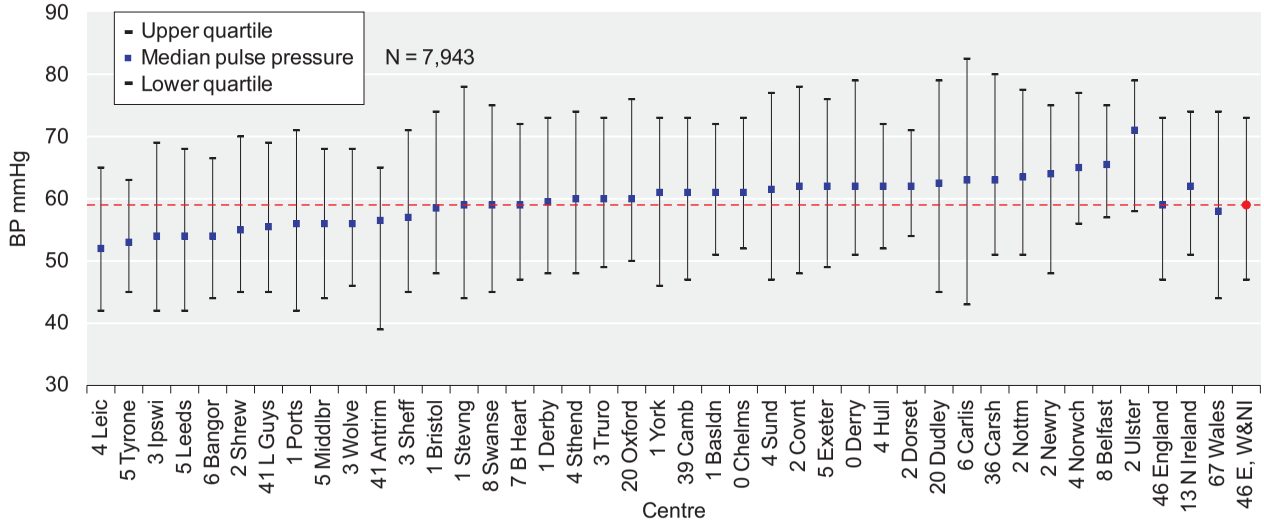

Figure 10.31: Median PP: post-HD

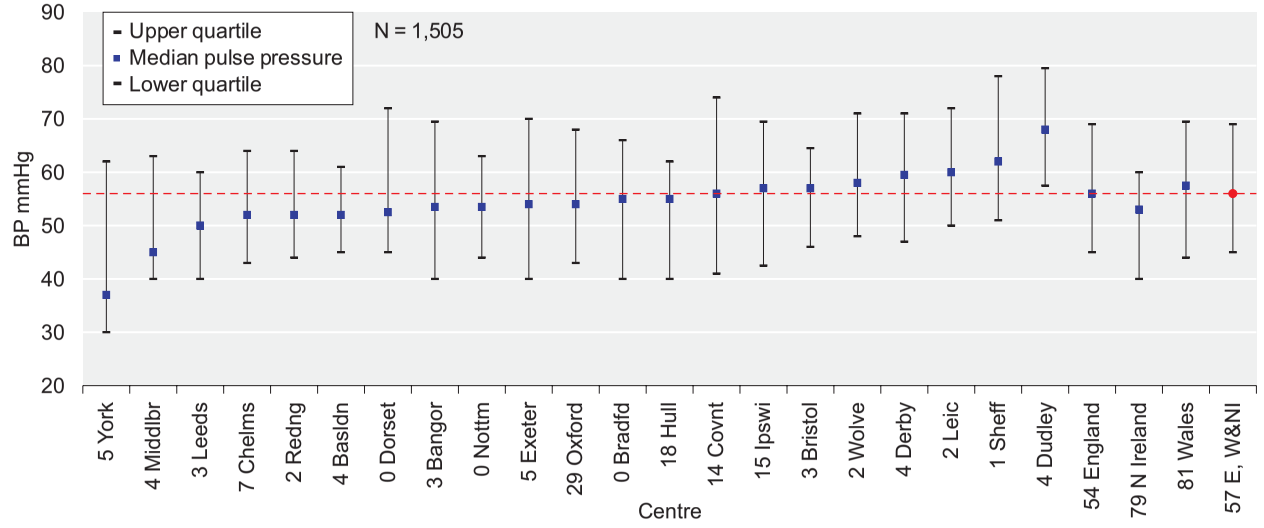

Figure 10.32: Median PP: PD

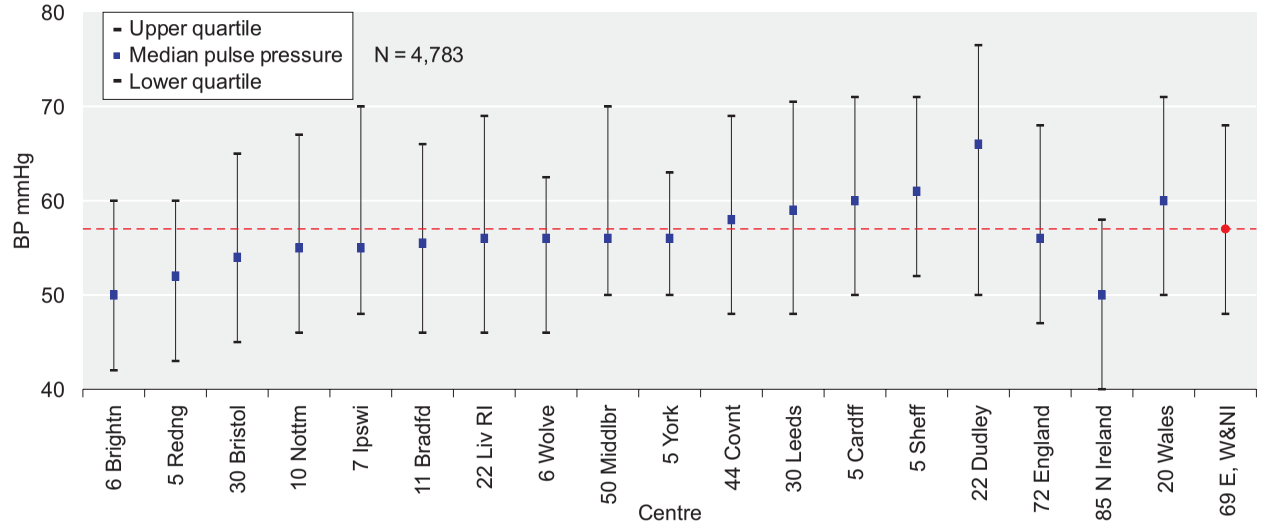

Figure 10.33: Median PP: Tx

pulse pressure for pre-HD, post-HD, PD and transplant was 66, 59, 56 and 57 mmHg respectively. A high SBP accounts for the wider PP in pre-HD readings.

Blood pressure by primary diagnosis

Figures 10.34 to 10.41 show the variation in blood pressure control by primary diagnosis for all treatment modalities (post-HD data is shown). The prevalence of hypertension varied with the underlying renal condition and was highest in vascular disorders (diabetes, renovascular disease or hypertension), lower in glomerulonephritis and lowest in tubular disorders. Blood pressure control was significantly better on HD for all diagnostic groups. Post-HD, 43% of patients with vascular disease, 49% with glomerulonephritis and 51–54% with tubular disorders achieved the standard. Poor blood pressure control was due to a high SBP.

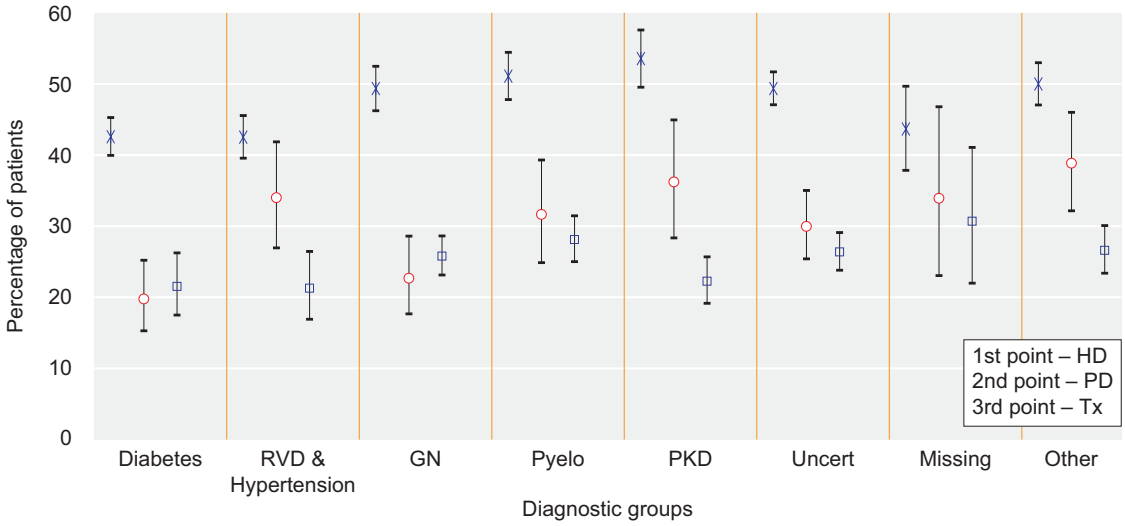

Figure 10.34: Percentage of patients with BP in standards by primary diagnosis

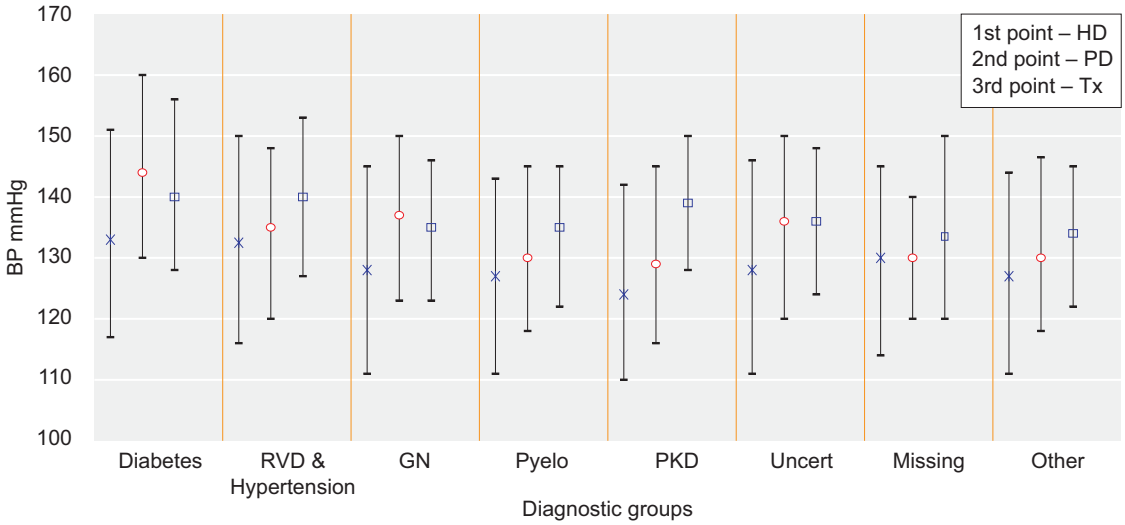

Figure 10.35: Median SBP by primary diagnosis

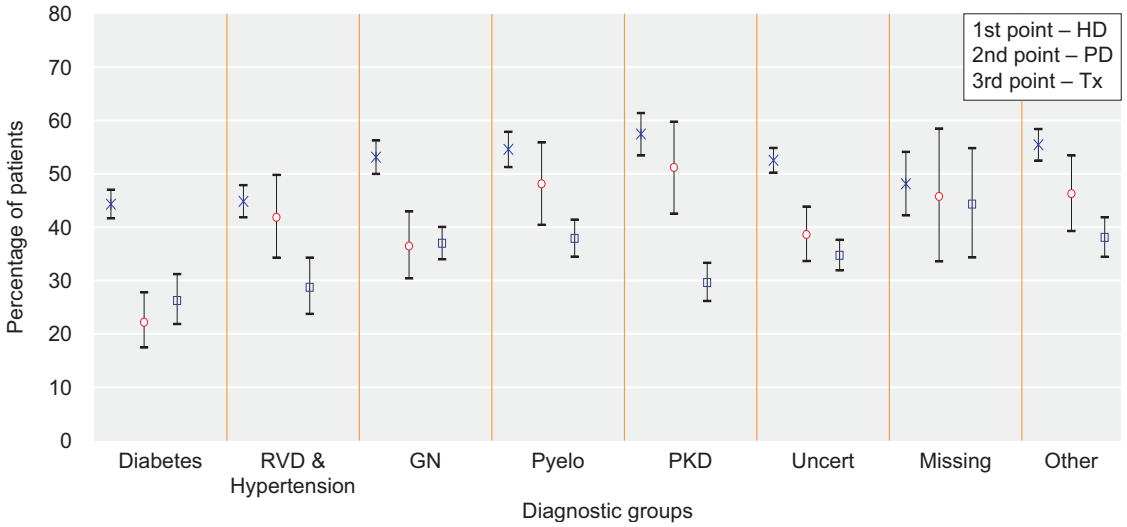

Figure 10.36: Percentage of patients with SBP in standards by primary diagnosis

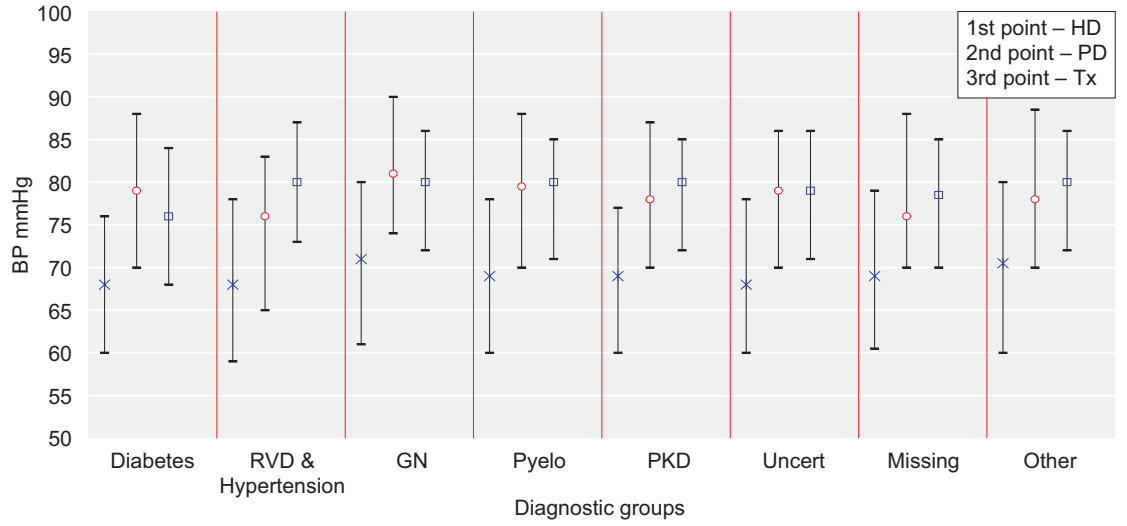

Figure 10.37: Median DBP by primary diagnosis

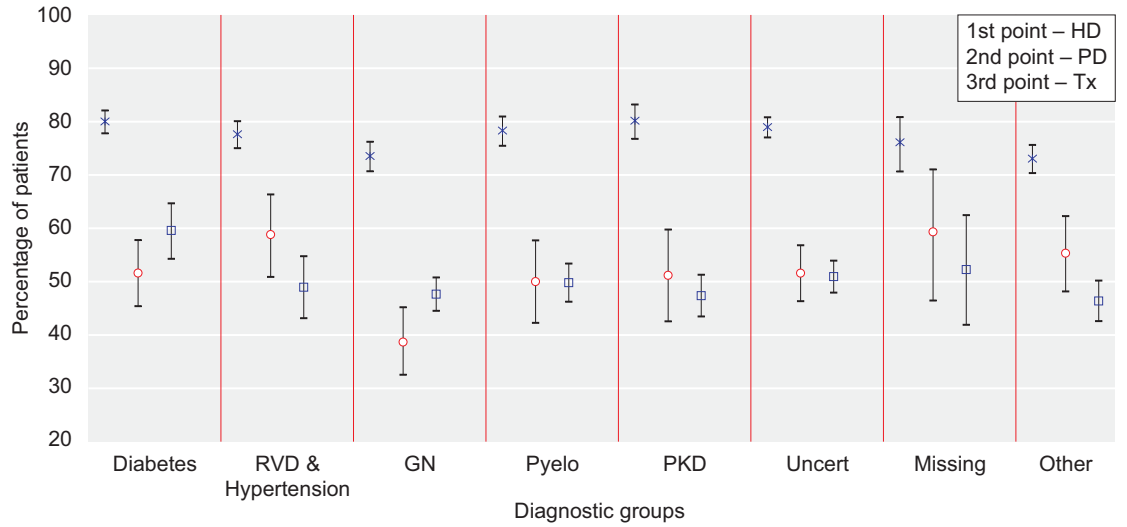

Figure 10.38: Percentage of patients with DBP in standards by primary diagnosis

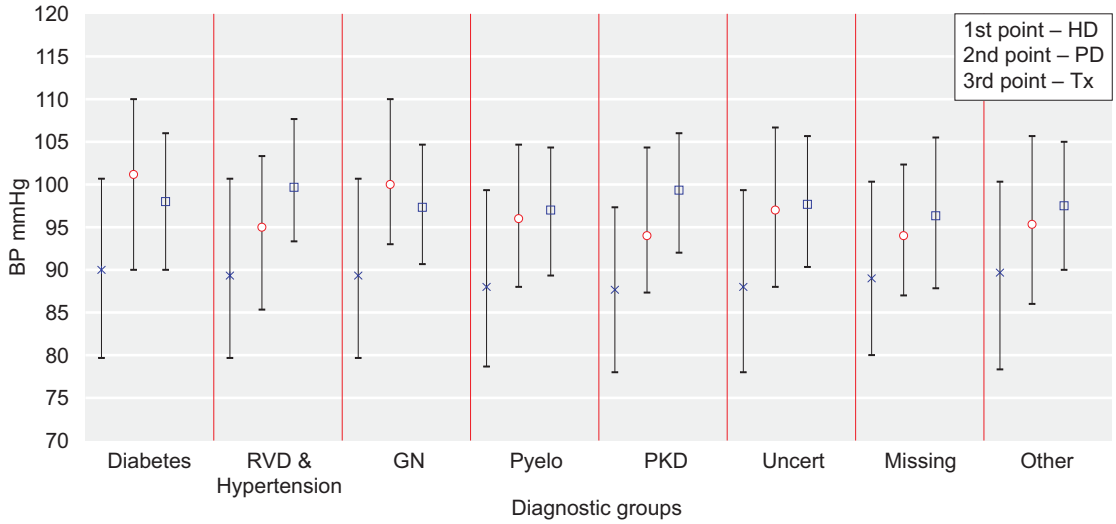

Figure 10.39: Median MAP by primary diagnosis

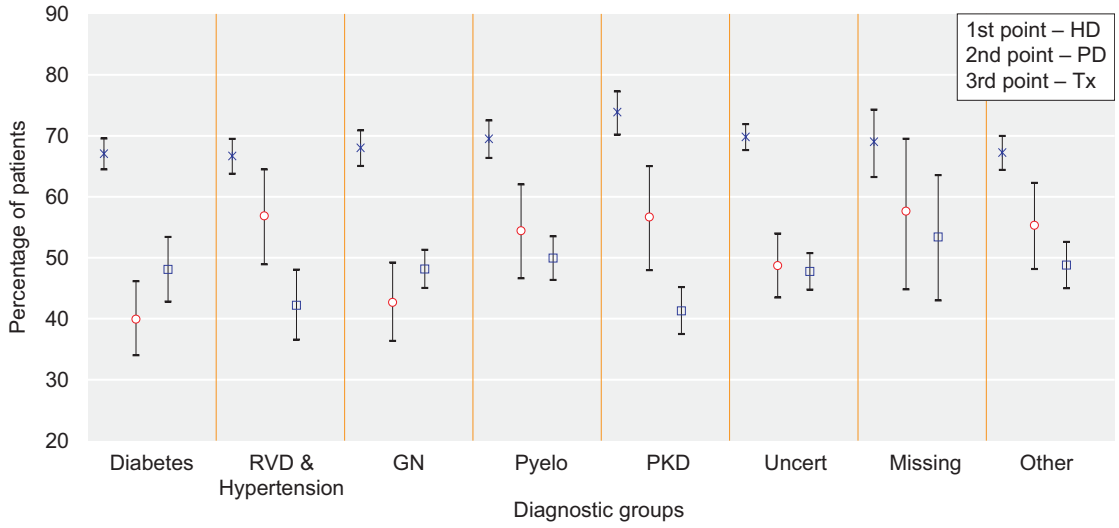

Figure 10.40: Percentage of patients with MAP in standards by primary diagnosis

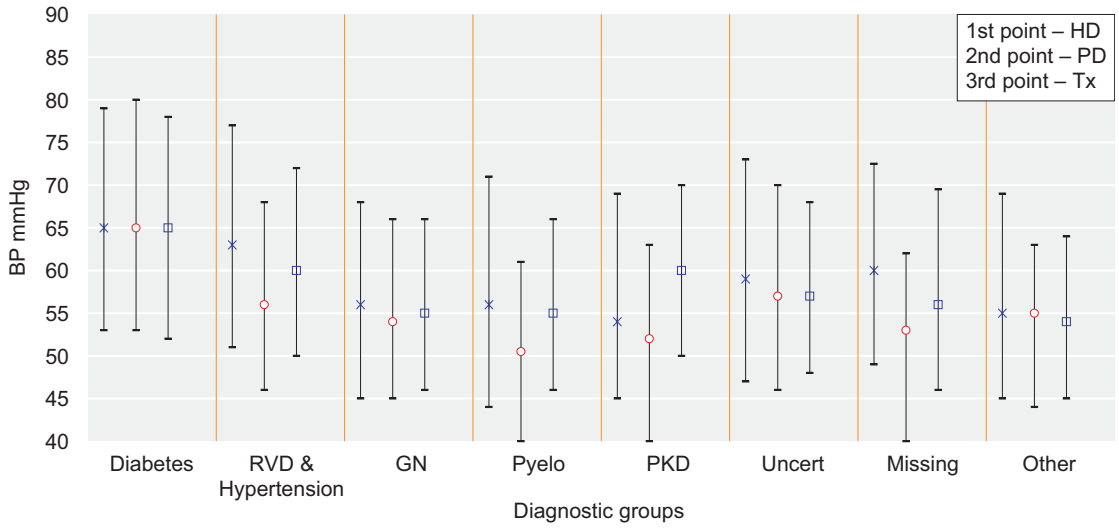

Figure 10.41: Median PP by primary diagnosis

Future directions

Publication of observational data has failed to improve blood pressure control over the last nine years. This is distinct from other areas such as anaemia and dialysis adequacy where significant improvements have been made. The UKRR now needs co-morbidity data for every patient on its database to address important clinical questions. Adjusting for co-morbidity is essential to show whether good blood pressure control improves cardiovascular outcomes and survival on RRT. The UKRR also intends to collect a number of data items from each HD session. These will include pre- and post-dialysis blood pressure and episodes of symptomatic intradialytic hypotension. These data will clarify whether blood pressure variation through the dialysis week has more prognostic value than the random readings currently collected by the UKRR.

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