South East London Integrated Care System

NHS South East London

Targeted prevention, detection and early disease optimisation in the multimorbidity model of care (MMMoC)

Phase II evaluation report

Prepared by the MMMoC evaluation working group

We are a partnership of NHS commissioners and providers, the boroughs of Bexley, Bromley, Greenwich, Lambeth, Lewisham and Southwark and the voluntary and community sector

Contents

Executive summary

Background
Chronic Kidney Disease (CKD) is common, underdiagnosed, and associated with significant cardiovascular, renal and health inequality burdens. As part of the multi-morbidity model of care (MMMoC) in South East London (SEL), CKD detection and optimisation represented a major opportunity to improve health outcomes and prevent disease progression.

Ambition of the work and its evaluation
To improve early and equitable CKD detection, optimise evidence-based treatment, reduce future cardiovascular and kidney complications, and evaluate the impact of integrated neighbourhood-based care.

Describing the intervention
Between 2023–2025, six sites across 12 Primary Care Networks delivered or interacted with four complementary programmes of work focussing on targeted prevention, detection and early disease optimisation:

1. Community detection of CKD with peer educators (HIDDEN CKD)
2. Targeted digital remote testing of at-risk groups (HIDDEN BP)
3. Comprehensive proactive medical reviews in primary care (long list work)
4. Rapid pharmacological optimisation of patients with CKD using point of care (PROTECT KIDNEY)

Method of evaluation
The overall MMMoC was evaluated through an interrupted times series analysis looking at detection, disease management, clinical markers, holistic care provision and service use. For individual programmes of prevention, detection, and optimisation work; implementation was evaluated through activity data and outcomes were defined in terms of detection or medical optimisation. Qualitative data was sought to test the acceptability of new ways of working with service users and staff.

Results
Overall, the MMMoC prevention, detection and early disease optimisation work demonstrated statistically significant improvement in guideline: urine albumin creatinine ratio (uACR) testing, sodium glucose co-transporter 2 inhibitor (SGLT2i) prescription, and blood pressure control. There was also substantial reduction in outpatient appointment use.

Individual programmes of work demonstrated impact across screening, testing, and treatment optimisation:

- 964 residents received community kidney screening; 373 (38.7%) had abnormal initial albuminuria results and CKD was confirmed in 231 (23.9%) with 171 (17.7%) being new cases.
- 3283 service users with hypertension who had not been tested for 5 years (with no previous albuminuria) completed a digital remote home testing kit, 40% of tests had abnormal results requiring prioritised follow-up

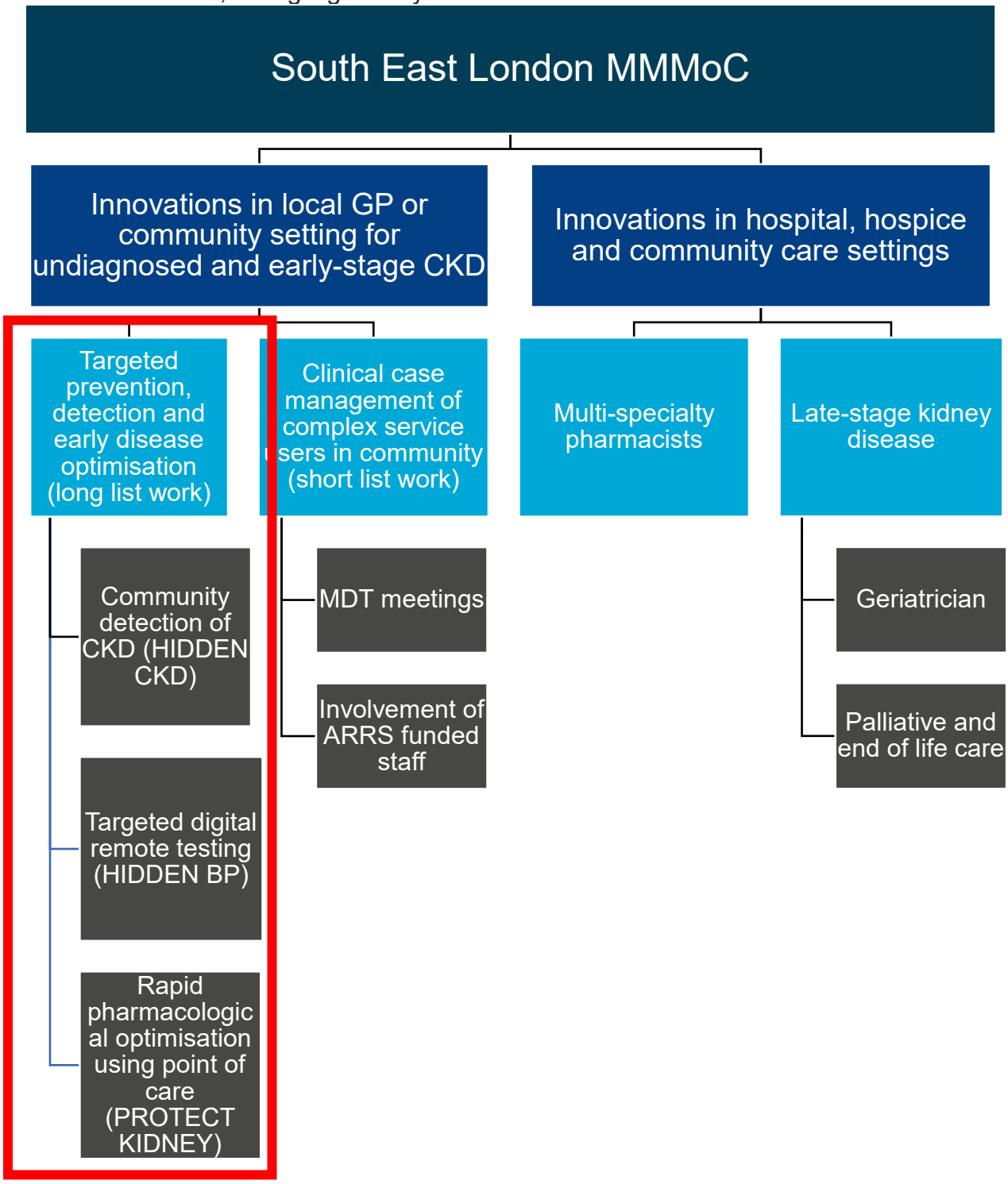
- Kidney point of care (POC) clinics reviewed 296 patients, with 64% receiving full pharmacological optimisation of their treatment.

Conclusion

Integrated community-based CKD detection and optimisation is feasible, acceptable and effective. Combining targeted outreach, digital innovation, proactive case-finding and rapid medicines optimisation improved key clinical processes, accelerated evidence-based care and reduced outpatient utilisation, supporting wider adoption of neighbourhood-based models to improve cardiovascular and kidney health while reducing inequalities. Further economic evaluation and scale up activities are underway.

Structure of the MMMoC

This diagram illustrates the structure of the SEL MMMoC from the perspective of the subsequent evaluation and can be used to support understanding throughout. This report focuses on the targeted prevention, detection and early disease optimisation element of the work, as highlighted by the red box.



Error! Reference source not found.*Figure 1: Structure of the multimorbidity model of care (MMMoC)*

Chapter 1. Introduction and background

Early detection and risk stratification of CKD are key for delivering timely, proactive and protective care to reduce end-stage kidney disease and cardiovascular disease on a population level. One of the earliest signs of CKD is protein in the urine, known as microalbuminuria, detected by a urine albumin creatinine ratio (uACR) test. Although most people with CKD do not progress to end-stage kidney disease, they have a significantly higher risk of cardiovascular events [1]. A raised uACR is an independent predictor of cardiovascular disease [2], even when blood tests are normal, which means both blood and uACR tests are required to fully stage CKD.

In the UK, diabetes and hypertension are the leading causes of CKD. Guidelines recommend an annual uACR for people with diabetes and a uACR every one to five years (annually if poorly controlled) for people with hypertension [3]. However, CKD remains under-detected in these groups, especially among people with hypertension [4].

There are two separate challenges that this part of the MMMoC work seeks to address:

1) Proactive and equitable detection of CKD, and
2) Timely medical optimisation of CKD, focussing on minimising cardiovascular risk

The inequality report from Kidney Research UK [5] demonstrates that nationwide, there is a higher chance of those with CKD being diagnosed later and progressing faster if they are in lower socioeconomic groups and/or from minoritised ethnic groups. This correlates with an up to five-fold increase in dialysis within these groups.

In SEL, our CKD registers were half their expected size [6,7], with substantial potential to improve clinical outcomes for non-coded and coded service users through identification and evidence-based medicines optimisation. Service users who have CKD and are not coded have up to double the mortality rate and double the risk of being prescribed nephrotoxic drugs compared to correctly coded service users [8]. Whilst we have medications (e.g. ACE-I/ARB, SGLT2i) that once optimised may delay progression to end-stage kidney disease in some patients by up to 15 years [9], a significant proportion of our CKD population require regular reviews and medicines optimisation [10].

For this report, any relevant definitions and abbreviations are included in the glossary in **Error! Reference source not found.**.

Chapter 2. Ambition of the work

2.1 Ambition of the MMMoC overall

Overall, the MMMoC aimed to build a person-centred, holistic, and fully integrated model of care for people living with mLTCs across the care pathway in SEL. The model sought to strengthen both horizontal integration (within care settings e.g. across specialties and roles) and vertical integration (across primary, secondary and community care), improving coordination, access and outcomes for service users with complex needs. The various interconnected areas, as described in **Error! Reference source not found.**, functioned collaboratively to deliver effective and equitable care for service users, improve clinical and non-clinical staff experience, and build efficiency into the system overall.

2.2 Ambition of the targeted prevention, detection and early disease optimisation branch of the work

For service users

- To improve early diagnosis of kidney disease, especially in underserved groups who have been shown to have poorer outcomes.
- To develop an accessible and acceptable way of rapidly optimising care following early diagnosis.
- The ultimate outcome of both of these activities is a reduction in heart attacks, strokes and kidney failure over the next few decades for our residents.

For multi-disciplinary staff

- To promote integration between secondary care, primary care, public health, population health, academia, community organisations and volunteers to improve the holistic understanding of kidney disease and cardiovascular disease.
- To provide education across the system, increasing the confidence in identification and optimisation of kidney disease.
- To facilitate new ways of working which reflect the shift to prevention, community and digitally enabled solutions.
- To test the acceptability of point of care testing and/or digital urine analysis in the community setting for staff.

The system overall

- To improve the efficiency of CKD diagnosis and optimisation by drawing specialty expertise into the community (primary care, community pharmacy, community settings).
- To reduce non-elective service use for cardiovascular renal metabolic disease through proactive engagement in early disease.

Chapter 3. Describing the intervention

3.1 The MMMoC overall

The interventions implemented as part of the MMMoC span innovations in local GP or community settings for service users with undiagnosed and early-stage CKD as well as innovations in hospital, hospice and community care settings for those with late-stage CKD. The work took place at various locations across SEL, a diverse and relatively deprived population with over two million residents. Each element of the MMMoC, as reflected in Figure 1, took an integrated approach to service-user care. Across all elements, there was horizontal and vertical collaboration to ensure a service-user-centric approach that engaged with the whole person, their priorities and needs. In addition, population health data was used in each instance to ensure care was proactive, preventative of disease progression and worked to reduce inequalities.

3.2 The targeted prevention, detection and early disease optimisation branch of the work

3.21 Project wide approach to targeted prevention, detection and early disease optimisation

Project sites were identified in each SEL borough through an expression of interest process in September 2023. Between October 2023 to January 2024, SEL integrated care system (ICS) facilitated monthly, in-person, codesign workshops. These four workshops enabled relationship development, trust building and thus the formation of each integrated neighbourhood team (INT). Teams included a range of clinical and non-clinical staff from primary, secondary, community and voluntary care settings, and included ARRS funded roles. From January to April 2024, INTs finalised their operating procedures, ran their service user searches and risk stratified their cohorts (using the Clinical Effectiveness Group (CEG) APL-Renal risk stratification tool [11] which is compatible with EMIS).

Collaboration across the MMMoC enabled significant innovation in care delivery. This report outlines the population-level evaluation approach and findings for the overall programme related to early CKD detection and optimisation, as well as detailed evaluations of three individual projects: digital remote testing, POC clinics, and community testing.

3.22 Individual programmes of work

1) Community detection of CKD with peer educators (HIDDEN CKD)

This project is a collaboration between academia (King's College London (KCL)), secondary care (King's College Hospital (KCH)), community (Africa Advocacy Foundation) and charity (Kidney Research UK (KRUK) and Kidney Care UK).[1]

The project is ongoing across SEL and sees the training of local peer educators supervised by clinical staff to deliver culturally congruent community-based CKD testing events in high-risk groups. The project is unique in its delivery and the provision of follow up for any one with abnormal results (uACR) linking them into routine care directly through communication with their GP or a nurse led clinic at KCH.

As part of targeted testing, it was key to coordinate with a community-based programme of work because without this, efforts to improve optimisation of identified patients only risk increasing already significant health inequalities.

2) Targeted digital remote testing of at-risk groups (HIDDEN BP)

This programme of work explores how a remote, targeted testing programme could most effectively help close the detection gap alongside other complimentary workstreams. It was supported by the NHS Digital Topol Fellowship[2]. The digital remote testing kit used, Minuteful Kidney from Healthy.io, had government supported deployment via the NHS Accelerated Access Collaborative [12]. The kit comprises of a urine testing pot and urine testing strip which can be used in conjunction with a smartphone app to semi-quantitatively test uACR. This means that the kit does not give an exact number for the uACR but classes it as normal (<3.39mg/mmol), abnormal (3.39mg/mmol – 33.9mg/mmol) or high abnormal (>33.9mg/mmol) levels of albuminuria. A key advantage of this remote test result is that it is automatically available for review on the primary care electronic patient record (EMIS) on completion.

A semi-quantitative digital remote testing kit therefore triages an at-risk population for further testing rather than provides a diagnosis end point; within routine practice a uACR between 3 and 30mg/mmol would need repeating 3 months apart to be conclusive. The approach sought to identify a population where this triage would add to routine care by identifying an undertested but high-risk population rather than duplicate existing care pathways.

Lessons learned from the initial roll out of Minuteful Kidney digital remote testing kit were applied to the MMMoC roll out. In this initial use, kits were sent to consenting service users of participating practices who had a diagnosis of diabetes and no recorded uACR in the past year. Between 2021 and 2025, 31,600 test kits were sent out to 27,000 eligible service users and 13,910 (52%) completed a test. Of the

[1] More information regarding the project can be found on the website. There is also a toolkit for ICSs to adopt the work for their populations which was co-developed by the HIDDEN CKD team, the London Kidney Network (LKN) and KRUK which can be found here.

[2] https://topol.digitalacademy.nhs.uk/digital-fellowships

completed tests, 64% were normal, 29% abnormal, and 7% high abnormal. An analysis of the initial deployment of digital remote testing kits demonstrated three main findings:

- **Lower completion rates were seen in specific groups**. Namely, adults over the age of 70, people with missing ethnicity/language data, those in deprived areas, and those with limited recent healthcare contact [13].
- **Not all abnormal results signalled *new* disease** (some had previously identified albuminuria)
- **Follow-up actions**, including repeat testing, coding and medial optimisation, **were inconsistent** across those found to have albuminuria.

The refined approach for the MMMoC drew on these findings from the initial deployment, local and national population data and stakeholder input. Minuteful Kidney digital remote testing kits were subsequently sent to service users aged 18-70 years old with a diagnosis of hypertension and no recorded uACR in the previous 5 years. Key service messages were adapted following peer and service user review and once a kit was sent, the kit provider, Healthy.io, contacted recipients via phone or text to support completion.

The service was offered to all MMMoC sites that had previously used the service, with an enhanced targeted offer. A total of 5208 service users received a digital remote testing kit.

3) Comprehensive proactive medical reviews in primary care (long list work)

The long list work focuses on identifying service users with coded or likely un-coded CKD and providing holistic reviews focussing on service users' understanding of their diagnosis and optimisation of CKD and cardiovascular risk factors.

Overall, 3,222 people were seen as part of the long list work. Healthcare professionals reviewed service user notes on the long list to identify and act on need for further testing, ensure appropriate and updated CKD coding, and optimise medicines with service users. In some cases, this work took place over the phone and where appropriate, individuals had appointments at their local practice. 'Did not attend' (DNA) rates for the long list were estimated at 5%.

4) Rapid pharmacological optimisation of patients with CKD using POC testing (PROTECT KIDNEY)

Barriers to medical management of CKD include access to care, repeat blood tests, service user understanding of how an asymptomatic condition requires medication and clinician understanding of the threshold of treatment.

The kidney POC clinic was co-developed with numerous system partners across SEL as well as kidney patients. This included KCL, with funding from KRUK[3] to support the improvement of medical optimisation in early CKD [14]. The Health Innovation Network

[3] Home | Kidney Research UK | UK Kidney Disease Charity

(HIN) South London also developed learning resources including a clinician[4] and service user[5] website.

The clinic was designed to be led by an independent prescriber such as a pharmacist or specialist nurse, who could see service users with CKD who were eligible for medical optimisation which had not taken place in routine care. Given the development of a new clinic and technology, all clinics were supported by secondary care through the provision of a renal registrar and/or a multi-specialist pharmacist (MSP) initially. Two renal registrars had honorary contracts with primary care allowing them to support the running of clinics and meet training needs. These were novel working relationships which facilitated significant learning opportunities.

An EMIS search was developed in partnership with Clinical Effectiveness South East London (CESEL) to identify service users who met the eligibility criteria to be seen in the clinic. This list then needed manual review by a clinician and identification of a "clinic intent" before inviting service users to the clinic.

The clinic intent identified for eligible service users was one of the following:

- RAASi initiation and/or uptitration only
- RAASi initiation and/or uptitration AND SGLT2i initiation
- SGLT2i initiation only
- Any of the above + statin initiation

Five of the six MMMoC sites accepted the offer of a Siemen's EPOC machine and required consumables to deliver a point of care clinic at a practice or centralised PCN level. The clinic used the Siemen's EPOC[6] device to measure serum potassium and creatinine (allowing an eGFR to be calculated). As part of the clinic, a standard operating procedure (SOP) was produced detailing eligible service users, escalation of care based on national guidelines, device set up and operation, and red / amber / green charts for interpreting test results to support staff decision-making.

Notably, the MMMoC also facilitated a feasibility study into the running of a kidney health POC clinic run by a community pharmacist from within a neighbourhood pharmacy. This was a joint venture between the SEL pharmacy team, community pharmacy, primary care and secondary care. To overcome common interoperability challenges, a temporary contract, confidentiality agreement and a VPN to enable remote access to electronic health records supported effective working directly from the community pharmacy. This included accurately recorded interactions and prescriptions for service users on a shared record. The clinic provided added accessibility by running on a weekday evening and Saturday morning within the community. Furthermore, service users could leave their appointment with medication from the same location as their appointment, the pharmacy, which was prescribed and issued through their usual electronic patient record.

[4] https://healthinnovationnetwork.com/resources/south-east-london-point-of-care-chronic-kidney-disease-optimisation-clinician-resources/
[5] https://healthinnovationnetwork.com/resources/chronic-kidney-disease-patient-information-leaflets/
[6] https://www.siemens-healthineers.com/blood-gas/blood-gas-systems/epoc-blood-analysis-system

Both primary care and community pharmacy clinics saw service users for 20- or 30-minute appointments in quick succession over a period of weeks to rapidly medically optimise their CKD. Longer appointments allowed discussion, education, blood pressure readings and instant blood tests which in turn allowed escalation of medication as appropriate. Once service users were optimised medically, care was returned to the GP.

The implementation of the kidney POC clinics occurred differently within neighbourhoods dependent on staffing, IT infrastructure (e.g. PCN wide EMIS), preference and engagement. Table 1 shows the sites which hosted a kidney POC clinic and their respective population sizes, eligible population and seen population. This gives an idea of the scale of this clinic within total registered populations as well as the drop out from eligibility to optimisation for service users. Electronic patient record searches were conducted between October 2024 and April 2025.

Table 1: Sites hosting a Kidney POC clinic, including their total population size, eligible population and the number of service users seen.

Site	**Site type**	**Total registered population** (as per QoF 2024/2025)	**Eligible population from EMIS search + manual review** (% of total registered population)	**Service users seen in clinic** (% of eligible population)
Bexley	Practice	13,872	49 (0.4%) *	6 (12%)
Bromley	2 PCNs	75,579	72 (0.1%)	65 (90%)
Lambeth	Practice	12,480	60 (0.5%)	15 (25%)
Lewisham	PCN	56,286	97 (0.2%)	36 (37%)
North Southwark	PCN	20,0266	293 (0.1%)	145 (49%)
South Southwark	Practice	9,171	34 (0.4%)	29 (85%)
	TOTAL	**367,654**	**605 (0.2%)**	**296 (49%)**

*No manual search was undertaken at this site (i.e. generated through EMIS search only) and thus figures may be an over estimation of the eligible population within this practice.

The eligible population makes up <1% of the registered population for each practice which reflects how targeted the project was as well as the benefits of conducting at a PCN level with a centralised clinic. For the eligibility criteria please see below 3.24; the registered population includes all ages (e.g. under 18 years).

The proportion of service users optimised per site reflects implementation factors (administration, staff availability), service user preferences for being prescribed more medication and changes over time changing management. This is explored further in Table 4.

3.23 Regional context and parallel work outside of the MMMoC

Across this time period, there was also significant work across the system around CKD such as that done by the clinical effectiveness group who developed local guidelines, hosted webinars and provided local data driven meetings with primary care across the region to encourage detection and optimisation of CKD.

3.24 Cohort definitions for targeted interventions

Below are listed the definition of characteristics associated with different parts of early detection and optimisation work.

1) *Community detection of CKD with peer educators (HIDDEN CKD)*

Cohort: Residents offered community testing

The cohort selection was opportunistic for HIDDEN CKD and relied upon building connections within local underserved community groups. The only threshold to meet for being involved in the study was to give consent and to be present at a venue deemed to be appropriate by the HIDDEN CKD team to host a community testing event. These spaces were faith and non-faith spaces, with the breakdown below in Table 2.

Table 2: Community venues used for HIDDEN CKD screening events and number of residents tested

Venue	Number of people tested (%)
Faith based Church	551 (57.2)
Community event - Library	129 (13.4)
Community event- Healthcare	95 (9.9)
Higher Education Academy	76 (7.8)
Community event- Park	43 (4.5)
Community event - Gym	33 (3.4)
Faith based Mosque	21 (2.2)
Community event - Garden	16 (1.6)
TOTAL	**964 (100)**

2) *Targeted digital remote testing of at-risk groups (HIDDEN BP)*

Cohort: Service users receiving Minuteful Kidney[7] remote testing kit

Service users invited to participate, consented and enrolled in remote uACR testing met the following criteria:

- Diagnosed with hypertension (on the hypertension register)
- No uACR test performed in the past 5 years
- No previous uACR result above 3mg/mmol
- Under 70 years old

Exclusion criteria:

- Remote testing kit declined
- Living in a care home
- Living with severe frailty
- On the dementia register
- On the palliative care register
- On the CKD register
- Kidney transplant
- No consent to record sharing

3) *Comprehensive proactive medical reviews in primary care (long list work)*

Cohort: Service users receiving a holistic CKD review

CKD register

Adults placed on the Quality and Outcomes Framework (QOF) register for CKD. This equates to a diagnosis of CKD stage 3-5 only, as per the QOF guidelines. For service user-level metrics, this cohort includes all service users on the CKD register, excluding those on the long list or short list.

Long list

CKD staging guidance**Error! Bookmark not defined.** has been used to define the long list cohort. The long list population includes adults:

- Over the age of 18 years old
- With an eGFR measurement over 60 ml/min/1.73m^2 with microalbuminuria *or* with an eGFR measurement under 60 ml/min/1.73m^2 with or without microalbuminuria
- With or without other LTCs

Short list

CKD staging guidance [15] has been used to define the short list cohort. The short list population includes adults:

[7] https://minuteful.com/us/kidney

- Over the age of 18 years old
- With an eGFR between 45 and 60 ml/min/1.73m^2 with or without microalbuminuria [if cohort numbers too low, can go down to eGFR of 30. Left to local discretion]
- With at least one other LTC like diabetes and/or hypertension
- Who are a 'complex' service user for locally determined reasons. E.g. social-housing resident, carer responsibilities, severe mental illness, chronic pain, etc.

4. *Rapid pharmacological optimisation of patients with CKD using point of care (PROTECT KIDNEY)*

   Cohort: Service users eligible to attend a kidney POC clinic

A custom-made electronic patient record (EMIS) search followed by manual review identified service users suitable for the clinic as per the following criteria:

- Over the age of 18 years old
- With an eGFR measurement between 30 and 75 ml/min/1.73m^2 (inclusive)
- If diabetic: an ACR reading above 3mg/mmol
- If non-diabetic: an ACR reading above 22.6 mg/mmol

Exclusion criteria:

- Over 80 years old
- On ACE/ARB and SGLT2i
- Relative contra-indications to SGLT2i (e.g. Type 1 Diabetes Mellitus, history of Diabetic Ketoacidosis)
- Renal conditions without evidence / licenced indications for SGLT2i (Autosomal dominant polycystic kidney disease, renal transplant or other renal replacement therapy, Immunosuppression for renal disease and acute kidney injury.
- Contra-indication to finger prick testing.

Chapter 4. Key areas for evaluation

Our Phase II evaluation seeks to build on the findings of Phase I. Therefore, the goals of the Phase II evaluation are aimed at capturing the holistic and sustained impact, alongside the system-wide value of the MMMoC model in SEL. The evaluation approach was developed iteratively through the evaluation working group over a series of months. This group brought together clinical, analytical, and programme expertise and was responsible for agreeing the scope, focus, and feasibility of the evaluation activity.

The overall evaluation of the targeted prevention, detection and early disease optimisation element of the work focuses on these primary metrics:

To capture an increase in detection:

1. CKD prevalence

To capture medical optimisation (in line with national guidance):

2. SGLT2i prescription
3. Statin prescription
4. eGFR and uACR testing within the last 12 months
5. Blood pressure control

To capture changes in system use:

6. Non-elective admissions to hospital
7. Outpatient appointment utilisation
8. Accident and emergency attendance
9. GP appointments

Markers of holistic care demonstrated by the completion of:

10. Mental health screening
11. Patient activation measures

The individual programmes of work were independently evaluated and drawn together by the following measures of activity for service users participating in them. There was no comparison group:

1. Number of kidney health targeted tests performed in high-risk groups
2. Proportion of targeted tests identifying new disease
3. Proportion of service users with CKD receiving evidence based medical optimisation
4. Acceptability of service users and staff for any innovation of care

Chapter 5. Methodology of the evaluation

5.1 Project wide approach to evaluation for early identification and optimisation

A quasi-experimental interrupted time series [16] (ITS) regression approach was used to assess changes in outcomes over time associated with the introduction of the programme. ITS was selected to enable robust assessment of intervention effects in a real-world setting where randomisation was not feasible and where repeated outcome measures were available before and after implementation.

Analyses were undertaken at two levels:

- Service user-level ITS analyses, examining within-cohort (CKD register, long list, short list) changes over time; and
- Population-level ITS analyses, comparing trends between participating and non-participating PCNs.

A full description of the methodology used can be found in *Appendix 1*.

5.2 Individual programme evaluation methodology

The four projects looking at early identification and optimisation of CKD were undertaken by overlapping teams with slightly different stakeholders; the evaluation was pulled together and organised as one collaborative piece of work looking at early disease in the SEL population.

A summary of the project populations, teams involved and data collection is below in Table 3.

Table 3: Summary of project populations, interventions and settings

Project name	Adult population definition (method of identification)	Number of service users	Intervention (by whom)	Setting
Community detection of CKD with peer educators (HIDDEN CKD)	African and Caribbean communities present or resident in SEL (community expertise including Africa Advocacy foundation)	964	Education, blood pressure, uACR tests. (peer educators supervised by a clinical team leader)	Churches, mosques and non-faith community spaces across SEL
Targeted digital remote testing of at-risk groups (HIDDEN BP)	1: Service users with a diagnosis of diabetes and no uACR in the last year 2: Service users with a diagnosis of hypertension and no uACR in the last 5 years (bespoke electronic patient record searches)	3283	Digital remote uACR test sent to eligible service users who consented. (Minuteful kidney by Healthy.io)	Service user's home
Comprehensive proactive medical reviews in primary care (long list work)	Service users with with an eGFR over 60 ml/min/1.73m^2 with microalbuminuria *or* with an eGFR measurement under 60 ml/min/1.73m^2 with or without microalbuminuria (existing electronic patient record searches, risk stratification tools, clinically informed manual selection)	3222	Holistic medical review face to face or over the phone. (specialist nurse, GP, pharmacist)	All six participating primary care sites
Rapid pharmacological optimisation of patients with CKD using point of care (PROTECT KIDNEY)	Service users with an eGFR ≤75ml/min/1.73m^2, raised uACR: ≥3mg/mmol + diabetes OR ≥22.6 mg/mmol without diabetes, not on ACEi/ARB and/or SGLT2i. (bespoke electronic patient record searches)	296	Face to face rapid pharmacological optimisation clinic with point of care potassium, creatinine and eGFR testing. (specialist nurse or pharmacist)	Five primary care sites and one community pharmacy

Table 4 summarises the data collected for each project and how this has been analysed.

Table 4: Summary of project data collection and analytics

Project name	Data collected	Analysis undertaken (by whom)
Community detection of CKD with peer educators (HIDDEN CKD)	• Participant demographics • CKD risk factors (self-reported) • Number of uACR tests undertaken • Proportion of abnormal uACR results • Post event engagement with HIDDEN nurse-led follow-up and subsequently with primary care	Descriptive analysis RA, RM, KG, KB
Targeted digital remote testing of at-risk groups (HIDDEN BP)	• Number of remote uACR tests sent out • Number of remote uACR tests completed • Proportion of normal, abnormal and high abnormal tests • Electronic record of participant: CKD risk factors, medication history, cardiovascular disease and severity, primary care service use • Routine care kidney health check	Descriptive analysis and logistic regression to look at the relationships between test completion, test result and population characteristics. KG
Comprehensive proactive medical reviews in primary care (long list work)	• Number of eligible service users identified • Proportion of eligible service users on guidance informed SGLT2i prescription • Proportion of eligible service users on	Interrupted time series comparing participating and non-participating sites CB, EN, MMMoC evaluation group
Rapid pharmacological optimisation of patients with CKD using point of care (PROTECT KIDNEY)	• Number of service users eligible for clinic and description of demographics and co-morbidity of population • Proportion of eligible service users invited to clinic • Proportion of eligible service users attending clinic • Proportion of eligible service users optimised in clinic (and description of activity) • Patient and staff acceptability of the clinic • Resource required to provide the service (ongoing)	Descriptive, qualitative (focus groups, interviews and surveys undergoing thematic review) and economic (modelled reduction in cardiovascular events associated with medical optimisation (ongoing)) KG, RG, JG, JS, AB

Individual projects have and will submit more in-depth analysis for peer review in the near future which will be available publicly.

Key for analyses:

- RA: Roseline Agyekum, Clinical researcher, King's College London, HIDDEN lead
- RM: Rachel Musomba, Epidemiology researcher, London school of hygiene and tropical medicine (LSHTM), HIDDEN lead
- KB: Professor Kate Bramham, King's College London
- KG: Dr Kathryn Griffiths, Clinical researcher, King's College London (SEL ICB and HIN South London)
- RG: Dr Rouvick Gama, Clinical researcher, King's College London (KRUK fellow, KHP post doc)
- JG: Jessica Gwynn, Project manager, HIN South London
- JS: Joe Sladen, Value and Outcomes Consultant, Boehringer Ingelheim
- AB: Anna Buylova, Health Economist, HIN South London
- CB: Cameron Bebbington, Health Intelligence Manager, NHS South East London ICB
- EN: Esther Negbenose, Health Intelligence Analyst, NHS South East London ICB

Chapter 6. Results

6.1 Project wide results in early identification and optimisation

SGLT2i prescription

Following the intervention period, multimorbidity model of care sites showed an accelerated rate of guideline prescription of SGLT2i in CKD (+0.21 percentage points per month (95%CI 0.12 – 0.30, p < 0.001)), translating to approximately 7 additional service users per month above the pre-intervention trend. There was no significant change in prescription rates in non-participating sites (see figure 1).

For the subgroups in participating practices receiving the most interventions (long list and short list) there were significant immediate increases in guideline prescription of SGLT2i; for the short list subgroup there was an increase of 15.48 percentage points per month (95%CI 12.20 to 18.75, p < 0.001) and for the long list subgroup there was an increase in 5.05 percentage points per month (95%CI 12.20 to 18.75, p <0.001).

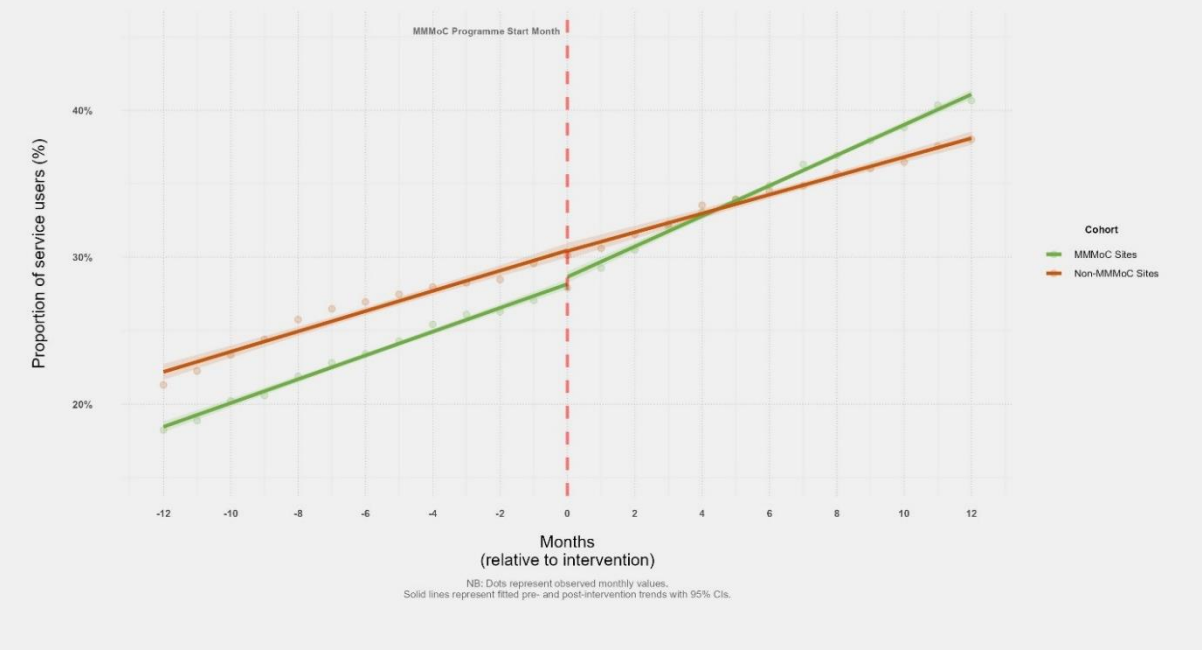


Figure 2: The proportion of service users prescribed SGLT2i for participating and non-participating sites pre and post the introduction of the multi-morbidity model of care

Blood pressure control

There were immediate increases in the proportion of controlled blood pressure in the subgroups receiving most intense intervention (long list subgroup had a 2.98 percentage point increase per month (95%CI 1.01 to 4.94, p <0.005) short list subgroup had a 5.62 percentage point increase per month (95%CI 2.45 to 8.80, p <0.001).

Albumin creatinine ratio (ACR)

There were immediate increases in ACR completion in the intervention groups. The long list had an 11.65 percentage point increase equivalent to 428 additional service users (95% CI 7.61 to 15.69; p < 0.001) and the short list had a 19.54 percentage point increase (12.70 to 26.38; p < 0.001) equivalent to 209 additional service users. Post-

intervention trends flattened; however, remained above 60% and 80% for uACR for long list and short list, respectively.

Outpatient attendances

There was a significant reduction in all outpatient attendances in service users in the long list and short list subgroups; a post intervention reduction of 26.18 attendances per 1000 population per month (95% CI -42.0 to -10.35, p <0.003) in the long list group and a post intervention reduction of 38.13 attendances per 1000 population per month (95%CI -45.29 to -30.98, p value <0.001) in the shortlist (see figure 2).

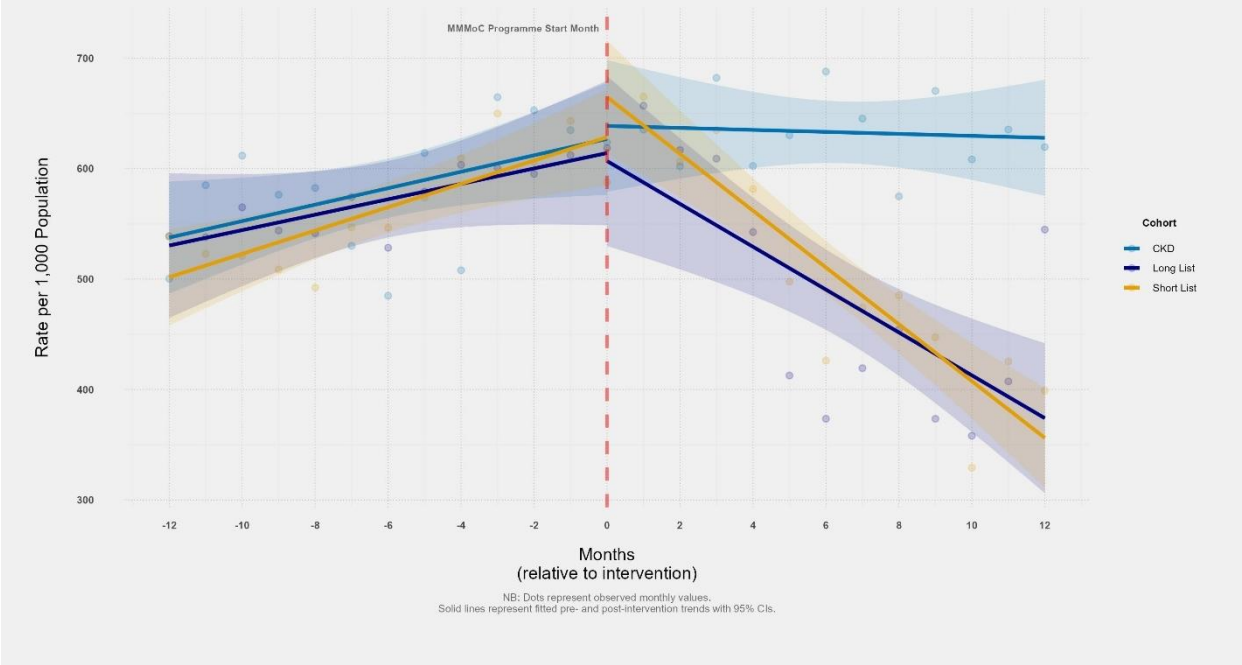


Figure 3: The rate of outpatient attendances for subgroups of participating practices pre and post MMMoC

Primary care appointments

There were significant reductions in the trend of post intervention primary care appointments for those in the short list subgroup with a reduction of 27.96 appointments per 1000 population per month (95% CI -49.54 to -6.38; p = 0.014) (see figure 3).

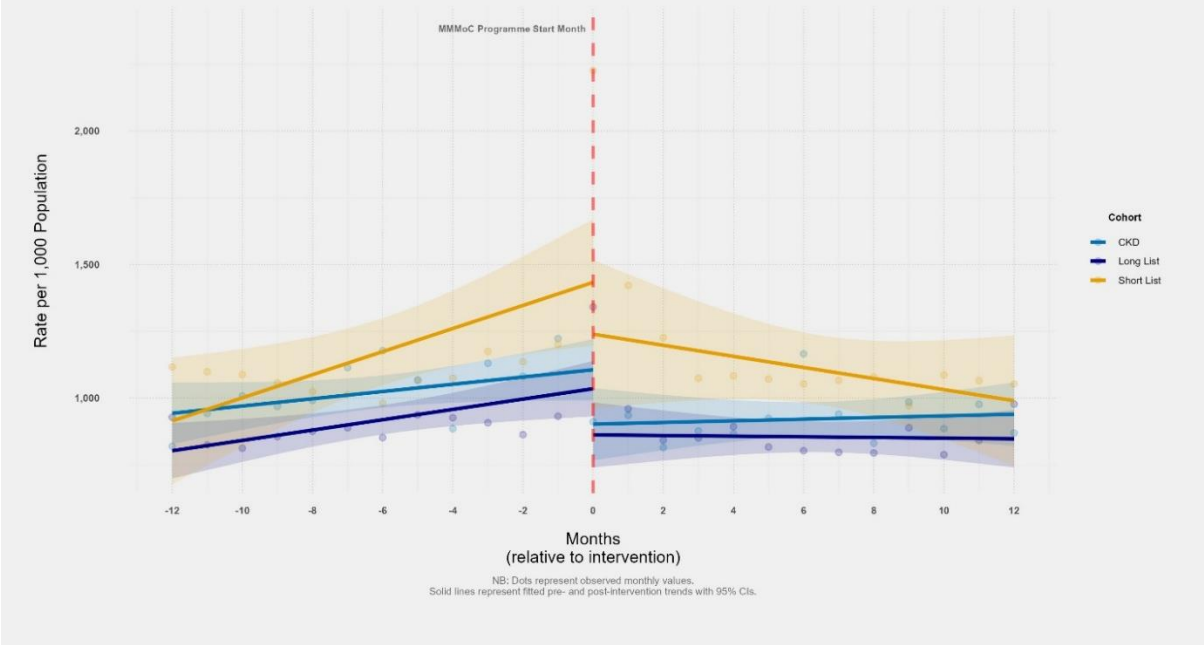


Figure 4: The trend of primary care appointment use for subgroups of participating practices pre and post multi-morbidity model of care

Further results from ITS analyses on the whole programme of targeted prevention, detection and early disease optimisation can be found in *Appendix 2*. This includes full model estimates with confidence intervals for: proportion of the population on QOF CKD register; SGLT2i prescription; statin prescription; blood pressure control; non-elective hospital admissions; outpatient attendances; specialist outpatient attendances (cardiology/diabetes/renal); A&E attendances and GP appointments.

6.2 Results from individual programmes of work

1) *Community detection of CKD with peer educators (HIDDEN CKD)*

The HIDDEN CKD programmes performed 964 uACR tests in non-medical settings for residents during the MMMoC; over 40% of those performed were abnormal requiring further action. These tests were performed by peer educators in the context of a community space providing culturally congruent education around CKD.

Table 5: Characteristics and semi- quantitative uACR results of people participating in the HIDDEN CKD project

Characteristic	Total	Semi quantitative uACR result		
		uACR <3 mg/mmol	uACR 3-30 mg/mmol	uACR >30 mg/mmol
Participants n (%)	964 (100%)	533 (55.3%)	373 (38.7%)	58 (5.9%)
Age, years (Mean ± SD)	50.8 (±14.2)	49.0 (±14.7)	52.6 (±13.5)	55.0 (±14.1)
Body Mass Index, kg/m^2 (Mean±SD)	29.8 (±5.7)	29.4 (±6.0)	30.05 (±5.1)	31.2 (±6.8)
Gender n (%)				
Female	541 (56.1%)	278 (51.3%)	236 (43.6%)	27 (4.9%)
Male	423 (44.8%)	255 (60.3%)	137 (32.4%)	31 (7.3%)
Ethnicity n (%)				
Black	825 (85.6%)	436 (52.8%)	337 (40.8%)	52 (6.3%)
West African	652 (67.6%)	344 (52.7%)	261 (40.0%)	47 (7.2%)
Other African	48 (5.0%)	26 (45.8%)	20 (41.7%)	2 (4.2%)
Caribbean	103 (10.7%)	50 (48.5%)	50 (48.5%)	3 (2.9%)
Black Other	22 (2.3%)	16 (72.7%)	6 (27.3%)	0 (0%)
Asian	56 (5.8%)	41 (73.2%)	14 (25.0%)	1 (1.8%)
White	51 (5.3%)	39 (76.5%)	10 (19.6%)	2 (3.9%)
Mixed	32 (3.3%)	18 (1.8%)	11 (34.3%)	3 (9.3%)
Co-morbidity (self-reported) n (%)				
No known diagnosis	613 (63.5%)	375 (61.1%)	214 (34.9%)	24 (3.9%)
Hypertension	241 (25.0%)	103 (41.9)	118 (48.9%)	20 (8.3%)
Diabetes	100 (10.4%)	42 (40.5%)	45 (44.5%)	13 (12.8%)
Chronic Kidney Disease	11 (1.1%)	3 (27.3%)	6 (54.5%)	2 (18.2%)
Other	37(3.8%)	25 (67.5%)	9 (24.3%)	3 (8.1%)
Prefer not to say	26 (2.6%)	7 (26.9%)	16 (61.5%)	3 (11.5%)

2) Targeted digital remote testing of at-risk groups (HIDDEN BP)

Figure 5 shows the dissemination of digital remote testing kits within the project, highlighting that 3,283 people with hypertension who had not had a uACR in the past 5 years completed a test. Of this cohort, 1,979 (60.3%) of the results were normal (Minuteful kidney has reasonable sensitivity at this level [17]) and so do not require routine retesting for another 5 years unless they have uncontrolled blood pressure.

Meanwhile, 1,162 (35.4%) show abnormal semiquantitative results. Given the nature of the test, we cannot be sure if those with an abnormal result do have early kidney disease. However, the remote testing allows identification of those requiring further investigation (e.g. a kidney health check with blood tests and a repeat quantitative uACR). Lastly, the 142 service users (4.3%) identified with high abnormal results are likely to have CKD given the sensitivity and specificity for this level of albuminuria. These results will have become immediately available to their GP.

Overall, the adherence rate was 68% for the targeted roll out compared with 52% for the initial roll out of the service representing a reduced cost per test for the system. Although the cohorts should not be directly compared, this increase in completion rate was accompanied by enhanced messaging and peer reviewed invitation which did not take place in the initial roll out.

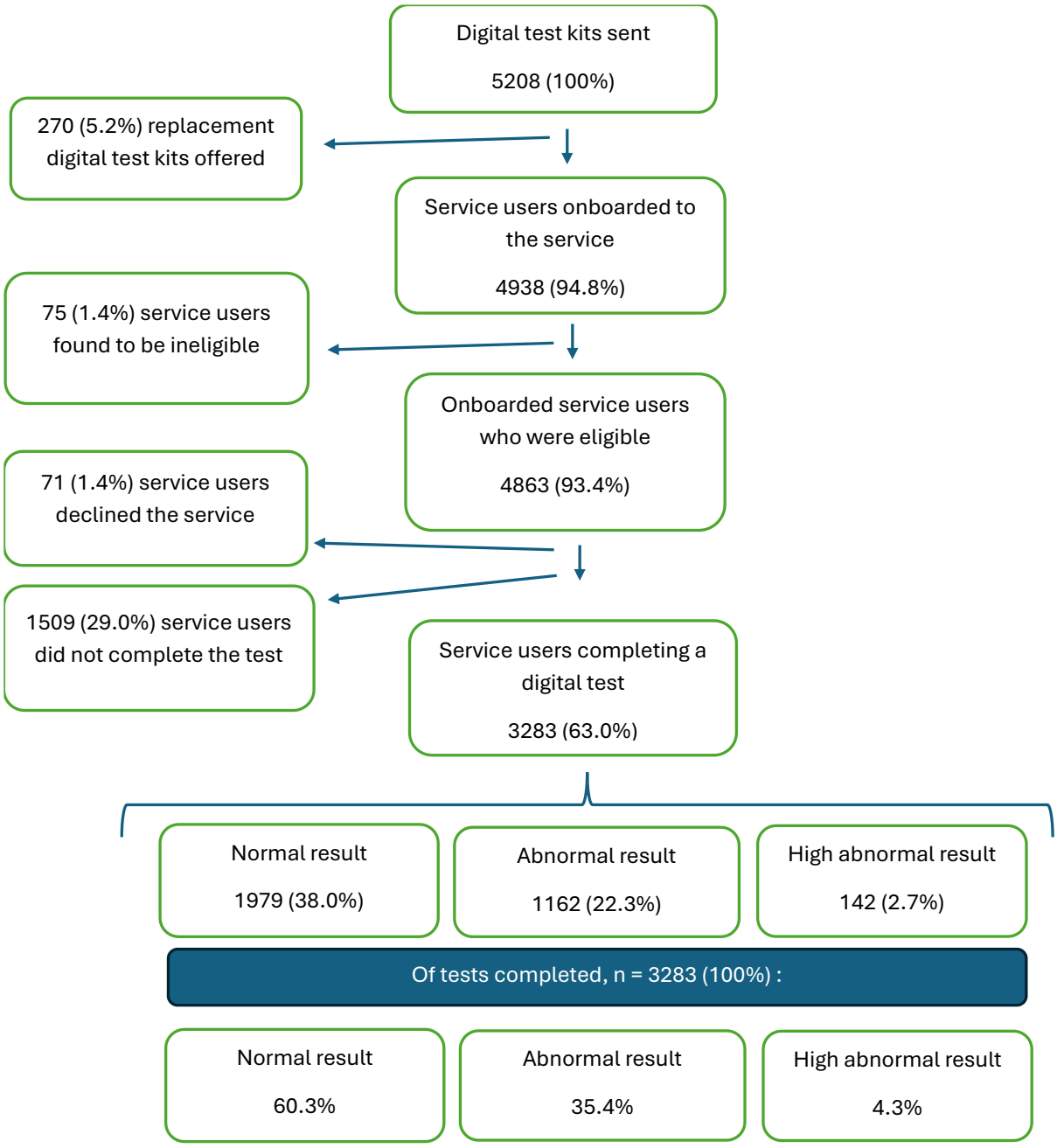


Figure 5: Consort diagram showing dissemination of digital remote testing kits in the MMMoC.

Substantial resource is required to identify those with silent kidney disease who have not been tested as per guidelines within optimised routine care. This resource must be paired with proactivity to formally diagnose CKD where appropriate.

Further analysis is being undertaken to understand the correlation between remote digital testing and CKD diagnosis as well as the medical optimisation achieved in those who were newly diagnosed.

3) *Comprehensive proactive medical reviews in primary care (long list work)*

The results for this programme of work are captured within the overall interrupted time series (see 6.1); given the volume of activity that took place across six sites and 12 Primary Care Networks, the data was extracted at a system level not a site level to allow comparative analysis.

4) *Rapid pharmacological optimisation of patients with CKD using point of care (PROTECT KIDNEY)*

Overall, as shown by Table 6, 296 service users were seen in kidney POC clinics and 190 (65%) of those were fully medically optimised for CKD (defined as maximum tolerated dose of ACEi/ARB, SGLT2i and statin) in clinic. These service users had rapid medical optimisation of these medications facilitated by POC instant results and regular extended appointments with a pharmacist or specialist nurse.

Table 6: Service users seen in kidney POC clinic and proportion medically optimised in clinic

Site	**Site type**	**Service users seen in clinic** (% of eligible population)	**Service users medically optimised in clinic** (% of those seen in clinic)
Bexley	Practice	6 (12%)	3 (50%)
Bromley	2 PCNs	65 (90%)	51(78%)
Lambeth	Practice	15 (25%)	11 (73%)
Lewisham	PCN	36 (37%)	31(86%)
North Southwark	PCN	145 (49%)	70 (48%)
South Southwark	Practice	29 (85%)	24 (83%)
TOTAL		**296 (49%)**	**190 (64%)**

The recorded and observed reasons service users were not optimised in the Kidney POC clinic can be split into two groups. Firstly, there were eligible service users who could not access the clinic, declined the invite, DNA their first appointment or were not invited or booked despite identification. Secondly, there were the service users who attended the clinic but did not reach medical optimisation. In these instances, reasons included declined medication changes, lost to follow up, ineligibility despite initial screening (e.g. due to subsequent repeat uACR normal or optimised in the meantime within routine care) or incomplete optimisation by the clinic. These issues could be minimised in future with increased administrative support and resource (i.e. capacity to contact patients over the phone as opposed to text message invitation) and supported training for those running a new clinic. Although, each clinic was supported by a renal registrar or multi-specialist pharmacist, but this support became remote after initial set up to test longer term sustainability.

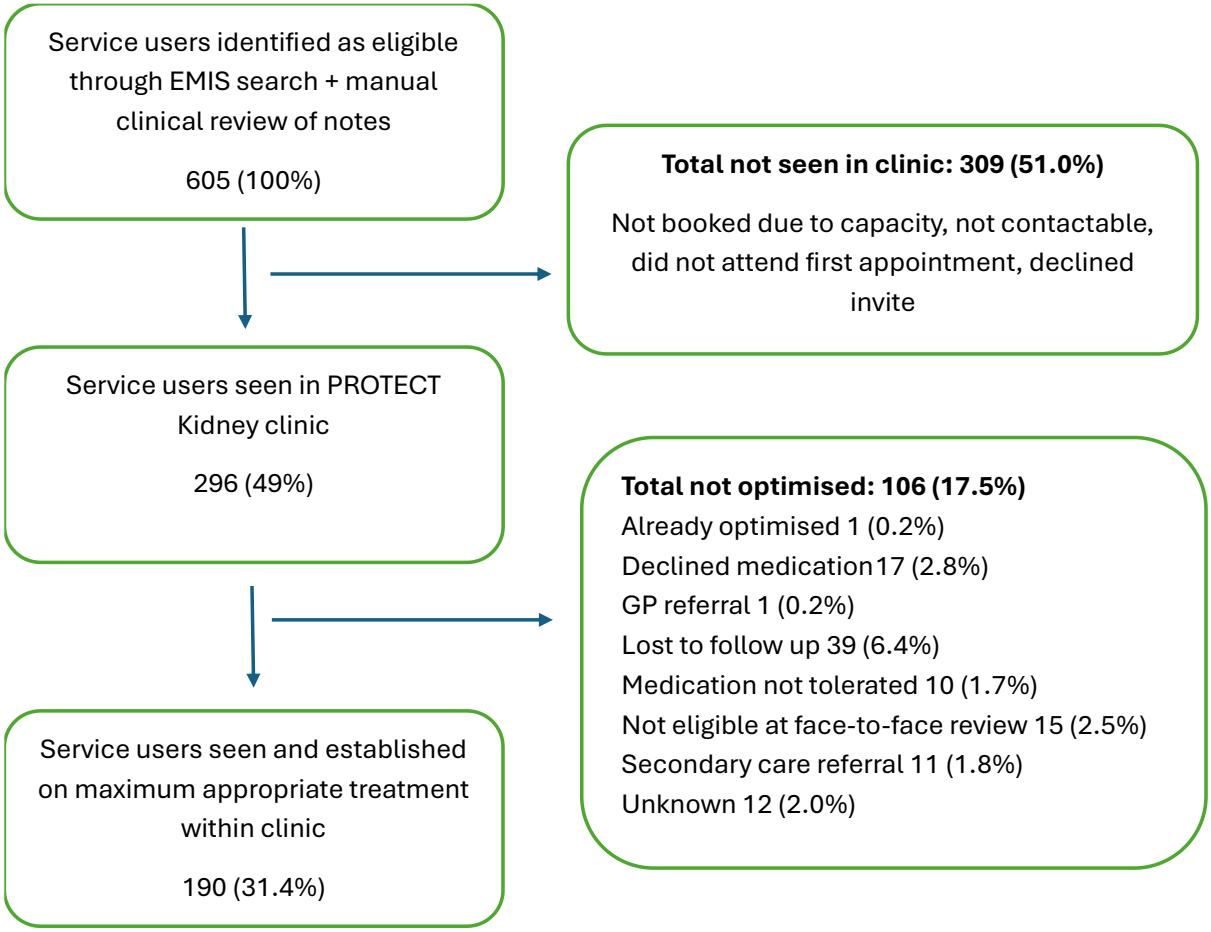


Figure 6: Consort diagram for PROTECT Kidney showing path from identification to optimisation

Implementing a kidney POC in community pharmacy (PROTECT Kidney)

The feasibility of running a kidney POC clinic within community pharmacy was demonstrated through successful implementation with reasonable fidelity. 31 service users were invited to the community pharmacy clinic; seven (23%) of which did not attend any booked and communicated appointments and one of whom (4%) was lost to follow up and did not re-attend after the initial clinic appointment.

Of the 24 (77%) service users who attended between April and July 2025, the number of appointments per service user (excluding DNAs) ranged from one to five with an average of two. Eight (33%) service users did not have treatment escalated which included three ineligible patients (13%). Meanwhile, 15 (63%) service users had rapid treatment optimisation (RAASi optimisation and/or SGLT2i +/- statin). All service users starting new medication had a follow up appointment (often by phone if no blood test needed) and SGLT2i was not tolerated by one patient, so the prescription was not continued. No adverse events were reported during the clinic period.

Qualitative analysis

Qualitative evaluation by the HIN[8] highlighted that both staff and service user groups viewed POC testing positively with minor, practical limitations reported. Key themes highlighted by service users included acceptability of the POC process which was deemed both fast and painless. In fact, one service user'

> '*Loved the immediacy [of the POC clinic; and found it] reassuring and efficient'*

Moreover, service users found the visual results easy to understand and therefore stated a clear preference for POC compared to traditional phlebotomy.

From the healthcare professional perspective, staff commented on clinical efficiency of the POC approach and the reliability of results after an initial familiarisation process with the equipment. One member of staff noted that:

> *'This is 100% times better… before we'd send bloods off and phone patients in the week. This cuts all of that out — we can adjust medication immediately.'*

The more overall efficient process was appreciated by staff. They highlighted the faster diagnosis, immediate medication titration, clearer patient discussions and better flow through the pathway. However, some staff did recognise that there were some operational challenges including difficulty in recruiting staff confident in venous sampling and the occasional machine issues relating to temperature and the drawing of samples. In turn, this highlighted a need for SOPs which recognise the potential for machine failure and include a discharge process.

> *'Sometimes it would only give potassium and not eGFR… it was a bit inconvenient after taking the time to collect the sample'*

Overall, the POC approach was universally valued as a cornerstone of the pathway, enabling rapid, patient centred, effective clinical decision making.

> *'We love the machine … it was fantastic'*

Whilst there is some need for operational refinement to scale up the process, the innovation of POC was valued from both a staff and service user perspective:

> *'It was radical… the first time we could invite patients, test their blood, optimise medication and support them all in one consultation.'*

[8] https://healthinnovationnetwork.com/

Chapter 7. Discussion

The evaluation of the targeted prevention, detection and early disease optimisation shows statistically significant increases in medical optimisation and blood pressure control for patients with CKD. These outcomes are associated with a reduction in cardiovascular end points (heart attacks, heart failure, stroke, death) for service users.

Individual programmes of work implemented to deliver these outcomes were evaluated independently and show promise as ways to deliver community-based detection, primary care targeted detection and rapid medical optimisation in a service-user centred way. Linking a variety of targeted detection models for CKD with accessible medical management which is rapid and proactive promises the biggest improvement in population health. The MMMoC has demonstrated specific scalable examples of each with implementation and activity data as well as acceptability to staff and service users.

The strengths of this evaluation include substantial scale and practical implementation evidence alongside appropriately thorough evaluation of overall outcomes. The MMMoC was an extensive transformation project, and an interrupted time series gives as rigorous evidence as possible for a real-world project occurring outside if controlled conditions such as this. The collaboration across the SEL integrated care system allowing internally driven evaluation using academic, data science and clinical (primary, secondary, community pharmacy) is a further strength demonstrating sustainable development of expertise within the system for application to further neighbourhood work.

Limitations of the work include the accuracy of routinely collected healthcare data, although this was mitigated against through site engagement at the outset of the work. Transformation in a complex system is also limited to evaluating temporal association with outcomes which may be confounded by outside factors. The vast engagement of the MMMoC means that most ongoing work was considered part of the programme and contained within a stream of work but the evaluation of specific cause and effect from individual interventions (rather than the sum of them) remains difficult.

The evaluation would be strengthened by economic evaluation, although given the complexities described above the return on investment for individual streams of work is hard to decipher from the overall evaluation. It would be more meaningful for individual programmes of work contained within the project and this will be delivered for the point of care kidney clinic within the year 2026.

The MMMoC work has provided evidence for supporting the shape of future neighbourhood work around cardiovascular renal and metabolic disease; this provides a platform for further development and scale up of specific practical models of work which have been implemented within the SEL infrastructure and population.

This evaluation provides a blueprint of how we may generate internal evaluation for transformation work beyond what has previously been delivered in line with the 10-year

NHS plan which seeks to be more rigorous in the review of service transformation and delivering value for service users and the system more widely.

Chapter 8. Next steps

1. The Healthy Hearts Pathway is being implemented jointly by the HIN, SEL ICB and King's Health partners to scale up learnings from the POC Kidney clinic to deliver a service which provides rapid pharmacological optimisation for service users with cardiovascular renal metabolic disease
2. Economic evaluation for POC Kidney clinic to be delivered by the end of 2026
3. Service user level analysis to be completed for the digital remote testing with Healthy.io which will provide information to inform further scale up of similar activity within neighbourhoods
4. We aim to deliver peer reviewed publications for each of the programmes of work to further disseminate learnings and receive feedback regarding the evaluation methodology and execution
5. HIDDEN CKD is being scaled in other parts of London (North West and North East) and with continued support from Kidney Research UK we hope to deliver a return-on-investment report as part of this. Targeted testing activities continue in the community.
6. These streams of work will feed into the development of neighbourhood models by maintaining high levels of evaluation allowing the scale up of successful innovations.

Chapter 9. Conclusion

This evaluation demonstrates that an integrated neighbourhood approach to chronic kidney disease prevention, detection and optimisation can deliver measurable improvements in both clinical care and system performance at scale. Across South East London, the combined use of targeted community outreach, digital remote testing, proactive case-finding and rapid point of care medicines optimisation was associated with improved CKD monitoring, increased evidence-based prescribing, better blood pressure control and reduced outpatient utilisation, while successfully engaging populations at risk of underdiagnosis and inequitable outcomes. Importantly, the programme shows that innovative multidisciplinary models can move beyond identifying disease to accelerating effective treatment in community settings, providing a practical and scalable framework for improving cardiovascular and kidney health across integrated care systems.

Chapter 10. Acknowledgements

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Sharif Yacoob, Service Improvement Manager (CESEL/Lambeth GP federation)

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Chapter 12. Appendices

Appendix 1. Analyses performed for the interrupted time series of the overall project

For service user-level analyses, **outcomes were aligned using relative time**, such that month 0 corresponded to the start of intervention for each service user within intervention cohorts. This approach ensured that **all service users**, regardless of when they were identified or engaged, **were analysed on a common temporal scale**. Cohorts who did not receive the intervention were assigned the arbitrary 'intervention' date of April 1, 2024, consistent with the project implementation. Months were coded relative to the intervention, with up to 12 months prior coded as negative values and up to 12 months post-intervention coded as positive values, where cohort data were available. This alignment allowed **consistent estimation of pre-intervention trends, immediate level changes, and post-intervention trends across cohorts,** while avoiding dilution of effects that would arise from using absolute calendar time when intervention dates varied.

Monthly outcome measures were aggregated at cohort level. For each outcome, segmented regression models of the form below were fitted:

$$Y_t = \beta_0 + \beta_1 Time_t + \beta_2 Intervention_t + \beta_3 PostTime_t + \varepsilon_t$$

Where:

- $Time$ represents continuous time (months) prior to intervention;
- $Intervention$ is a binary indicator (0 pre-intervention, 1 post-intervention) estimating the immediate level change;
- $PostTime$ represents time elapsed since intervention, estimating change in trend; and
- ε represents the error term.

The intervention month (month 0) was excluded from modelling to determine clear pre- and post-intervention boundaries. For clinical and process measures, models were weighted by the corresponding denominator so that months with larger underlying populations contributed proportionally more to the model estimates. To support interpretation of percentage point changes, absolute service user counts were calculated by multiplying coefficient estimates by time-matched denominators (pre-intervention average for pre-intervention trends, month 0 denominator for immediate level changes, and post-intervention average for post-intervention trend changes). It should be noted that the CKD cohort is substantially larger than the intervention cohorts (long list and short list). Therefore, absolute service user counts should not be compared directly across cohorts. These figures are provided solely to contextualise the clinical significance of percentage point changes within each cohort. Moreover, those seen through the MMMoC intervention, those on the long list and short list, have data points alongside those seen on the CKD register as this is deemed a reasonable comparator for what routine care would have looked like among this population had they not been seen on the innovative MMMoC pathways. To account for autocorrelation in the monthly time series, coefficient standard errors were estimated using Newey–West HAC standard errors (lag = 1).

For utilisation outcomes, results were expressed as rates per 1,000 population; for clinical and process measures, outcomes were expressed as proportions or percentage points. Results are reported with 95% confidence intervals (represented by the shaded areas in the graphs) and p-values, with statistical significance assessed at the 5% level. P-values were adjusted for multiple testing using the Benjamini–Hochberg false discovery rate method.

Appendix 2. Complete results for the interrupted time series analyses performed

Table A: Full model estimates with confidence intervals for the proportion of the population on the QOF CKD register.

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend difference**
Detections	**Population**	**MMMoC sites**	**+0.03** (0.03 to 0.03, p < 0.001)	**+0.02** (0.01 to 0.04, p = 0.008)	**-0.01** (-0.02 to -0.01, p < 0.001)
		Non-MMMoC sites	**+0.03** (0.02 to 0.03, p < 0.001)	**+0.03** (0.02 to 0.04, p < 0.001)	**-0.01** (-0.01 to -0.01, p < 0.001)

Table B: Full model estimates with confidence intervals for the proportion of service users prescribed an SGLT2i

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend**
SGLT2i	**Service user**	**CKD**	**+0.75** (0.66 to 0.84; p < 0.001)	NS	NS
		Long list	**+1.03** (0.97 to 1.08; p < 0.001)	**+5.05** (3.49 to 6.61; p < 0.001)	NS
		Short list	**+1.27** (0.82 to 1.71; p < 0.001)	**+15.48** (12.20 to 18.75; p < 0.001)	NS
	Population	**MMMoC sites**	**+0.83** (0.76 to 0.89; p < 0.001)	NS	**+0.21** (0.12 to 0.30; p < 0.001)
		Non-MMMoC sites	**+0.15** (0.11 to 0.18; p < 0.001)	NS	NS

Table C: Full model estimates with confidence intervals for the proportion of service users prescribed a statin

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend**
Statins	**Service user**	**CKD**	**+0.62** (0.37 to 0.87; p < 0.001)	NS	**−0.39** (−0.66 to −0.11; p = 0.009)
		Long list	**+0.41** (0.34 to 0.49; p < 0.001)	**+2.58** (1.56 to 3.60; p < 0.001)	NS
		Short list	**+0.15** (0.11 to 0.18; p < 0.001)	**+4.32** (3.91 to 4.72; p < 0.001)	**+0.17** (0.11 to 0.23; p < 0.001)
	Population	**MMMoC sites**	**+0.65** (0.39 to 0.91; p < 0.001)	NS	NS

		Non-MMMoC sites	**+0.62** (0.38 to 0.86; p < 0.001)	NS	**-0.40** (-0.67 to -0.13; p = 0.005)

Table D: Full model estimates with confidence intervals for the proportion of the population with controlled blood pressure.

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend difference**
Blood Pressure	**Service user**	**CKD**	**+0.15** (0.12 to 0.18; p < 0.001)	**−0.43** (−0.81 to −0.06; p = 0.025)	**−0.05** (−0.10 to −0.01; p = 0.023)
		Long list	NS	**+2.98** (1.01 to 4.94; p = 0.005)	NS
		Short list	**+0.55** (0.20 to 0.91; p = 0.004)	**+5.62** (2.45 to 8.80; p = 0.001)	NS
	Population	**MMMoC sites**	**+0.33** (0.25 to 0.42; p < 0.001)	**−2.93** (−3.73 to −2.13; p < 0.001)	NS
		Non-MMMoC sites	**+0.21** (0.06 to 0.37; p = 0.011)	NS	NS

Table E: Full model estimates with confidence intervals for the rate of non-elective hospital admissions.

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend**
Non-elective admissions	**Service user**	**CKD**	**-0.51** (-0.76 to -0.27; p < 0.001)	**+3.22** (1.36 to 5.07; p = 0.002)	**+0.35** (0.09 to 0.62; p = 0.011)
		Long list	**+0.25** (0.06 to 0.44; p = 0.011)	**+5.05** (3.49 to 6.61; p < 0.001)	**-0.70** (-1.11 to -0.28; p = 0.002)
		Short list	NS	NS	NS
	Population	**MMMoC sites**	NS	NS	NS
		Non-MMMoC sites	NS	NS	NS

Table F: Full model estimates with confidence intervals for the rate of outpatient attendances, and specialist outpatient attendances (cardiology/diabetes/renal).

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend difference**
Outpatient attendances (all)	**Service user**	**CKD**	NS	NS	NS
		Long list	**+6.78** (5.15 to 8.41; p < 0.001)	**+4.57** (2.52 to 6.62; p < 0.001)	**-26.18** (-42.02 to -10.35; p = 0.003)
		Short list	**+12.42** (7.29 to 17.55; p < 0.001)	NS	**-38.13** (-45.29 to -30.98; p < 0.001)
	Population	**MMMoC sites**	**+2.45 (**0.69 to 4.22; p = 0.009**)**	NS	NS
		Non-MMMoC sites	**+2.76 (**1.03 to 4.50; p = 0.003**)**	NS	NS

Outpatient attendances (cardiology/ renal/ diabetes)	**Service user**	**CKD**	**-1.69** (-2.63 to -0.74; p = 0.001)	NS	**+1.87** (0.88 to 2.85; p < 0.001)
		Long list	**-1.38** (-2.15 to -0.62; p = 0.001)	NS	NS
		Short list	NS	NS	**-2.33** (-4.11 to -0.55; p = 0.013)
	Population	**MMMoC sites**	**-0.20** (-0.32 to -0.08; p = 0.003)	NS	**+0.24** (0.11 to 0.36; p < 0.001)
		Non-MMMoC sites	NS	NS	NS

Table G: Full model estimates with confidence intervals for the rate of A&E attendances.

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend difference**
A&E attendances	**Service user**	**CKD**	**+0.19** (0.12 to 0.25; p < 0.001)	NS	NS
		Long list	**+0.15** (0.02 to 0.29; p = 0.024)	NS	NS
		Short list	**−0.47** (−0.62 to −0.33; p < 0.001)	**+1.71** (0.52 to 2.90; p = 0.007)	**+0.68** (0.47 to 0.88; p < 0.001)
	Population	**MMMoC sites**	NS	NS	NS
		Non-MMMoC sites	NS	NS	NS

Table H: Full model estimates with confidence intervals for the rate of GP appointments.

			***Estimate** (95% CI; p-value)*		
Metric	**Analysis level**	**Cohort**	**Pre-intervention trend**	**Immediate level change**	**Post- vs pre-intervention trend**
GP appointments	**Service user**	**CKD**	**+22.44** (10.74 to 34.14; p < 0.001)	**-277.52** (-419.29 to -135.76; p < 0.001)	**-19.34** (-34.95 to -3.73; p = 0.018)
		Long list	NS	NS	NS
		Short list	NS	NS	**-27.96** (-49.54 to -6.38; p = 0.014)
	Population	**MMMoC sites**	NS	**-195.96** (-333.34 to -58.57; p = 0.007)	NS
		Non-MMMoC sites	**+9.20** (4.90 to 13.50; p < 0.001)	**-114.47** (-159.74 to -69.20; p < 0.001)	**-8.03** (13.68 to -2.37; p = 0.008)

Chapter 13. Glossary

Term	Full term	Definition
A&E attendances	Accident and emergency attendances	The number of visits to an accident and emergency hospital department.
ACEi	Angiotensin-converting enzyme inhibitors	Blood pressure lowering medication that prevents an enzyme from making angiotensin 2, a hormone that narrows blood vessels and raises blood pressure. They help to protect kidney function and treat heart failure.
ARB	Angiotensin receptor blockers	Blood pressure lowering medication that blocks the action of angiotensin 2, a hormone that narrows blood vessels and raises blood pressure. They help to protect kidney function and treat heart failure.
APL risk stratification tool	Active service link risk stratification tool	A tool developed by Queen Mary's University London that organises routine data to help primary care prioritise CKD management tasks, e.g., identifying service users with a diagnosis of CKD but no recent blood test and uncontrolled blood pressure.
ARRS	Additional roles reimbursement scheme	NHS England funding scheme to expand the primary care workforce by providing recurrent funding for specific multi-disciplinary roles at PCN and practice level.
BP	Blood pressure	Blood pressure is the force of the blood pushing against the walls of the arteries as it circulates around the body. A healthy blood pressure is 120/80 mmHg for an adult without underlying health conditions.
CEG NEL / CESEL	Clinical effectiveness group North East London / Clinical effectiveness South East London	Data-driven, evidence-based units leading transformation and quality improvement to improve service user outcomes and reduce inequalities.
CI	Confidence interval	The range of data values likely to contain the true population parameter with a specified level of confidence (e.g. 95%).

CVRM	Cardiovascular renal metabolic	The interconnected dysfunction of the heart, kidneys and metabolic system (including obesity and diabetes).
CKD	Chronic kidney disease	A chronic condition where the kidneys cannot effectively filter waste and excess fluid from the blood. It can lead to kidney failure, requiring dialysis or a transplant.
Diabetes	A chronic metabolic disorder characterised by high blood-glucose levels	High blood-glucose (sugar) levels can either be caused because the body does not produce enough insulin, or because the body becomes resistant to the effects of insulin. High glucose levels can lead to organ damage over time.
DNA	Did not attend	When a service user misses a scheduled appointment without notice.
eGFR	Estimated glomerular filtration rate	A blood-test-derived estimate of how well the kidneys filter waste from the blood. Used to stage chronic kidney disease and guide treatment plans.
EMIS	Egton Medical Information Systems	Widely used UK primary care electronic health record system enabling GPs to record consultations, medications, diagnoses, test results and care plans. It is the system used by most GPs across South East London.
HIDDEN	Health Inequalities in kiDney Disease, mEeting the urgent Need to identify early disease in high-risk communities	This is an umbrella term for a number of pieces of research looking at reducing inequalities within kidney disease led by Professor Kate Bramham at King's College London. Examples include HIDDEN-BP, HIDDEN-CKD.
Hypertension	High blood pressure	A condition where blood pressure is consistently high. This is often asymptomatic but increases the risk of kidney disease, heart attack and stroke.
ICB	Integrated care board	NHS regional bodies responsible for planning and funding health services across a geographical area.
ICS	Integrated care system	The NHS, council, social services and voluntary services form a partnership across regions to help improve the delivery of health and social care for their populations. An ICB sits within the ICS.
IMD	Index of multiple deprivation	A commonly used UK measure that ranks neighbourhoods based on deprivation factors such as income,

		employment, health, crime, housing, and education.
INT	Integrated neighbourhood team	Where all parts of the health and care system – primary care, social care, community health, mental health, acute, and wider system partners – work closely together to support service user's needs more systematically.
ITS	Interrupted time series	A statistical evaluation method that analyses trends before and after an intervention to understand its impact when randomised trials are not feasible.
KCH	King's College Hospital NHS Foundation Trust	A hospital trust providing specialist and community care in south east London.
KFRE	Kidney failure risk equation	A validated risk prediction tool that calculates a service user's probability of progressing to kidney failure in 2 or 5 years based on their age, sex, eGFR and ACR.
Lipid-lowering therapy	Therapy which aims to reduce cholesterol and triglyceride levels in the blood	Lipids are a fatty compound that perform a range of functions. Having too much of certain lipids increase the risk of cardiovascular disease. Hence there is a need for lipid lowering therapies (medication) e.g. statins.
MDT	Multidisciplinary team	A group of professionals from different disciplines who collaboratively assess and plan care, ensuring holistic, coordinated, and service user centred management.
mLTCs	Multiple long-term conditions	When a person lives with two or more chronic illnesses at the same time (e.g., diabetes, heart failure, CKD).
MMMoC	Multimorbidity model of care	A person-centred, holistic, and fully integrated model across all care settings delivered through INTs. Aims to shift care nearer to the service user, through community-based INTs and optimising proactive care.
NHS	National Health Service	The NHS is the UK's publicly funded healthcare system that provides medical care, free at the point of use for residents.
Non-elective inpatient admissions	Emergency treatment including an overnight stay in hospital	Non-elective refers to the emergency/unplanned element of the visit. An inpatient admission is where a service user is required to stay overnight in hospital.

NS	Not significant	The observed effect or difference in the data is small enough that it could reasonably have occurred by chance rather than reflecting a true underlying effect.
Outpatient attendances	Treatment received in a hospital or clinic without requiring an overnight stay	Planned attendance at a hospital or clinic without the need to stay overnight. This can be for a consultation, diagnostic test, minor procedure or follow up.
PCN	Primary care network	Groups of GP practices serving populations, working with community, mental health, pharmacy, and voluntary partners to deliver enhanced and shared services.
POC	Point of care	Diagnostic tests delivered at the time of care, enabling faster decision making.
PP	Percentage point	A unit used to describe the absolute difference between two percentages. For example, an increase from 40% to 50% represents a 10-percentage point (pp).
PROTECT KIDNEY	Primary Care Allied Health Professional-Led Point-of-Care Pathway to Optimise cardio-Renal Medications for People with Chronic Kidney Disease	This is the name given to the point of care kidney clinic designed and protocolised by Dr Rouvick Gama.
QOF	Quality and outcomes framework	A national NHS voluntary primary care reward and incentive scheme. It supports resourcing and rewarding good clinical practice (prevention, screening and diseas e clinical management) in primary care.
SEL	South East London	A geographic area and NHS Integrated Care System covering the London boroughs of Bexley, Bromley, Greenwich, Lambeth, Lewisham and Southwark.
SGLT2i	Sodium-glucose co-transporter 2 inhibitors	A class of medications that lower blood glucose levels by increasing glucose excretion in the urine. These medications are protective of the kidney and the heart.
SOP	Standard operating procedure	A mandatory document providing step-by-step instructions for clinical or non-clinical

		tasks to ensure consistent, safe, and high-quality care
Statins	A type of lipid lowering medication	The most used medicine to lower cholesterol levels in the blood. Statins have been shown to reduce the risk of heart attacks and strokes and are the recommended first line for people with CKD.
uACR	urine Albumin creatinine ratio	A urine test that measures how much protein (albumin) is present in the urine, adjusted for the amount of creatinine in the same sample. This is used to screen for, stratify and monitor CKD. A raised ACR is associated with more advanced CKD and is an independent risk factor for cardiovascular disease.