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Referral patterns to renal services: what has changed in the past 4 years?

Helen Hobbs[1], Paul Stevens[1], Berhard Klebe[1], Jean Irving[1], Roger Cooley[2], Donal O'Donoghue[3], Stephen Green[4] and Christopher Farmer[1]

[1]Department of Renal Medicine, Kent Renal Service, East Kent Hospitals NHS Trust, Ethelbert Road, [2]Computing Laboratory, University of Kent, Canterbury, Kent, [3]Renal Unit, Hope Hospital, Salford, Manchester and [4]Department of Heath, Vascular Programme, London, UK

Correspondence and offprint requests to: Christopher K. T. Farmer; E-mail: Chris.farmer@ekht.nhs.uk

Abstract

Background. Awareness of chronic kidney disease (CKD) has been prompted by the publication of several large epidemiological studies since 2002. This has led to various initiatives for the early identification and management of CKD, including the introduction of automated glomerular filtration rate (GFR) reporting and renal indicators in the primary care quality and outcomes framework (QOF) since April 2006. These initiatives were intended to promote identification of CKD and have had an impact on referral patterns to renal services. The aim of this study was to understand the nature of this impact in a catchment population of 1.2 million people.

Methods. Data were collected and recorded from all written referrals from primary care between 1 April 2004 and 31 March 2008. Referral patterns for each postcode sector were mapped using Microsoft MapPoint 2004. The effect of chance on referral patterns was modelled by using small area analysis techniques. The association between the CKD prevalence reported from QOF data and the estimated CKD prevalence was examined at post-code district level.

Results. There were 1461 referrals in 2 years prior to the introduction of the initiatives and 2890 referrals in the 2 years post-introduction. The main reason for referral in both groups was impaired renal function or previously established renal disease. Reported comorbidity was similar between the groups. Mapping showed that there was wide heterogeneity in referral behaviour in the first 2 years of the study, which was less in the second period. Small area analysis suggested that the variation that led to the extremal quotients observed in both of the study periods was not due to random variation in referral pattern alone. There was no correlation between the reported CKD prevalence and the referral rates.

Conclusion. Referral patterns have changed between 1 April 2004 and 31 March 2008. The main findings were an increase in referral rate and in the age at referral without a significant change in reported comorbidity of the people referred. The main increase in referral rates was seen in more advanced CKD suggesting more targeted referral of patients with CKD to renal services.

Keywords: chronic kidney disease; eGFR; referral patterns; small area analysis

Introduction

Many factors may have influenced referral rates from primary to secondary care for suspected or established kidney disease over recent years. The prevalence of chronic kidney disease (CKD) has risen in association with the prevalence of diabetes and hypertension, together with an ageing and growing population [1,2]. However, several other factors will have an impact on referral rates to renal services in the UK including:

1. Increased recognition of CKD through the publication of several large epidemiological studies [3–6].
2. Changes in national policy promoting increased recognition and early identification of people with CKD through publication of part 2 of the Renal National Service Framework in February 2005 [7]; introduction of automated reporting of estimated glomerular filtration rate (eGFR) by pathology laboratories in association with a serum creatinine request in adults since April 2006; and the introduction of targets relevant to renal medicine into the General Medical Services (GMS) contracts as part of the Quality and Outcomes Framework (QOF) [8] in April 2006. QOF represents one of the main sources of income for primary care providers across the UK, rewarding practices for providing good quality care. It forms part of the new General Medical Services (GMS) contract, introduced on 1 April 2004. Participation by general practices in the QOF is voluntary and measures achievement against a wide range of evidence-based indicators. There were four renal indicators at the time of the study, the first of which required primary care to produce a disease register of people with stage 3–5 CKD. Prevalence estimates for CKD 3–5 can therefore be calculated from the returns made from primary care [9].
3. Publication and dissemination of UK guidelines for identification, management and referral of CKD in September 2005 [10].

All of these measures are likely to have increased recognition of CKD in the population and altered referral patterns from primary to secondary care.

Many other factors influence referral patterns from primary to secondary care including population demographics, geography, GP practice structure, policy or funding as well as guidelines and educational initiatives. There is broad literature discussing variation in referral patterns from primary to secondary care. What is unique about the recent period is the number of near concurrent initiatives that have both highlighted CKD as a significant public health problem and actively promoted its identification.

Aims

The aims of this study were to examine the effect of recent initiatives on the referral pattern of people with CKD from primary to secondary care across East and part of West Kent in the UK. There were four main objectives:

1. To describe the patient demographics of the written referrals to a specialist kidney service over a 4-year period spanning the introduction of these initiatives, 2 years before and 2 years after the introduction of eGFR reporting and renal indicators in the QOF.
2. To map referrals to kidney services in Kent from primary care, model the estimated prevalence of CKD and examine the relationship between the predicted prevalence and the observed referral rate by a postcode sector.

Table 1. Classification of reasons for referral of patients from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK

Reason for referral	Definition
Impaired renal function	Stated as the reason for referral in the letter, raised serum creatinine, low eGFR
Proteinuria	Stated as the reason in the letter, positive urine dipstick, raised urine protein creatinine ratio, raised urine albumin creatinine ratio
Hypertension	Stated as the reason for referral
Polycystic kidney disease: family history of ADPKD	Stated as the reason for referral
Bladder out flow obstruction: bladder tumour, benign enlarged prostate, prostatic cancer. Kidney stone disease	Stated as the reason for referral
Abnormal ultrasound: small kidneys, stones, cysts	Stated as abnormal ultrasound or as the reason for referral
Abnormal biochemistry: abnormal serum potassium, abnormal serum sodium, abnormal serum calcium	Stated as the reason for referral
Anaemia	Stated as the reason for referral or low haemoglobin level (<11 g/dl)

3. Assess the impact of eGFR reporting and the QOF on the type and rate of referral to kidney services.
4. Assess the correlation between the Quality and Outcomes Framework (QOF) reported prevalence of CKD using the Quality Management and Analysis System (QMAS) [1,2], observed referral rates and estimated prevalence of CKD.

Methods

Data collection and analysis of the referrals

All written referrals from primary care to kidney services within a 4-year study period, 1 April 2004 to 31 March 2008, were included. Data from GP referrals were prospectively recorded including the postcode of the patient referred and of the referring GP, the primary reason for referral (Table 1) and reported patient comorbidity (Table 2).

Stages of CKD were classified using the National Kidney Federation KDOQI guidelines with the exception of stage 3, which was divided into stages 3A and 3B following the National Institute of Health and Clinical Excellence CKD guideline [11]. A proportion of patients were classified as eGFR unknown where there was no recorded value prior to referral from primary care.

Estimation of the prevalence of CKD by postcode sector

Estimation of CKD risk across Kent was calculated using age and gender data from the UK 2001 census [1]. The data, which were grouped by electoral wards, had to be reorganized to match the referral data, which were grouped by postcode sector. Where a postcode sector crossed electoral ward boundaries, the population characteristics from the electoral ward were applied in proportion to the population within each postcode sector involved. A postcode is composed of an out-code (area + district) and an in-code (sector + unit). Postcode sectors are represented by an out-code and the first digit of the in-code, for example CT2 9. The average size of the population of a postcode sector is ∼6500 and these are of the order of 9500 sectors in the UK of which 163 are in Kent, our study area.

Table 2. Classification of comorbidity of patients referred from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK

Comorbidity	Definition
Diabetes: type I and II, and glucose intolerance	Listed in past medical history, GP code, HbA1c > 7.0%, sustained raised blood glucose, anti-hyperglycaemic medication listed in prescribed medication
Hypertension	Listed in past medical history, GP code, antihypertensive therapy listed as prescribed medication
Ischaemic heart disease: angina, myocardial infarction, angiography and coronary artery surgery	Listed in past medical history, GP codes, nitrates listed as prescribed medication
Cardiac: arrhythmias, cardiomyopathy congestive cardiac failure, left ventricular failure and valvular disease	Listed in past medical history, GP codes
Vascular disease: cerebral vascular disease, stroke, claudication, peripheral vascular disease, transient ischaemic attack and aortic aneurysm	Listed in past medical history, GP codes, GP codes
Hyperlipidaemia: hypercholesterolaemia	Listed in past medical history, GP codes (raised serum lipids, cholesterol, triglycerides.)
Joint disorders: rheumatoid arthritis, osteoarthritis, joint pain, back pain, spondylosis gout and polymyalgia rheumatica	Listed in past medical history, GP codes
Respiratory diseases: chronic obstructive airways disease, asthma, emphysema, pulmonary fibrosis and pulmonary embolus	Listed in past medical history, GP codes, inhaled steroids, ventolin listed in prescribed medication, GP codes
Anaemia	Listed in past medical history, GP codes
Infection: urinary tract infection, cystitis septicaemia, chest infection and tuberculosis	Listed in past medical history, GP codes
Malignancy: all malignancy other than primary renal and prostate cancer	Listed in past medical history, GP codes
Gastroenterological disorders: gastric and duodenal ulceration, ulcerative colitis, Crohn's disease, coeliac disease, pancreatitis, diverticular disease, cirrhosis of the liver and irritable bowel syndrome	Listed in past medical history, GP codes
Urological: bladder tumour, benign prostatic hypertrophy, prostatic cancer, renal stone disease, bladder stone disease, transurethral resection of prostate and transurethral resection of bladder tumour	Listed in past medical history, GP codes
Renal other: nephrectomy, primary renal cancer, known chronic pyelonephritits, renal artery stenosis, adult polycystic kidney disease and single kidney	Listed in past medical history, GP codes
Family history: family history of adult polycystic kidney disease, hypertension and renal disease	Listed in past medical history, GP codes
Other: depression, hypothyroidism, psychiatric disorders and biochemical disorders	Listed in past medical history, GP codes, lithium listed in prescribed medication

This table shows how the comorbidity data were defined and grouped for analysis. The analysis only included comorbidity reported at the time of referral from primary to secondary care.

Mapping of referral patterns

The postcode of the patient was recorded in order to map the proportion of the population referred by postcode sector in Kent using Microsoft MapPoint® 2004 that took the population statistics from the 2001 census. The observed CKD referral rate at postcode sector level was calculated; this was expressed per 10 000 population per annum. For each referral, an assessment of renal function was made by using the serum creatinine measured either at the time of referral or within 6 months prior to the referral date. eGFR was calculated using the four-variable MDRD equation [12]. Creatinine assays used in Kent were directly calibrated to the method employed by the central laboratory used for the MDRD Study (Beckman Rate Jaffe/CX3 Synchron assay [13]).

Modelling the effect of chance on referral patterns

When prevalence estimates are compared in small areas, quite considerable differences may arise by chance alone. In order to model these differences, we used the extremal quotient (EQ) method, previously described by Deihr *et al*. [14]. In this analysis, the EQ was used to give an estimate of the amount of variation in referral rates seen by chance alone. We then compared this value to the observed value in our population. The maximum expected EQ was calculated using a combination of NEOERICA [5] and Office of National Statistics [1] data.

Association between the QOF GP reported prevalence and the estimated CKD prevalence

The following datasets were used to examine the correlation between QOF returns for the prevalence of stage 3–5 CKD, the expected prevalence of CKD and referral rates by specific GP practices.

Using the QOF database, renal disease returns for June 2007 in Kent, and the prospective audit of referrals to our department, the referral rates were compared against the reported prevalence of CKD by GP practices. Also, using the NEOERICA database [5] combined with the Office of National Statistics data as described above, the expected prevalence of CKD was compared to the reported prevalence of CKD by each area. These data were compared by postcode district because the QOF data crossed the postcode sector boundaries. However, aggregate figures have been used for countywide estimates of the expected prevalence, and the postcode district data have been used as shown in Figure 4, as discussed below.

The study period was divided into two groups in the following manner:

Group 1. Referrals between 1 April 2004 and 31 March 2006: this period was prior to the introduction of eGFR reporting, prior to the introduction of renal indicators in the QOF and prior to the widespread dissemination of the UK renal referral guidelines.

Group 2. Referrals between 1 April 2006 and 31 March 2008: this period followed the introduction of the above measures.

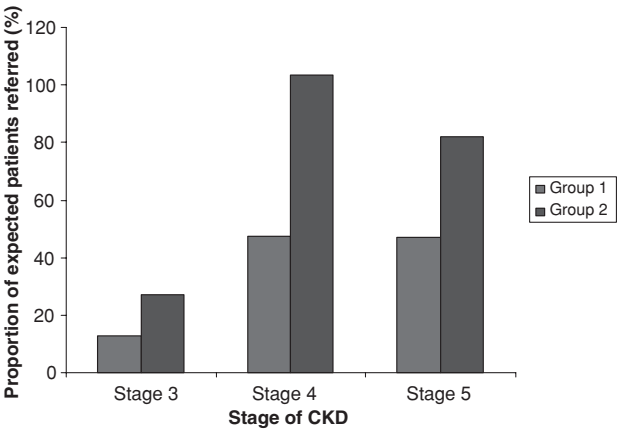

Fig. 1. Number of patients referred from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK. This is expressed as a proportion of expected prevalence by stage of chronic kidney disease (CKD).

Patient characteristics were presented as mean (± standard deviation). The comparison of means was performed using the χ^2-test for non-parametric variables. The one-way ANOVA (*t*-test) was performed for comparison of means between groups in parametric variables. *P*-value <0.05 was considered to be statistically significant. Statistical analyses were performed using SPSS, version 12.0 (SPSS Inc, Chicago, IL, USA)

Results

Group 1 (1 April 2004–31 March 2006)

Patient demographics and renal function at the time of referral. There were 1460 referrals in this time period. The mean age of all patients was 65.7 (±17.1 years). Age increased as mean GFR fell (P <0.001, ANOVA).

The overall mean eGFR of patients referred was 48.4 (±30.0) ml/min/1.73 m^2. In total, more males were referred, 835 (57.2%); however, the excess was only seen in stage 1–3 CKD. There was no difference in eGFR between males and females (males 45.9 ± 31.1 and females 46.4 ± 26.7 ml/min/1.73 m^2, $P = 0.76$).

Those with diabetes mellitus had a lower eGFR than those without (46.0 ± 26.7 ml/min/1.73 m^2 compared to 48.6 ± 30.0 ml/min/1.73 m^2, $P = 0.007$).

Reasons for referral. The specific reasons for referral are summarized in Figure 2a and b. The most common reasons for referral were an abnormal serum creatinine (or eGFR) and established kidney disease (835/1460; 57.2%). The lower their GFR the more likely the patients were to be referred. A total of 374/1460 (25.6%) patients were referred for evaluation of proteinuria/haematuria, people with eGFR ≥60 ml/min/1.73 m^2 were more commonly referred for evaluation of haematuria/proteinuria than those with lower levels of GFR [171/340; (50.3%) and 34/415; (8.2%) respectively; chi-square P <0.001]. The reasons for referral of people with eGFR <60 ml/min/1.73 m^2 were similar in groups 1 and 2.

Diabetic patients were mainly referred for an abnormal creatinine or known established kidney disease (298/459, 64.9%). However, a significant number were referred for investigation and management of proteinuria and/or haematuria (181/459, 39.4%).

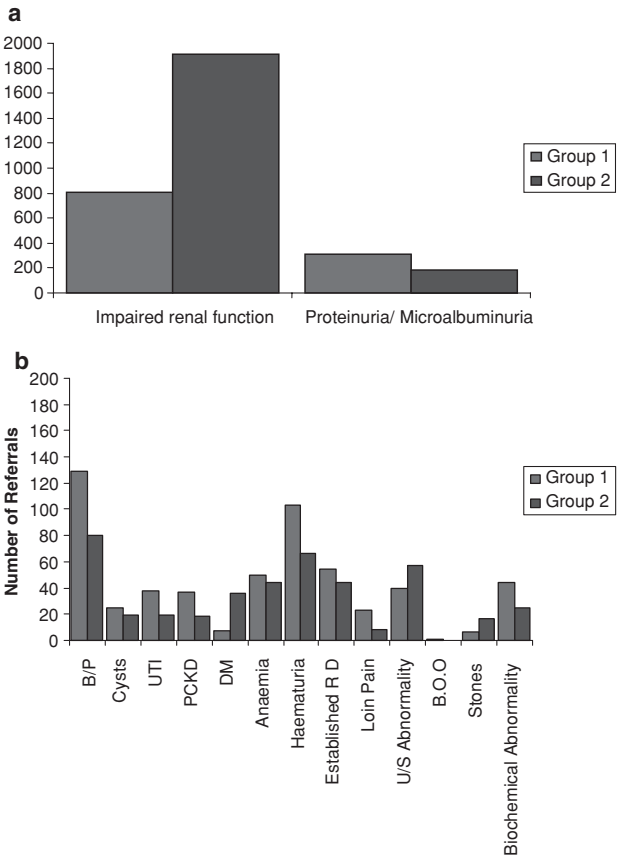

Fig. 2. (**a**) and (**b**): Documented reasons for referral from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK. B/P, hypertension; Cysts, acquired cystic disease; UTI, urinary tract infection; PCKD, autosomal dominant polycystic kidney disease; DM, diabetes mellitus; RD, renal disease; U/S, ultrasound; B.O.O., bladder outflow obstruction; Stones, nephrolithiasis.

Group 2 (1 April 2006–31 March 2008)

Gender, age and eGFR at referral. The number of referrals in the period following 1 April 2006 increased by 1325 giving a total of 2785, a 47.5% increase compared to group 1. Using data from our previous study [5], estimating the cost of referral of people with CKD to secondary care, we compared the observed referral rate with an expected referral rate in groups 1 and 2 (Figure 1). The mean age of people referred was 69.5 (±17.1 years), and age increased with worsening stage of CKD (P <0.001, one-way ANOVA).

Compared to group 1, fewer men were referred in this time period and proportionally fewer men were referred with stage 4 and 5 CKD; the overall eGFR of patients referred was lower (44.1 ± 22.5 ml/min/1.73 m^2), and the mean eGFR of women was lower than men (37.8 ± 22.5 versus 41.4 ± 22.4 ml/min/1.73 m^2, respectively, $P = 0.007$).

The diabetic patients' mean eGFR at referral was 48.7 ± 20 ml/min/1.73 m^2. This was significantly higher than in non-diabetics (42 ± 23.3 ml/min/1.73 m^2, $P = 0.004$).

Table 3. Number of patients in groups 1 and 2 referred from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK. This is classified by eGFR

GFR (ml/min/1.73 m^2)	Group 1, 1 April 2004–31 March 2006	Group 2, 1 April 2006–31 March 2008
≥60	340 (23.3%)	321 (11.5%)
45–60 (stage 3A)	148 (10.1%)	429 (15.4%)
30–44 (stage 3B)	389 (26.6%)	719 (25.8%)
15–29 (stage 4)	380 (26%)	830 (29.8%)
<15 (stage 5)	35 (2.4%)	61 (2.2%)
Stage unknown[a]	168 (11.5%)	425 (15.3%)
Total	1460	2785
Diabetes mellitus (type 1 or 2)	459	714

[a]Stage unknown denotes no recorded eGFR or serum creatinine in the 6 months prior to referral from primary to secondary care.

Reasons for referral. In group 2, as can be seen in Figure 2a, the most common reasons for referral were impaired renal function and established kidney disease (1955/2785; 70.2%). Proportionately more patients were referred for this reason, compared to group 1. As with group 1, the lower their GFR the more likely the patients were to be referred. A similar proportion of referrals of people with diabetes were seen in group 2 compared with group 1 (Table 3).

Comorbidity of all patients

Table 4 outlines the reported comorbidity of all patients. The prevalence of reported ischaemic heart disease increased with worsening stage of CKD. However, the prevalence of reported hypertension was similar and rather low between all groups as was the proportion of patients with reported hyperlipidaemia. There was no difference in the distribution of reported comorbidity at the time of referral between groups 1 and 2 (Table 4), with the exception of hypertension in those where renal function was unknown; this is because the primary reason for referral in this group was hypertension.

Mapping of referrals

The patterns of referral are shown in the two images in Figure 3. Figure 3a demonstrates the pattern of referral in group 1 prior to the introduction of guidelines, eGFR reporting and renal indicators in the QOF. There was a higher referral rate in East Kent as compared to West Kent that may represent an effect caused by the location of the Renal Unit at Canterbury (Figure 3a and b). There is considerable heterogeneity between referral rates by a postcode sector in group 1. Figure 3b demonstrates the pattern of referral in group 2 following the introduction of guidelines, eGFR reporting and renal indicators in the QOF. It shows a more homogeneous pattern across the county. The histograms shown in Figure 3c and d demonstrate that the variance from the mean number of referrals has reduced in group 2. The EQ for both periods (groups 1 and 2) was higher than expected by chance alone (greater than 2 SD higher than the mean) although it is not possible to compare EQ between the periods because the number of referrals doubled between study periods. This shows that the extremes of referral in some sectors remain, but the majority of referring postcodes are closer to the mean. This is unlikely to be simply due to regression to the mean as these data are not analysed cumulatively.

Results of the small area analysis

In order to establish that our observed EQ did not simply occur by chance alone, the EQ statistics, as described above, were calculated using the unadjusted population size. The simulated referral rates had a mean EQ of 8.3 with a standard deviation of 9.5. The upper 95% confidence interval for EQ was 27, and the observed EQ in both of the study periods was greater than this; therefore it was not due to random variation in referral pattern alone.

Association between the QOF reported CKD prevalence and the estimated CKD prevalence

We found no correlation between the QOF reported prevalence of CKD by postcode district and the expected prevalence of CKD ($R^2 = 0.017$). In addition, we found no correlation between the QOF reported prevalence per postcode district and the referral rate ($R^2 = 0.0008$), data not shown. However, there was a weak correlation between referral rate by postcode district and expected prevalence of CKD ($R^2 = 0.177$), as illustrated in Figure 4.

Discussion

This prospective study of referrals from primary care to a renal centre over 4 years demonstrates changes in referral patterns over the period studied. The number of patients being referred to renal services significantly increased after April 2006 in keeping with findings in other studies [15,16] Moreover, of those people being referred a greater proportion of patients had stage 3B, 4 and 5 CKD, but there has been little change in the number of people referred with stage 1 and 2 CKD. The mapping of the referral data (Figure 3a and b) demonstrates considerable heterogeneity across the region particularly prior to April 2006. Subsequent to that, the variability in referral pattern has reduced. However, there are still outliers contributing to a similar extremal quotient in referral numbers.

The study has demonstrated that the changes in local and national policy around April 2006 have had a significant effect on referral behaviour by primary care, but the reason for this is still open to question, as little correlation was observed, either between the reported QOF prevalence and the expected CKD prevalence, or between the reported QOF prevalence and the observed referral numbers (Figure 4).

The aim of recent initiatives in the UK was to highlight CKD and its importance to primary care providers, particularly through the implementation of eGFR reporting and the inclusion of renal indicators in the QOF. These initiatives followed previously published guidelines for the referral of patients with CKD and have meant that the greatest increase in referrals has been seen in those with more advanced CKD. This is likely to be due to the fact that eGFR

Table 4. Documented comorbidity of patients referred from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK

Comorbidity	Stage 1 + 2		Stage 3A		Stage 3B		Stage 4		Stage 5		No Cr	
Group	1	2	1	2	1	2	1	2	1	2	1	2
Diabetes	99 (30%)	69 (20%)	48 (34%)	112 (25%)	144 (38%)	217 (29%)	128 (35%)	252 (29%)	5 (14%)	15 (24%)	1 (1%)	75 (17%)
Hypertension	151 (46%)	131 (37%)	79 (56%)	245 (55%)	252 (67%)	465 (63%)	262 (72%)	504 (59%)	26 (72%)	29 (46%)	3 (2%)	169 (38%)
IHD	20 (6%)	22 (6%)	23 (16%)	60 (13%)	111 (30%)	162 (22%)	79 (22%)	206 (24%)	10 (28%)	21 (33%)	0 (0%)	49 (11%)
Cardiac	51 (16%)	5 (1%)	32 (23%)	21 (5%)	108 (29%)	50 (7%)	103 (28%)	76 (9%)	9 (25%)	6 (10%)	1 (1%)	19 (4%)
Vascular disease	8 (2%)	2 (1%)	6 (4%)	3 (1%)	36 (10%)	16 (2%)	40 (11%)	18 (2%)	4 (11%)	0 (0%)	0 (0%)	4 (1%)
Hyperlipidaemia	1 (0%)	13 (4%)	2 (1%)	21 (5%)	2 (1%)	41 (6%)	4 (1%)	41 (5%)	1 (3%)	2 (3%)	0 (0%)	11 (3%)
Joint disorders	14 (4%)	7 (2%)	14 (10%)	16 (4%)	31 (8%)	32 (4%)	36 (10%)	36 (4%)	2 (6%)	0 (0%)	0 (0%)	7 (2%)
Respiratory	22 (7%)	4 (1%)	9 (6%)	22 (5%)	25 (7%)	34 (5%)	36 (10%)	54 (6%)	3 (8%)	0 (0%)	1 (1%)	4 (1%)
Anaemia	0 (0%)	0 (0%)	1 (1%)	2 (0%)	0 (0%)	3 (0%)	4 (1%)	6 (1%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)
Infection	5 (2%)	1 (0%)	3 (2%)	4 (1%)	4 (1%)	3 (0%)	4 (1%)	4 (0%)	1 (3%)	0 (0%)	0 (0%)	5 (1%)
Malignancy	4 (1%)	11 (3%)	6 (4%)	23 (5%)	31 (8%)	50 (7%)	36 (10%)	48 (6%)	9 (25%)	2 (3%)	0 (0%)	17 (4%)
Gastro	4 (1%)	6 (2%)	2 (1%)	8 (2%)	3 (1%)	11 (1%)	25 (7%)	4 (0%)	1 (3%)	1 (2%)	0 (0%)	4 (1%)
Urological	18 (5%)	7 (2%)	14 (10%)	18 (4%)	34 (9%)	34 (5%)	6 (2%)	40 (5%)	5 (14%)	1 (2%)	0 (0%)	15 (3%)
Renal other	45 (14%)	27 (8%)	18 (13%)	19 (4%)	43 (11%)	25 (3%)	47 (13%)	19 (2%)	6 (17%)	0 (0%)	1 (1%)	20 (5%)
Family history	17 (5%)	1 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Other	54 (16%)	38 (11%)	15 (11%)	42 (9%)	47 (13%)	63 (9%)	45 (12%)	74 (9%)	1 (3%)	6 (10%)	2 (1%)	32 (7%)

For definitions of comorbidity refer to Table 2.
Group 1 refers to the period 1 April 2004–31 March 2006.
Group 2 refers to the period 1 April 2006–31 March 2008.
IHD, ischaemic heart disease; Gastro, gastroenterological disorders.

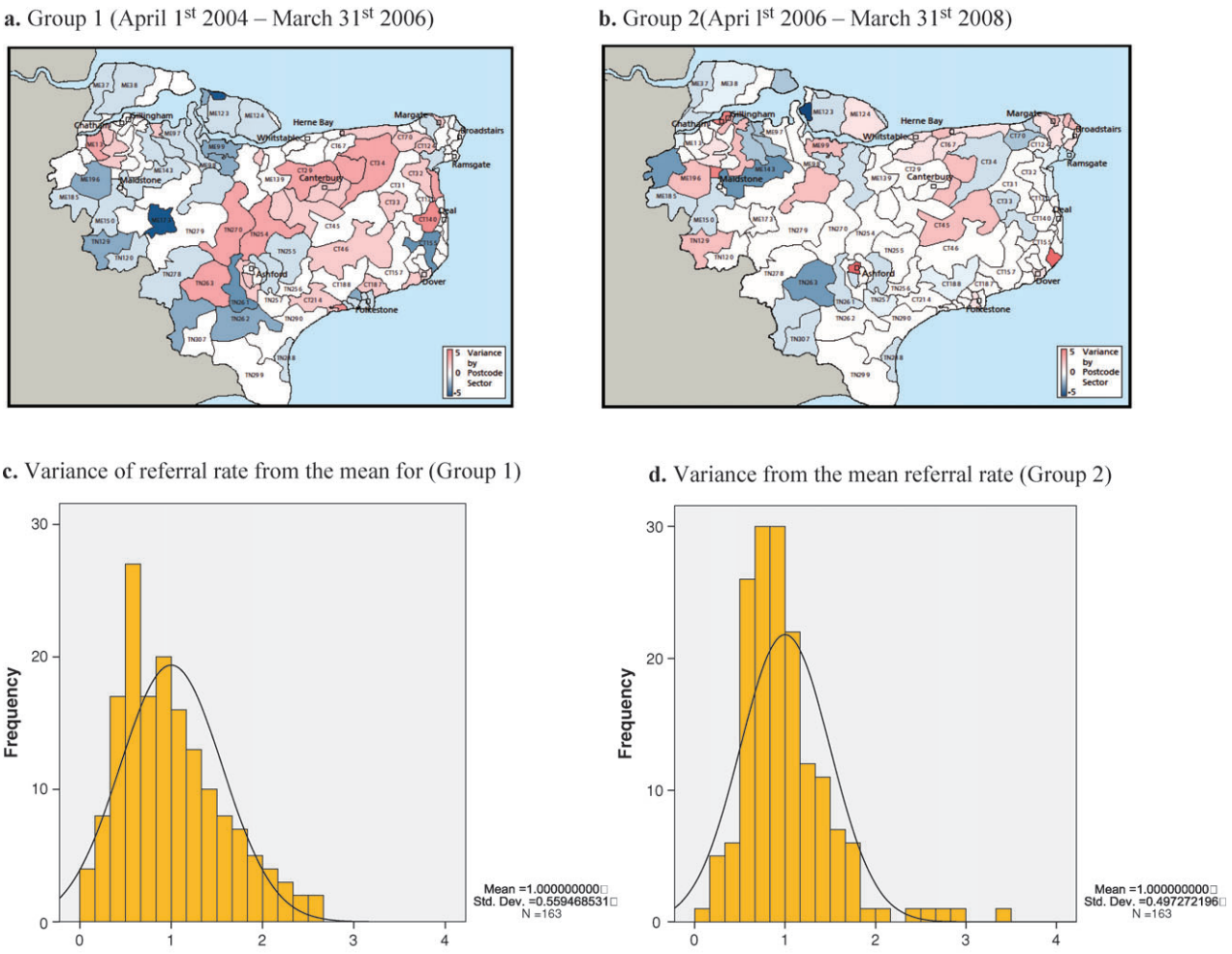

Fig. 3. Density maps of referral patterns of patients from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK. This is corrected for population size and demographics for the catchment area. (**a**) Group 1 (1 April 2004–31 March 2006). (**b**) Group 2 (1 April 2006–31 March 2008). (**c**) Variance of referral rate from the mean for (group 1). (**d**) Variance from the mean referral rate (group 2). The variance in referral rates in Groups 1 and 2 are expressed as multiples of the difference from the mean for each group.

reporting has highlighted more advanced CKD to GPs and the previously published referral guidelines concentrated on the management of stage 3–5 CKD.

There is, however, much debate about the impact of guidelines on referral practices. For example, Baker *et al*. [17] demonstrated that guidelines had little effect on referral of patients with back pain for an x-ray. Lea *et al*. [18] studied the level of knowledge of CKD amongst primary care providers and found little correlation between reported use of guidelines and knowledge of risk of CKD and concluded that guidelines have little effect on referral practice. Conversely, Griffiths *et al*. [19] found an improvement in appropriateness of referral and decreased inappropriateness of referral of patients with psoriasis following the implementation of guidelines, although these were accompanied by nurse support and education implying that this was not just the effect of guidelines alone. The observed effect in our study is likely to be due to the combined effect of all the initiatives occurring since April 2006.

This study has also demonstrated considerable heterogeneity in referral practice across our catchment area. There are many potential explanations for this observed variance, including patient characteristics, GP and practice characteristics, list sizes and practice policy. It is unlikely that differences in patient characteristics account for the observed variance because referral rates were standardized for population characteristics using ONS data. However, the use of ONS [1] data is a potential weakness of this study, as these are historical data and populations may have significantly altered between the 2001 census and the study period. Our standardization did not take into account other factors that may have an impact on the prevalence of CKD such as measures of deprivation. For example, Hippisley-Cox [20] showed that an underprivileged score accounted for 29% of total of both medical and surgical referral variance. Other studies [21] have demonstrated that population characteristics have little impact on GP referral behaviour. We have not included an analysis of practice structures across our area that may account for differences in referral variance, for example, the proportion of single-handed practices. The practice structure may have an impact on referral rates, and some studies have shown that single- and double-handed

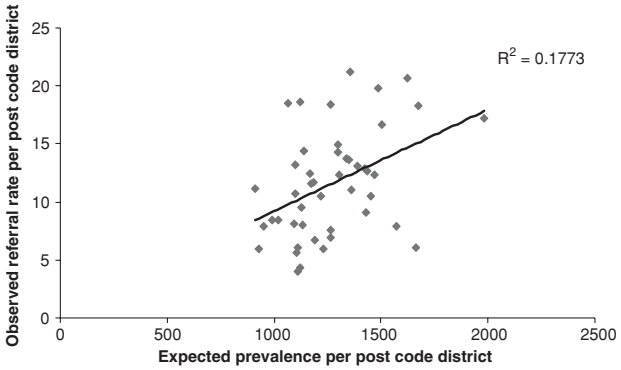

Fig. 4. A scatter plot comparison by postcode district the number of patients referred from primary to secondary care for investigation of kidney disease between 1 April 2004 and 31 March 2008 in Kent, UK, with the expected prevalence of CKD by postcode district.

practices tend to refer more patients [20,22]. Others have found the opposite [23]. In our study, there tended to be a lower referral rate from the Medway towns where there is a higher proportion of single-handed practices.

A potential confounding factor for the change in referral rate in some practices is that towards the end of the study period a computerized decision support tool was implemented in part of our study area. However, this decision support tool was only implemented in a population of ∼60 000 people at the time of this study (5% of the total population).

Many studies have observed that the distance from local hospitals has an impact on referral rates, particularly in rural practices [24], but these differences may be due to differences between rural and urban practices [25]. Our study did not demonstrate a clear effect of distance from our centre and referral rates; this may have been influenced by the establishment of outreach clinics in our satellite dialysis units well in advance of the study period.

The most likely explanation for the increase in referral rates in the period studied is the introduction of eGFR reporting to primary care, as this would explain the dramatic increase within a month of implementation. This is supported by the fact that our study has demonstrated that primary care providers preferentially refer people with stage 3–5 CKD. This suggests that eGFR reporting has increased the awareness of CKD as a whole, but in addition, has promoted recognition of CKD earlier as evidenced by the greatest increase observed in referrals at stage 3 CKD and the earlier referral of people with diabetes in group 2.

Whilst we have seen some improvement in the variance of referral pattern, there is still considerable heterogeneity across our region. It is possible that the recent introduction of NICE guidelines [11] and improved registers of people with CKD as part of the QOF will further standardize referral patterns.

Conclusion

This study has demonstrated that referral patterns have changed between 1 April 2004 and 31 March 2008 in Kent. The main findings are an increase in referral rate and in the age at referral without a significant change in comorbidity of the people referred.

The variation in referral pattern, examined by small area analysis, has altered, and there appears to have been a significant reduction in heterogeneity when analysing the distribution.

Overall it would appear that recent healthcare initiatives in the field of renal medicine have had a significant, and we would contend, beneficial impact on referral behaviour. This has potentially reduced healthcare inequalities across the County.

Conflict of interest statement. None declared.

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The clinicopathological implications of endothelial tubuloreticular inclusions found in glomeruli having histopathology of idiopathic membranous nephropathy

An-Hang Yang[1,2], Bing-Shi Lin[3], Ko-Lin Kuo[4], Chung-Chen Chang[5], Yee-Yung Ng[6] and Wu-Chang Yang[6]

[1]Department of Pathology and Laboratory Medicine, Ultrastructural and Molecular Pathology, Taipei Veterans General Hospital, [2]Department of Pathology, School of Medicine, National Yang-Ming University, [3]Division of Nephrology, Department of Medicine, Shin Kong Wu Ho Su Memorial Hospital, [4]Division of Nephrology, Department of Medicine, Taipei Branch, Buddhist Tzu Chi General Hospital, [5]Department of Nephrology, Cheng Hsin Rehabilitation Medical Center and [6]Division of Nephrology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan

Correspondence and offprint requests to: An-Hang Yang; E-mail: ahyang@vghtpe.gov.tw

Abstract

Background. The pathological recognition of secondary membranous nephropathy (MN) is sometimes difficult, especially in those showing primary idiopathic MN-like histomorphology. The ultrastructural finding of tubuloreticular inclusions (TRIs) in MN always evokes suspicion of their association with underlying diseases such as viral infections and autoimmune diseases. However, it is not clear whether some other underlying diseases are associated with TRI expression in MN. Since treatment of the underlying diseases is the primary consideration for the management of secondary MN, it is important to make out the clinical significance of TRI expression in MN.

Methods. Excluding the patients fully qualified for systemic lupus erythematosus (SLE) diagnostic criteria, we recruited 36 cases having a renal biopsy featured with histopathology of primary idiopathic MN but ultrastructural appearance of TRIs in glomerular endothelial cells (GECs). We investigated their clinical and pathological profiles and focused on the potential connections with the underlying diseases and treatment outcomes.

Results. One-third of our cases showed no identifiable underlying aetiology. Other underlying disease groups included autoimmune disease (25%), hepatitis (14.7%), potential *Helicobacter pylori* infection (13%), diabetes (5.6%) and lymphoma (5.6%). Pathologically, patients in the autoimmune group tended to have more heterogeneous membranous deposits with frequent mesangial and subendothelial deposits. While all patients of the autoimmune group presented complement C1q in glomeruli, more than two-thirds of the patients in others groups were negative for C1q. Clinically, the patients in autoimmune and hepatitis groups were younger in age and had less remission of proteinuria following treatment, while the other groups of patients achieved partial or complete remission more frequently.

Conclusion. The underlying diseases of our patients were consistent with the major disease categories that have been frequently linked to secondary MN. The HP group was more akin to undefined groups regarding their pathological and clinical profiles. Since the MN in the undefined group might be the only renal manifestation antedating other clinical presentations of the corresponding underlying disease, a