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Improving coding and primary care management for patients with chronic kidney disease:

an observational controlled study in East London

Abstract

Background
The UK national chronic kidney disease (CKD) audit in primary care shows diagnostic coding in the electronic health record for CKD averages 70%, with wide practice variation. Coding is associated with improvements to risk factor management; CKD cases coded in primary care have lower rates of unplanned hospital admission.

Aim
To increase diagnostic coding of CKD (stages 3–5) and primary care management, including blood pressure to target and prescription of statins to reduce cardiovascular disease risk.

Design and setting
Controlled, cross-sectional study in four East London clinical commissioning groups (CCGs).

Method
Interventions to improve coding formed part of a larger system change to the delivery of renal services in both primary and secondary care in East London. Quarterly anonymised data on CKD coding, blood pressure values, and statin prescriptions were extracted from practice computer systems for 1-year pre- and post-initiation of the intervention.

Results
Three intervention CCGs showed significant coding improvement over a 1 year period following the intervention (regression for post-intervention trend $P<0.001$). The CCG with highest coding rates increased from 76–90% of CKD cases coded; the lowest coding CCG increased from 52–81%. The comparison CCG showed no change in coding rates. Combined data from all practices in the intervention CCGs showed a significant increase in the proportion of cases with blood pressure achieving target levels (difference in proportion $P<0.001$) over the 2-year study period. Differences in statin prescribing were not significant.

Conclusion
Clinically important improvements to coding and management of CKD in primary care can be achieved by quality improvement interventions that use shared data to track and monitor change supported by practice-based facilitation. Alignment of clinical and CCG priorities and the provision of clinical targets, financial incentives, and educational resource were additional important elements of the intervention.

Keywords
chronic kidney diseases; disease coding; observational study; primary care.

INTRODUCTION

The estimated prevalence of chronic kidney disease (CKD) stages 3–5 in the UK is 5–6%.[1] Early identification of patients with CKD in primary care, particularly among those with risk factors such as diabetes and hypertension, enables proactive management of blood pressure, cardiovascular risk, and lifestyle factors, and subsequent referral to specialist services where there is evidence of progressive disease.[2] There is some evidence, albeit inconsistent,[3] that progression of CKD can be delayed by reduction of blood pressure.[4] High rates of cardiovascular risk associated with CKD can be reduced by blood pressure control and the use of statins.[5,6] There is evidence that delivery of these interventions in primary care can be extended through the target population by the use of quality improvement tools including local audits of CKD management, feedback, and education.[7,8]

Delivering improvements to the management of CKD in primary care involves a range of organisational and clinical negotiations. There is a continuing debate on whether the early identification of CKD is clinically important, or whether it is an example of overdiagnosis and prone to overtreatment.[9,10] This contributes to ambivalence among clinicians around disclosing a diagnosis of CKD to individuals. In turn this subverts the opportunities for patient engagement with lifestyle changes that lie at the heart of early management.[11] Additional challenges include the uncertainty of best clinical management in older and multimorbid patients,[12,13] and the complexity of the Read Codes used for labelling CKD stage in GP computer systems.

Adding a diagnostic CKD Read Code to the electronic health record enables regular recall for review, and provides a marker for the increased clinical scrutiny necessary for better management, in particular blood pressure control, an offer of lipid-lowering medication, and the avoidance of hazardous prescribing. The first report from the UK national CKD audit in primary care demonstrated that, on average, 70% of biochemically confirmed cases of CKD (stages 3–5) were given a diagnostic Read Code.[1] There was wide variation between practices, with the proportion of CKD cases uncoded ranging between 0–80%. Further analysis based on data from the national CKD audit demonstrates an association between coding status and management activity in primary care. Coded cases had higher rates of blood pressure to target, statin use, assessment of urinary albumin creatinine ratio, and immunisations.[14]

The second part of the national CKD audit linked hospital data on outcomes to

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How this fits in

Diagnostic coding for chronic kidney disease (CKD) in the GP record is less than optimal. Absence of coding is associated with poorer blood pressure control and management of cardiovascular risk; observational data also demonstrate higher rates of unplanned hospital admission among uncoded cases. This project demonstrates that a rapid and sustained improvement in CKD coding can be achieved across clinical commissioning groups using a range of quality improvement techniques.

the cases identified in primary care.[15] There were associations between lack of coding in primary care with higher rates of unplanned hospital admissions, acute kidney injury admissions, and deaths. The magnitude of the difference in admission rates between coded and uncoded patients increases as kidney function declines. As the estimated glomerular filtration rate (eGFR) declines below 40 mL/min/1.73 m^2 the unplanned admission rate doubles for uncoded cases.[15]

Translating evidence into routine clinical practice faces multiple challenges, including understanding professional knowledge and beliefs, and an appreciation of the structure, organisation, and context of health care in any given locality. Some of the key strategies for change management described by Kotter were reflected in planning the implementation of this programme.[16] These include building the case for change and forming a guiding coalition that includes both clinicians and managers; empowering others to act on the programme by the provision of education; comparative performance data and quality improvement tools; creating early wins for the programme; and consolidating the new approach into work as usual to ensure sustainability.

This quality improvement programme aimed to modify healthcare professionals' behaviour to increase the recorded diagnosis of CKD (stages 3–5) and improve key aspects of primary care management including blood pressure control and provision of lipid-lowering medication for cardiovascular risk reduction.

METHOD

Study design and setting

This prospective, controlled, cross-sectional study was set in East London primary care between 2016–2018. All 130 GP practices in three inner East London clinical commissioning groups (CCGs; City & Hackney, Newham, and Tower Hamlets) received all elements of the intervention. The 37 practices in a fourth CCG (Waltham Forest), referred to as the 'control CCG', did not start the intervention package until 1 year later and acted as a comparison group. In the 2011 UK Census, almost half of the population in each of these CCGs was recorded to be of non-white ethnic origin,[17] and the English Indices of Deprivation 2015 show that all three intervention localities fall in the lowest decile for social deprivation in England.[18]

Intervention

The intervention was conceived as a renal learning health system,[19] in which data from all parts of the system are used as feedback to improve both the future organisation and clinical performance within it. The interventions that supported CKD coding were part of a larger system change to the delivery of renal care, which encompassed the patient pathway from diagnostic identification and management in primary care through to attendance at the nephrology outpatient clinic.

The system-wide changes to the delivery of renal care had four components:

- a package of IT tools that supports practices to identify patients requiring diagnostic coding, improvements to blood pressure and cardiovascular management, and alerts to identify cases with a falling eGFR. Regular practice facilitation on clinical data management was offered routinely by the Clinical Effectiveness Group (CEG) who supported this package (https://www.qmul.ac.uk/blizard/ceg/). Additional renal-specific clinical facilitation, which focused on the importance of CKD coding and cardiovascular and blood pressure management, was offered to practice teams in the lowest decile of CKD coding;
- renal education and case discussions for GPs and practice nurses at CCGs, and cluster and practice events in all participating CCGs;
- a virtual CKD hospital clinic enabling nephrologists to view the primary care electronic health records, with informed patient consent, and document advice in the shared record available for all primary care clinicians to see. The clinic had a short wait time (approximately 7 days; previously the average wait was 64 days) with the aim of providing timely clinical advice for GPs in the

electronic health record, and triaging the minority of patients who required further investigation into outpatient clinics; and

- specialist renal nurse-led patient education sessions for those referred into the service.

Within this framework the interventions that primarily targeted the improvement of CKD coding and management included practice-based education sessions, the package of computerised quality improvement tools with facilitation, data sharing across practices, and CCG provision of financial incentives for target achievement at practice and cluster level.

Important contextual background to the intervention is that all 130 practices in the three intervention CCGs had prior experience of working with clinical data entry templates, quality improvement tools, and performance dashboards developed by the CEG. They also had CEG practice facilitation supporting the effective use of primary care data for better management of long-term conditions.[20] All three intervention CCGs supported the renal programme with a range of practice targets and financial incentives built into the enhanced service element of general practice contracts during the intervention period.

The control CCG began implementation of the virtual CKD clinic during the intervention year, and had clinician education sessions, but had no quality improvement tools or regular facilitation.

Data collection

Renal function, expressed as the eGFR, was calculated from recorded creatinine using the four-variable modification of diet in renal disease (MDRD) equation, which adjusts for sex and black ethnicity.[21] The study population with CKD (stages 3–5) in each CCG was identified from eGFR values of <60 mL/min/1.73 m^2 in the two most recent readings at least 3 months apart.

Demographic and clinical data were obtained for all adults >18 years with biochemical evidence of CKD. Patient-level variables included age; sex; ethnicity; latest blood pressure values; and diagnostic Read Codes for diabetes mellitus, hypertension, and CKD. All data were anonymised, and managed according to UK NHS information governance requirements.

Anonymised baseline practice coding and primary care management data for each of the three intervention CCGs were collected on a quarterly basis through EMIS Web (https://www.emishealth.com/products/emis-web?tab=primary-caref) for 1 year before the start of the intervention, and a further year following intervention. This was collated into CCG- and practice-level dashboards, and shared with commissioners and practice staff. Quarterly data from the control CCG were not available before April 2016. Reflecting the open cohort design, the population at each quarter differed from the previous one, reflecting the additions and losses from GP-registered lists. A quarterly CKD service newsletter was also circulated, providing further feedback to practices on coding performance.

All statistical analyses were performed using Stata (version 14). Linear regression analysis was used to examine the change in trend of the proportion of patients with a CKD Read Code pre- and post-intervention for each CCG. Proportions with 'blood pressure to target' and statin prescriptions were examined pre- and post-intervention. 'Blood pressure to target' refers to all patients with biochemical evidence of CKD with a blood pressure <140/70 mmHg, or <130/80 mmHg for those with diabetes or a urinary albumin creatinine ratio >70 mg/mmol. For non-diabetic patients with no recorded urinary albumin creatinine ratio values, the higher blood pressure target was used. A multilevel logistic regression model was used to observe the univariate and adjusted odds ratios (OR) in patients on statins and patients with a blood pressure to target, comparing intervention and control CCGs at the beginning and end of the study period. Standard errors were adjusted by clustering by practice.

The study conformed to the Standards for Quality Improvement Reporting Excellence (SQUIRE V2.0) guidance.[22]

RESULTS

Data were collected for 167 practices, of which 130 were in the three intervention CCGs and 37 were in the control group. At the final data collection point (April 2018) the number of people with biochemical evidence of CKD (stages 3–5) across all practices was 21 428.

Following the quarterly data collection before and after intervention, all three

Table 1. Regression for post-intervention trend in CKD coding

CCG	Coding change/quarter, %	*P*-value	95% CI
Tower Hamlets	2.85	*P*<0.001	1.73 to 3.96
City & Hackney	2.76	*P*<0.001	1.96 to 3.55
Newham	5.03	*P*<0.001	3.76 to 6.28

CCG = clinical commissioning group. CKD = chronic kidney disease.

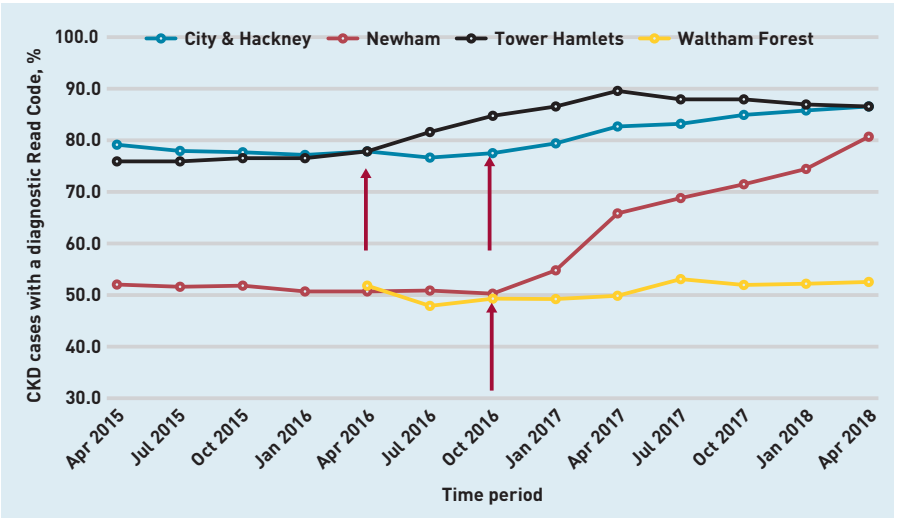

Figure 1. Coding improvement across three intervention CCGs in East London compared with the control CCG (Waltham Forest), showing percentage of CKD cases with a diagnostic Read Code. The red arrows indicate the start of the intervention: Tower Hamlets in April 2016, Newham and City & Hackney in October 2016. Data from Waltham Forest were only available from April 2016. CCG = clinical commissioning group. CKD = chronic kidney disease.

intervention CCGs showed significant coding improvement over a 1-year period following the intervention (regression for post-intervention trend $P<0.001$, Table 1). The CCG that started with the highest coding rates increased from 76% to 90% of CKD cases coded, and the CCG with lowest coding rates increased from 52% to 81% (Figure 1). The control CCG showed no change in coding over the 2-year period (April 2016 to April 2018). Variation in practice performance was also reduced (Figure 2).

Changes in the proportion of CKD cases with blood pressure to target, and those prescribed lipid-lowering medication over the 2-year period, were examined for all people with CKD in the three intervention CCGs combined. There was a significant increase in the proportion of people with blood pressure achieving target levels (difference in proportion $P<0.001$). Differences in statin prescribing were not significant (Table 2).

The management of blood pressure and cardiovascular disease (CVD) risk (statin prescribing) between control and intervention CCGs was compared at baseline (April 2016) and at the end of the study period (April 2018). At both baseline and endpoint,

Figure 2. Practice CKD coding: improvement and reduction in practice variation, Newham CCG, 2016–2018. Each dot represents a practice. The funnel plot (a) shows practice coding performance at the start of the intervention. The funnel plot (b) shows coding performance at the end of the project. The tracer plots on the right-hand side show the changes in coding rates, tracked over 2 years, by eight practices that started in the lowest coding quintile. Practices in green are two standard deviations above the mean coding rate. CCG = clinical commissioning group. CKD = chronic kidney disease.

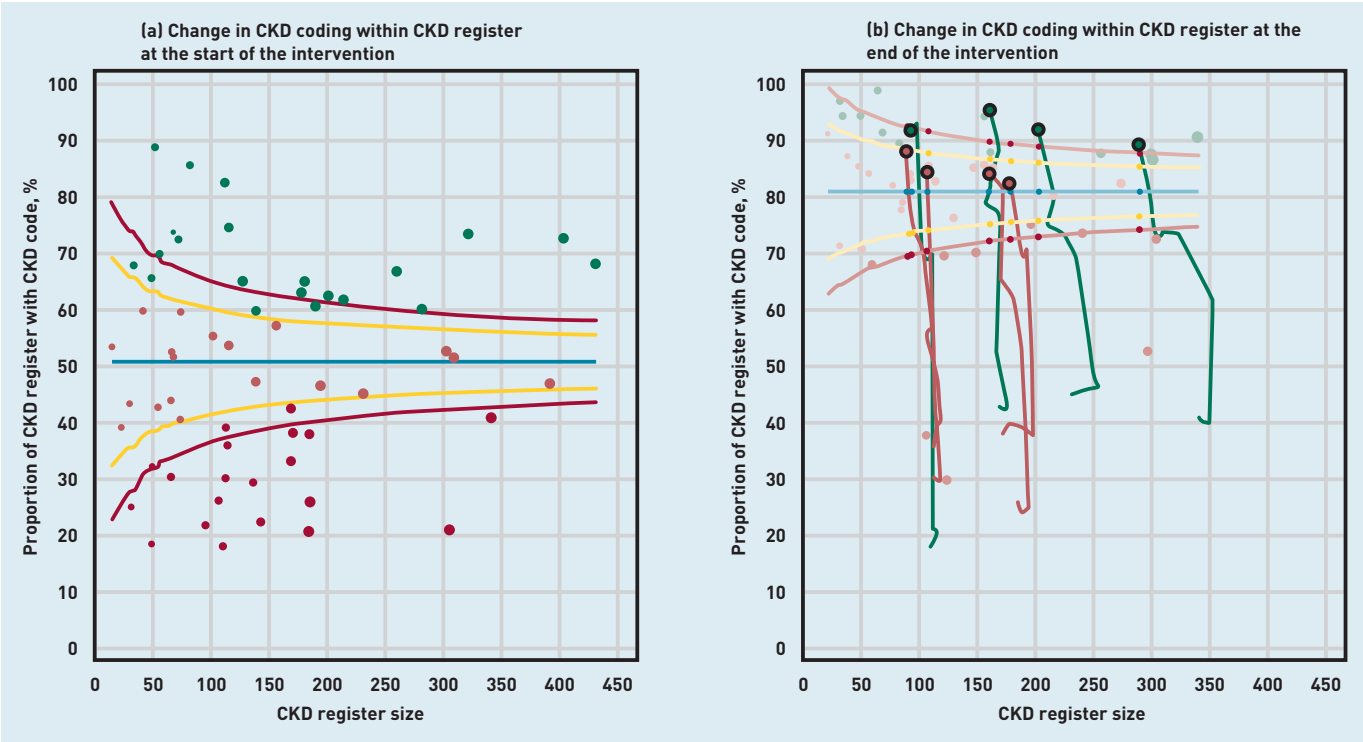

Table 2. Changes in the proportion of people with CKD achieving blood pressure to target[a] and statin prescribing in the three intervention CCGs over the 2-year study period

	Pre-intervention: January 2016 (*N* = 16 298) Mean proportion	Post-intervention: April 2018 (*N* = 15 811)	*P*-value[b]
Blood pressure to target[c]	0.52	0.54	<0.001
Statin use[c]	0.75	0.76	0.064

[a]All patients with CKD with blood pressure <140/90 mmHg or <130/80 mmHg if diabetic and/or urinary albumin creatinine ratio >70 mg/mmol. [b]A test of proportion was conducted to compare proportions 1 year pre- and post-intervention. [c]N = 16 300. CCGs = clinical commissioning groups. CKD = chronic kidney disease.

Table 3. Characteristics of all study patients with biochemical evidence of CKD (stages 3–5) at the end of the study period

	Total/all CCGs *N* (%) 21 428 (100.0)	Waltham Forest *N* (%) 5617 (26.2)	Tower Hamlets *N* (%) 4933 (23.0)	Newham *N* (%) 7250 (33.8)	City & Hackney *N* (%) 3628 (16.9)
Sex[a]					
Female	12 200 (56.9)	3222 (57.4)	2798 (56.7)	4124 (56.9)	2056 (56.7)
Male	9226 (43.1)	2393 (42.6)	2135 (43.3)	3126 (43.1)	1572 (43.3)
Age group, years					
<60	3510 (16.4)	797 (14.2)	749 (15.2)	1381 (19.0)	583 (16.1)
60–69	4103 (19.2)	977 (17.4)	956 (19.4)	1555 (21.5)	615 (17.0)
70–79	6245 (29.1)	1730 (30.8)	1346 (27.3)	2159 (29.8)	1010 (27.8)
≥80	7570 (35.3)	2113 (37.6)	1882 (38.2)	2155 (29.7)	1420 (39.1)
Ethnic group					
White	10 624 (49.6)	3213 (57.2)	2588 (52.5)	2941 (40.6)	1882 (51.9)
South Asian	6069 (28.3)	1042 (18.6)	1782 (36.1)	2846 (39.3)	399 (11.0)
Black	2999 (14.0)	657 (11.7)	330 (6.7)	1068 (14.7)	944 (26.0)
Other	851 (4.0)	174 (3.1)	134 (2.7)	289 (4.0)	254 (7.0)
Not stated	885 (4.1)	531 (9.5)	99 (2.0)	106 (1.5)	149 (4.1)
Diabetes					
No	12 477 (58.2)	3612 (64.3)	2682 (54.4)	4131 (57.0)	2052 (56.6)
Yes	8951 (41.8)	2005 (35.7)	2251 (45.6)	3119 (43.0)	1576 (43.4)
Hypertension					
No	5167 (24.1)	1529 (27.2)	1227 (24.9)	1746 (24.1)	665 (18.3)
Yes	16 261 (75.9)	4088 (72.8)	3706 (75.1)	5504 (75.9)	2963 (81.7)
Statins					
No	5784 (27.0)	1932 (34.4)	913 (18.5)	1999 (27.6)	940 (25.9)
Yes	15 644 (73.0)	3685 (65.6)	4020 (81.5)	5251 (72.4)	2688 (74.1)
BP to target[b]					
No	10 396 (48.5)	3026 (53.9)	2185 (44.3)	3666 (50.6)	1519 (41.9)
Yes	11 032 (51.5)	2591 (46.1)	2748 (55.7)	3584 (49.4)	2109 (58.1)
Mean systolic BP (SD), mmHg	131.1 (15.2)	132.7 (15.5)	130.6 (15.5)	131.1 (14.8)	129.2 (14.7)

[a]Data not available for all patients. [b]All patients with CKD with blood pressure <140/90 mmHg or <130/80 mmHg if diabetic and/or urinary albumin creatinine ratio >70 mg/mmol. BP = blood pressure. CKD = chronic kidney disease. SD = standard deviation.

the intervention CCGs performed better than the control CCG. Endpoint comparison shows blood pressure to target (adjusted OR 1.48, 95% confidence interval [CI] = 1.29 to 1.71) and statin prescribing (adjusted OR 1.41, 95% CI = 1.23 to 1.60; Tables 3–5).

Differences in blood pressure and statin prescribing were also examined by each participating CCG. This demonstrates almost twice the odds of statin use in those with CKD in Tower Hamlets compared with Waltham Forest (adjusted OR 1.95

Table 4. Odds ratios for statin use in patients with CKD: comparing intervention CCGs with control CCG at baseline and 1-year post-intervention[a]

Baseline comparison (April 2016)			Comparison 1-year post intervention		
CCG	***N***	**AOR (95% CI)**	**CCG**	***N***	**AOR (95% CI)**
Without intervention	4909	1	Without intervention	5617	1
With intervention	16 059	1.53 (1.35 to 1.73)	With intervention	15 811	1.41 (1.23 to 1.60)

[a]Adjusted for age, sex, ethnicity, presence of diabetes, hypertension, and CKD coding. Standard errors are adjusted for clustering by practice. CCG = clinical commissioning group. CKD = chronic kidney disease. AOR = adjusted odds ratio.

Table 5. Odds ratios for blood pressure to target[a] in people with CKD, comparing intervention CCGs with control CCG at baseline and 1-year post-intervention[b]

Baseline comparison (April 2016)			Comparison 1-year post intervention		
CCG	***N***	**AOR (95% CI)**	**CCG**	***N***	**AOR (95% CI)**
Without intervention	4909	1	Without intervention	5617	1
With intervention	16 059	1.65 (1.43 to 1.89)	With intervention	15 811	1.48 (1.29 to 1.71)

[a]All patients with CKD with blood pressure <140/90 mmHg or <130/80 mmHg if diabetic/urinary albumin creatinine ratio >70 mg/mmol. [b]Adjusted for age, sex, ethnicity, presence of diabetes, hypertension, and CKD coding. Standard errors are adjusted for clustering by practice. CCG = clinical commissioning group. CKD = chronic kidney disease. AOR = adjusted odds ratio.

95% CI = 1.69 to 2.24) and almost twice the odds of blood pressure to target in those with CKD in City & Hackney compared with Waltham Forest (adjusted OR 1.92, 95% CI = 1.64 to 2.24) (further information is available from the authors on request).

The average difference in mean systolic blood pressure for people with CKD between the combined intervention CCGs and the control CCGs was 2.2 mmHg (intervention CCGs 130.5 standard deviation [SD] 15.0, control CCG 132.7 SD 15.5, *t*-test for comparison of means, $P<0.001$) (further information is available from the authors on request).

DISCUSSION

Summary

Over a 2-year study period a linked set of interventions to improve CKD coding and management, embedded within a system-wide renal service change, has significantly increased CKD coding among general practices in three geographically contiguous CCGs. This has been accompanied by significant improvements in management of blood pressure to target.

In comparison to the control CCG, practices in the two intervention CCGs had significantly higher odds of achieving blood pressure to target and prescribing statins for CVD protection. These are two aspects of care for people with renal impairment that make an important difference to the risk of a CVD event.[23] However, these differences were also present at the start of the observation period and cannot be attributed to the intervention.

The average difference in blood pressure between the people with CKD in the intervention and control group was 2.2 mmHg. Such changes to whole population blood pressure control may reduce the progression of kidney disease, particularly for those with proteinuria.[4]

Strengths and limitations

A strength of this study is the application of this complex service change to whole health economies, rather than to selected practices. The inclusion of a natural control CCG strengthens the impact of the intervention. In the financial year 2017–2018 there was partial change to the renal service in the control CCG. Some diffusion of the intervention was likely, as the service change was widely reported by CCGs at sustainability and transformation plan events. This would be expected to reduce the between-group differences.

The involvement of consultant nephrologists and specialist renal nurses in all elements of service delivery was a key aspect of the success of this programme,

which builds on the core elements of quality improvement and change management that the CEG has delivered in other clinical domains.[24–26] The importance of demonstrating early programme success, by regular feedback of coding improvement, reflects the use of the *'strategy for change'* described by Kotter.[16]

This was a pragmatic programme evaluation, recognising variation in the way the intervention was implemented in each of the three CCGs; for example, some minor differences in the choice of practice-level achievement targets and the delivery of financial incentives for coding. The decision to concentrate specialist renal nurse facilitation in Newham CCG, which had the lowest baseline coding rates, also creates unevenness in implementation of the different elements of the programme. The importance of recognising these contextual differences between CCGs in their approach to implementing and incentivising change within constituent practices is an essential consideration in future decisions on scaling up such interventions. Differences in context may determine the effectiveness of implementation, and hence the likelihood of achieving similar changes to that reported in this study.

Comparison with existing literature

Other studies have demonstrated the existing shortfall in the primary care management of CKD in comparison with national guidance. In 2011, Hull *et al* found that 50% of those with a diagnosis of hypertension and an eGFR <60 ml/min/1.73 m^2 had a blood pressure <130/80,[27] while Van Gelder and colleagues, in the Netherlands, found coding rates of 31% and blood pressure managed to target in 43%,[28] and Fraser and colleagues have demonstrated the burden of comorbidities among those with CKD managed in primary care.[29]

Previous trials and quality improvement strategies, which show evidence of effectiveness for improving blood pressure management, have largely focused on selected high-risk populations with CKD rather than unselected primary care populations.[30] A pragmatic trial in primary care using audit-based education found a similar 2 mmHg reduction in systolic blood pressure comparing practices exposed to guidelines and prompts, or to usual care.[8]

A number of studies have demonstrated associations between CKD and risk of all-cause hospitalisation.[31] A recent matched primary care cohort found twice the risk of admission for heart failure and a fivefold risk of acute kidney injury admission among those with CKD stage 3B in comparison with no CKD.[32] This suggests that a focus on improved coding and management for those with CKD and associated conditions, such as heart failure, could contribute to a reduction in hospital admissions.

Implications for practice

This study forms part of the evaluation of a system change in the delivery of care for people with CKD across primary and secondary settings in East London. The learning renal health system described here has implications for clinical practice and patient safety on a national scale. If all CCGs in England adopted a similar approach to improve CKD coding and the management of blood pressure in the CKD population, this would have a significant effect on the risk of CVD events, and may possibly reduce hospital admissions.

The three intervention CCGs had a well-developed working relationship with the CEG[20] and the range of primary care support services they offer. Historically the clinicians and managers in these CCGs have been early adopters of evidence-based clinical change of value to patients and the health economy. Such interventions require an IT infrastructure to enable the delivery of practice dashboards and the facilitation required to engage practice teams in using IT tools to support clinical change. These interventions also require a stable and respectful relationship between managers, clinicians, and secondary care specialists to engage in data sharing for learning across the whole patient pathway, and hence utilise to the full the opportunities for service change and development.

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Ethical approval

Ethical approval was not required as patient-level data are anonymised, and only aggregated patient data are reported in this study. All GPs in the participating East London practices consented to the use of their anonymised patient data for research and development for patient benefit.

Provenance

Freely submitted; externally peer reviewed.

Competing interests

The authors have declared no competing interests.

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