The **C**hildren and **Y**oung **P**eople's **H**ealth **P**artnership (**CYPHP**) Evelina London Model of Care: An Opportunistic Cluster Randomised Evaluation to Assess Child Health Outcomes, Healthcare Quality, and Health Service Use

Statistical Analysis Plan
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This current version of the SAP and all preceding versions will be stored in the CYPHP Evaluation SharePoint drive.

Document history

Version	**Date**	**Changes made**	**Justification for change**
Version 1.0	9JUL21	N/A - First complete version	
Version 1.1	8MAR22	Section 11.10 added	Describing plan for outcomes where minimal correlation is observed within clusters; this was identified as a possibility prior to unblinding.

Contents

LIST OF ABBREVIATIONS

ACS	Ambulatory care sensitive
ACT	Asthma control test
CHU-9D	Child health utility instrument
CYP	Children and young people
CYPHP	Children and Young People's Health Partnership
DOB	Date of birth
ED	Emergency Department
EMIS	Egton Medical Information Systems
EUC	Enhanced usual care
GP	General practice
GSTT	Guy's and St Thomas' NHS Foundation Trust
HC	Health Check
HSU	Health service use
ICC	Intraclass coefficient
ICD-10	International Classification of Diseases, 10th edition
ID	Identifier
IDACI	Income deprivation affecting children index
IMD	Index of Multiple Deprivation
IQR	interquartile range
IRAS	Integrated Research Application System
ISRCTN	International Standard Randomised Controlled Trial Number'
KCH	King's College Hospital
LSOA	Lower super output area
LTC	Long term condition
MCID	Minimum clinically-important difference
NEA	Non-elective admission
NHS	National Health Service
OA	Output area
OP	Outpatient
PAS	Patient administrative system
PEDSQL	Pediatric Quality of Life Inventory
POEM	Patient Oriented Eczema Measure
SAP	Statistical analysis plan
SD	Standard deviation
SDQ	Strengths and Difficulties Questionnaire
UK	United Kingdom
WEMWBS	The Warwick-Edinburgh Mental Wellbeing Scale

1. INTRODUCTION

This statistical analysis plan (SAP) provides a framework and guidelines for the statistical analysis of the Children and Young People's Health Partnership (CYPHP) randomised controlled trial for presentation, reporting and publication. Any deviations from the statistical analysis plan will be documented in the statistical end of trial report.

1.1 Trial design - Background and Rationale

Lambeth and Southwark have high levels of deprivation. These boroughs have higher than national average rates of child mortality and high unplanned health service use, and rising hospital outpatient use for children and young people (CYP) with long term conditions (LTC). The local Clinical Commissioning Groups (CCGs), Local Authorities, and Healthcare Providers have attempted to address these problems by forming The Child and Young People's Health Partnership (CYPHP) and together implementing a new model of integrated healthcare across the two boroughs. The CYPHP model aims to deliver more effective, coordinated care in primary care and community settings, and promote better self-management for CYP with common health complaints and LTCs. The CYPHP model is designed as a large-scale quality improvement initiative implementing integrated care pathways for children, for example across service provider organisations and professional groups.

This cross-organisational, system-wide, transformative, and academically rigorous approach to improving child health services aims to deliver care to traditionally hard to reach groups.

The intention of the Partnership is to roll out the full CYPHP Evelina London model of care across Lambeth and Southwark. However, due to resource limitations, implementation will occur in phases. In the first phase (~two years), approximately half of GP practices across the boroughs will implement the CYPHP model while others will offer enhanced usual care (EUC). It is expected that all the EUC practices will also adopt the CYPHP model after two years, so that all of Lambeth and Southwark will eventually be using the CYPHP model. This phased roll-out schedule offers the unique opportunity for a rigorous evaluation of the CYPHP Evelina London model of care at scale, using an opportunistic cluster Randomised Controlled Trial (cRCT) design. The unit of randomisation is the "GP hub", a group of general practices who work together to share workloads, and where the GP – paediatrician co-located clinics occur. We term these GP hubs as clusters. During the first phase of roll-out, outcomes in the CYPHP model practices can be evaluated, while the EUC practices offer a natural comparator control group. Seventy GP practices across Lambeth and Southwark, grouped into 23 clusters, were randomised to provide either the CYPHP model of care (n=11) or enhanced usual care (n=12).

We hypothesise that the CYPHP Evelina model of care will improve the quality of care provided to children which will improve both children's health and reduce their health service use compared with patients from EUC practices.

1.2 Related work

This analysis plan is not a stand-alone piece of work but sits within a mixed method evaluation that incorporates both process and economic evaluations. The process and economic evaluation analysis plans are described in separate documents. There is also a detailed document on Data and reporting guidelines and a published study protocol.[1]

2. PURPOSE OF THE EVALUATION

- To evaluate the impact of the Children and Young People's Health Partnership (CYPHP) Evelina London model of care on the health, healthcare, and health service use of children and young people (CYP).
- To understand how and why the CYPHP Evelina London model of care was effective or ineffective, and to identify contextually relevant strategies for successful implementation as well as practical difficulties in adoption, delivery and maintenance to inform wider implementation.
- To assess the costs of delivery and cost effectiveness of the CYPHP Evelina Model of care compared to enhanced usual care.
- To generate rigorous evidence for local, national and international service providers and commissioners and contribute to the evidence base in CYP health services research.

3. TRIAL EVALUATION OVERVIEW

This evaluation will address the above objectives using data about children aged 0-15 years (<16) registered with a GP practice in Southwark or Lambeth. The evaluation will take 3 levels.

1. A population evaluation (all children)
2. A tracer condition evaluation (all children identified as having or potentially having asthma, eczema, constipation)
3. a) A consented tracer condition evaluation (all children with asthma, eczema, or constipation who have consented for additional data collection and associated data linkage)
   b) A consented tracer condition evaluation (all children with asthma, eczema, or constipation who have consented for additional data collection and associated data linkage) including only those who met the threshold to be offered CYPHP service(s).

4. INTERVENTION

The intervention is outlined in detail in the evaluation protocol. In brief, the CYPHP Evelina London model aims to provide comprehensive coordinated care for CYP through several mechanisms:

- Integrating primary and secondary healthcare
- Integrating physical and mental healthcare
- Integrating healthcare with public health
- Improving the age appropriateness of care.
- Providing tailored care that is responsive to patients' needs

During phased roll out and the evaluation trial, the CYPHP Evelina London model comprises two groups: 1) interventions that are being implemented across both arms of the trial, called "enhanced usual care" (EUC) and 2) The full CYPHP Evelina London model, comprising EUC plus additional interventions. Thus, EUC serves as the control arm, and the full CYPHP Evelina London model serves as the intervention arm.

4.1 Enhanced usual care (control arm)

All practices within Lambeth and Southwark will receive:

- Decision support tools for GPs comprising guidelines (in line with national evidence-based guidelines), algorithms, and referral guidance for common conditions such as constipation, eczema, urinary tract infection, enuresis, headache, and food allergies. They are in an electronic format, embedded into local GP data systems so that they can be accessed easily during a consultation.
- Paediatric hotline enabling rapid communication between GPs and paediatricians to discuss urgent support, management, or referral of an individual child or young person.
- School-based emotional resilience building and mental health first aid.
- Minor illness and wellness support and services for the most common problems and illnesses, to help parents and professionals to keep CYP well at home.
- CYPHP Health Checks for CYP with tracer conditions (asthma, epilepsy (service discontinued for epilepsy), eczema, constipation) and their parents – a condition-specific biopsychosocial questionnaire about disease or condition status, emotional wellbeing, and social factors. Information collected from the CYPHP Health Check is added to patients' GP records, and families are sent a summary of their scores on the questionnaires.
- CYPHP Health Packs following the Health Check, for CYP with tracer conditions, and their parents, comprising self-management support, health promotion, and health education material.

4.2 CYPHP Evelina London model (intervention arm)

In addition to the components of the EUC arm, the CYPHP Evelina London model comprises two types of clinical services:

Targeted care for CYP with ongoing (tracer) conditions

CYP with tracer conditions are eligible for a tailored clinical service delivered by the multidisciplinary CYPHP Health team in primary and community care settings and in patients' homes. Children are actively identified for the service using a call and recall system which interrogates their primary health care records for evidence of the condition from diagnosis, management or treatment, identifies CYP with a tracer condition, and invites the parent/carer to complete a CYPHP Health Check. Health Check responses are used to triage CYP based on clinical need. The length and intensity of intervention is left to the clinical judgement of the multi-disciplinary team delivering CYPHP services.

Universal care available for CYP with any condition.

CYP with any condition are eligible for "in-reach" CYPHP clinics. These clinics are integrated child health clinics jointly run by GPs and local "Patch Paediatricians" who are linked to a cluster of GP practices. Clinics are held in primary care settings. They offer generalist and specialist advice co-located and coordinated conveniently close to home for patients. In-reach clinics will typically be for CYP who would otherwise have been referred to hospital for an outpatient appointment with a general paediatrician.

5. SAMPLE SIZE, RECRUITMENT, RANDOMISATION, AND BLINDING

5.1 Sample size and power

Population Evaluation

Pseudo-anonymised data from all children (<16 years) within participating practices will be used to analyse the impact of the CYPHP Evelina London model on health service use.

11 clusters in each arm, and an average of 3800 CYP per cluster, provides over 87% power to detect a reduction of 20% in the rate of non-elective admissions, assuming a coefficient of variation of 0.142, as explained below.

The number of CYP per cluster is estimated conservatively based on the 89382 CYP (age 0-15) registered in 2015 in the GP practices in the 23 randomised clusters. For each financial year 2013-14 – 2015-16, the baseline rate of non-elective admissions and the coefficient of variation was estimated using counts of non-elective admissions per cluster from financial years 2013-14 – 2015-16, and counts of CYP enrolled per cluster during 2013-2015. The coefficient of variation used in the sample size calculation was the mean of these three estimates. The rate of non-elective admissions was the total rate estimated by combining data from the three financial years.

Tracer Condition Evaluation

With 11 clusters in each study arm, the study team will need to recruit a minimum of 1006 CYP with a long-term tracer condition (asthma, constipation or eczema**)** per arm (total 2012). This number of participants will give the study 90% power to detect a mean minimum clinically important difference (MCID) of 4.5 points (standard deviation 16.5) in the primary child-health outcome tool (parental reported PEDSQL (Varni et al, 1999),[2] as used previously with children with chronic health conditions such as asthma (Varni et al, 2004).[8] Intraclass coefficient (ICC) is assumed to be 0.02 based on study of quality of life in children and young people with a related condition, hay fever (Hammersley et al, 2010). Inter-cluster variation is assumed to be (0.03) based on the harmonic mean and variance of cluster size derived from GP registrations. This number also accounts for a 30% loss to follow up.

In total there are **23 clusters**, 12 in one arm and 11 in the other. As such the outlined sample size underestimates the total power as we have assumed 11 clusters in each arm.

5.2 Recruitment

The CYPHP Evelina London model of care is part of a service quality improvement initiative by a local partnership including service providers and commissioners of care, and is being implemented after extensive consultation and co-development with local stakeholders. Therefore, and in keeping with guidelines for the ethical conduct of cRCT's, patients within GP practices are being asked for their consent to participate in the follow-up evaluation, rather than consent for participation in a new model of care as this is part of a new standard service roll out. (Campbell et al, 2012)

OVERVIEW OF RECRUITMENT – TRACER CONDITION

1) **Providing service information for CYP and families.** Eligible patients with one of the three tracer conditions will be identified by their GP and receive text messages and a letter and information sheet outlining the new services being delivered in their GP practice. Potential participants are invited to contact the service, either by telephone or by logging onto a web page. The web page is a portal modelled on an existing and well-established platform in use for several years by another local programme (IMPARTS). It was adapted for use in CYPHP and tested for acceptability with local CYP and families.
2) **Inviting CYP and parents to participate in evaluation.** Parents of CYP receiving the service (either the CYPHP Evelina London model or EUC) for a tracer condition will be invited to participate in the evaluation, and provided with information sheets about the evaluation, in formats for the parent and child. These will be provided through the portal, in person, or by post.

3) **Informed consent/assent.** Those who would like to participate will be asked to give informed consent (using the web-based portal, in person, or by post) to participate in the evaluation and follow-up. Specifically, parents will be asked to:
    a. provide informed consent for the evaluation team to 1) access their child's clinical details including a baseline clinical screening questionnaire which is completed on entry into the clinical service, and 2) have access to, and link, the child's GP and hospital data to assess the impact of CYPHP on both primary and secondary health service use. The baseline clinical screening questionnaire, completed for clinical services, includes the Strengths and Difficulties Questionnaire, and a condition-specific questionnaire: Asthma Control Test, GSTT Symptom Severity Measure (for constipation), or Patient Oriented Eczema Measure.
    b. complete an evaluation questionnaire at baseline (including health related quality of life measured by PEDSQL and CHU9D, and parental wellbeing measured by the Warwick-Edinburgh Mental Wellbeing Scale), and complete the clinical screening questionnaire and evaluation questionnaire at 6-month, and annual follow-up.
    c. give informed consent to be contacted to potentially participate in qualitative studies evaluating the service

Patient information sheets will make it clear that parents can consent or refuse consent to any of these components. Participants will be free to withdraw consent without prejudice at any time.

A parent/carer alone or with their child may be involved in the recruitment process. If the CYP is under 12 years of age the parent/carer will be asked to provide, on behalf of the child, informed consent, if they are happy to take part in the evaluation. If the CYP is between 12 and 16 years of age, the parent will be asked to provide informed consent and if the CYP is available at the time when parental consent is requested, the CYP will be asked to provide assent if they wish to participate.

TRACER CONDITION RECRUITMENT TIMELINE

Recruitment began in April 2018. The first participant was consented 22MAY2018, following their Health Check 24APR2018. Recruitment is planned to complete in December 2020.

POPULATION EVALUATION DATA

The evaluation has data sharing agreements granting access to pseudo-anonymised data for all CYP under the age of 16 across the two boroughs for population level service-use analysis. Data in this pseudo-anonymised format are available from EMIS, a clinical records and informatics system used in primary care, and hospital administrative data. As individuals' data are provided in anonymized form (e.g. from administrative data sources or registries) to the research team for population-level evaluation, these CYP are not considered research participants (Weijer et al, 2012, p4), therefore individual consent is not required and as outlined in our ethics application and approval, Section 251 approval from the Confidential Advisory Group is not required.

5.3 Randomisation

As part of the implementation of the CYPHP Evelina London model within Lambeth and Southwark, GP practices are grouped into virtual clusters. Clustering is a pragmatic clinical delivery decision, because it allows sharing of resources and holding specialist in-reach clinics without added expense to the practices. Where possible clusters were created aligned to GP Federation "neighbourhoods" or other groupings.

Of the 100 GP practices within Lambeth and Southwark, 25 took part in pilot testing of some components of the CYPHP Evelina London model of care to refine the model and test feasibility. As such these 25 practices are not randomised. All other practices are eligible to take part in the trial evaluation.

Randomisation is at the level of the primary care practice cluster. 23 clusters were randomised, by an external statistician.

Randomisation was stratified by borough, and restricted with the following restriction factors:
- Baseline Index of Multiple Deprivation (IMD) / Income Deprivation affecting children Index (IDACI) score per cluster
- CYP population <16 per GP cluster
-Paediatric OP referrals 2015-2016

These restrictions factors are believed to affect health related quality of life and patterns of health service use. Restricted randomisation on these factors helps to ensure that clusters are comparable with regards to (i) number of patients within each cluster, (ii) the socio-demographic profile of their patient population (iii) the referral patterns within clusters.

5.4 Blinding

The study statistician, health economist, and researchers involved in recruitment will be blind to group allocation. The statistician and health economist will only have details of participants by study number and pseudonymised patient ID.

The evaluation will not be blinded at the level of the service delivery or participant.

6. DATA

Data will be extracted from three main sources:

1) Primary care (GP) clinical administrative systems
2) Secondary care (hospital) clinical patient administrative systems
3) Survey/questionnaire data (consented patient level) from a patient portal
    a. Note: For service evaluation, Health Check data are also available.

6.1 Primary care clinical data

All practices within Lambeth and Southwark use the Egton Medical Information System (EMIS). Agreements on sharing data have been made between CYPHP and the GP federations for Lambeth, Southwark North and Southwark South. We will receive data on all children aged <16 registered with Lambeth and Southwark GP practices. Extractions will take place every quarter (3 months). See Data and reporting guidelines document for more details.

6.2 Secondary care clinical patient data

All hospital activity is recorded within the patient administrative system (PAS). The activity of interest to our evaluation is:

- Admitted patient care data
- A&E data
- Outpatient data

Agreements on sharing data have been made between CYPHP and the trusts in Lambeth and Southwark - Guy's and St Thomas's (GSTT) and King's College Hospital (KCH). We will receive quarterly extracts of health care activity at St Thomas's, Guy's or King's College Hospitals of

children registered with Lambeth and Southwark GP practices. Local coding (within St Thomas's, Guy's or King's College Hospitals) is completed within a month of a patient's health activity, with a freeze date of 6 weeks after the activity. This will mean the coding will be relatively stable and few changes will be made after 2 months of patients' activity/discharge.

6.3 Survey/questionnaire data from CYPHP Health Check

Patient/parent-reported measures are collected when parents complete a health check for their child. These are listed below and described in section **Error! Reference source not found.**

- Mental health and wellbeing using the Strengths and Difficulties Questionnaire (SDQ) (all patients)
- Asthma severity using the Asthma Control test (ACT) (Asthma patients)
- Constipation severity as measured by CYPHP Constipation Score (Constipation patients)
- Eczema severity using the Patient Oriented Eczema Measure (Eczema patients)
- Demographics
    - Language most commonly spoken at home
    - CYP Age
    - CYP Gender
    - CYP Ethnicity (categories in Appendix)
    - Carer Ethnicity (categories in Appendix)
- Social Questions
    - Do you have concerns about your housing situation?
    - Do you always have enough food for your family?
    - Do you ever struggle to pay your household bills?
    - Do you have any concerns about your mental wellbeing?
    - Do you or anyone else in the household smoke?
    - What is your employment status?

6.4 Survey/questionnaire data from study database

Once the patient has consented to the study the participants will be asked to complete further questionnaires (listed below). These are described in section **Error! Reference source not found.**

- PedsQL
- CHU9D
- WEMWBS
- School & Work Absence Questions
    - How many days of school has your child missed due to ill health or attending health-related appointments in the past three months?
    - How many days of work have you missed in the past three months due to your child's illness or healthcare appointments?

Follow-up data is collected at 6 and 12 months (+ up to 4 months) following baseline data collection. At the follow-up time points the Health Check questionnaires are also repeated.

The schedule of events for the tracer condition analysis of CYPHP is displayed in Table 1**.**

Table 1: Schedule of data collection for CYPHP Tracer Condition Questionnaires

	Procedures	**CYPHP Health Check**	**Baseline Study Questionnaires**	**CYPHP Service entry**	**6-month Follow-up Study Questionnaires**	**12-month Follow-up Study Questionnaires**
Health Checks	ACT	C			C	C
	POEM	C			C	C
	Constipation questionnaire	C			C	C
	SDQ	X			X	X
	Social Questions	X			X	X
	Health Check Demographics	X				
Evaluation Questionnaires	Eligibility assessment		X			
	Informed consent		X			
	PedsQL		X (1° child outcome)		X (1° child outcome)	X (1° child outcome)
	CHU9D		X		X	X
	WEMWBS		X (1° parent outcome)		X (1° parent outcome)	X (1° parent outcome)
	School & Work Absence Questions		X		X	X
CYPHP Services	Offer of CYPHP Services			Requires registration with GP in intervention arm and clinical need identified at Health Check triage		
	Receipt of CYPHP Services			Receive service if: Parent/carer/CYP agrees and takes up service		

X: collected on all participants

C: collected on participants with the relevant condition

6.5 Data linkage

Pseudonymised patient identifier

Each patient identified will be assigned a pseudonymised ID based on their NHS number. The pseudonymised ID will allow linkage of CYP's health records across data sets (primary and secondary care) and longitudinally over time.

Information on the pseudonymisation process can be found in the CYPHP Data Management Plan.

7. STUDY TIME PERIODS

7.1 Study timeline and trial periods

CYPHP Funded: October 2016
Staff Recruitment: 1 October 2016 – 31 March 2017
Trial and Service Set up, intervention embedding: 1 April 2017 – 31 March 2018
Trial start: 1 April 2018
Trial period ends: 30 June 2021

See diagram in Appendix.

Baseline health service use data: Use annual rate(s) for financial year(s) (April-March) for 2014/15, 2015/16, 2016/17 (omitting 2017/18 as during set-up period service implementation began in some areas). Using annual rates avoids issues of seasonality. Where only one year of baseline data is needed, use 1 Apr 2016-31 Mar 2017.

Secondary analysis: Using the trial time period 1 July 2020 - 30 June 2021 (the period with most complete embedding of services).

7.2 Before/After Analyses and Interrupted Time Series

Before/After analyses

- In the control (EUC) arm, we will compare outcomes during the trial period with outcomes prior to the trial.
- In the intervention arm, we will compare outcomes with those observed prior to CYPHP.
    - A) Randomised intervention clusters only
    - B) Pilot and intervention clusters (i.e. quasi-experimental population)

Interrupted Time Series

- Interrupted Time Series analyses will be conducted using the time periods described above.

8. STUDY POPULATIONS

8.1 Health Service Use Population level populations

Inclusion criteria:

- Aged 0-15 (<16) years
    - Within the study period (April 2018 to June 2020)
- Registered with a randomised Southwark or Lambeth GP practice
    - Within the study period (April 2018 to June 2020)

This will be an open cohort, including children who register with a GP practice during the course of the trial. Trial arm assignment is described in section 18.

Exclusion criteria:
We excluded children who had <30 days observation time. Reasons for short observation time include

- Children turning 16 years shortly after the start of the trial period,
- Children registering with a GP practice shortly before the end of the trial period.

➢ Randomised population

Intervention and control only, *excluding* pilot clusters or practices where the randomisation allocation could not be determined.

➢ Quasi-experimental population

Intervention, control *and* pilot clusters

8.2 Health Service Use Tracer condition populations

Subset of populations in section 8.1, excluding those without a tracer condition (asthma, constipation, or eczema).
Definition of tracer condition: Uses the same methodology applied by the CYPHP call/recall system, i.e. diagnosis, disease management, or therapy codes in the primary care record, and age restrictions. The clinical (Read/SNOMED) codes and therapies are listed in Appendix. For all conditions, an individual's complete records are interrogated.
If a subject meets the call/recall criteria for a tracer condition, they are defined as having a tracer condition from the first recorded event used in the definition (e.g. if they are defined as having asthma due to having an asthma diagnosis or three prescriptions of asthma medication in one year, we define their asthma 'start date' as the date of the first of those prescriptions or diagnosis).
We treat all conditions as ongoing, i.e. the observation period is continuous from the 'start date' of their condition (described above) until their observation 'end date' which occurs when they leave a GP practice, turn 16 years of age, or reach the end of the study period.

➢ Randomised HSU Tracer condition population

Intervention and control only, *excluding* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

➢ Quasi-experimental HSU Tracer condition population

Intervention, control *and* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

8.3 HSU Tracer condition population where Health Check shows clinical need

Purpose: Study impact of intervention on health service use of CYP meeting criteria for CYPHP clinical service

Inclusion criteria:

- Completed a Health Check, and Health Check results meet or exceed threshold for clinical need (see Appendix for thresholds).
- Aged 0-15 (<16) years
  - At time of completing a health check
- Registered with a randomised Southwark or Lambeth GP practice
  - At time of completing a health check

For health service use events, include only those which occur within 12 months after Health Check completion.

➢ Randomised HSU Tracer condition in clinical need population

Intervention and control only, *excluding* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

➢ Quasi-experimental HSU Tracer condition in clinical need population

Intervention, control *and* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

8.4 Consented tracer condition population

Inclusion criteria:

- Aged 0-15 (<16) years
  - Age at date of consent
- Registered with a Southwark or Lambeth GP practice included in the trial.
  - Registration at time of consent
- Parental informed consent confirmed

➢ Randomised consented population

Intervention and control only, *excluding* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

➢ Quasi-experimental consented population

Intervention, control *and* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

Note: Self-report of tracer condition by parent/carer/CYP is acceptable. We will not confirm these against primary care data.

8.5 Consented tracer condition population where Health Check shows clinical need

Purpose: Study impact of intervention on those meeting criteria for CYPHP clinical service

Inclusion criteria:

- Aged 0-15 (<16) years
  - Age at date of consent
- Registered with a Southwark or Lambeth GP practice included in the trial.
  - Registration at time of consent
- Parental informed consent confirmed
- Completed a Health Check, and Health Check results meet or exceed threshold for clinical need. See Appendix.

➢ Randomised consented in clinical need population

Intervention and control only, *excluding* pilot clusters

Subpopulations:

- Asthma
- Eczema
- Constipation

➢ Quasi-experimental consented in clinical need population

Intervention, control *and* pilot clusters

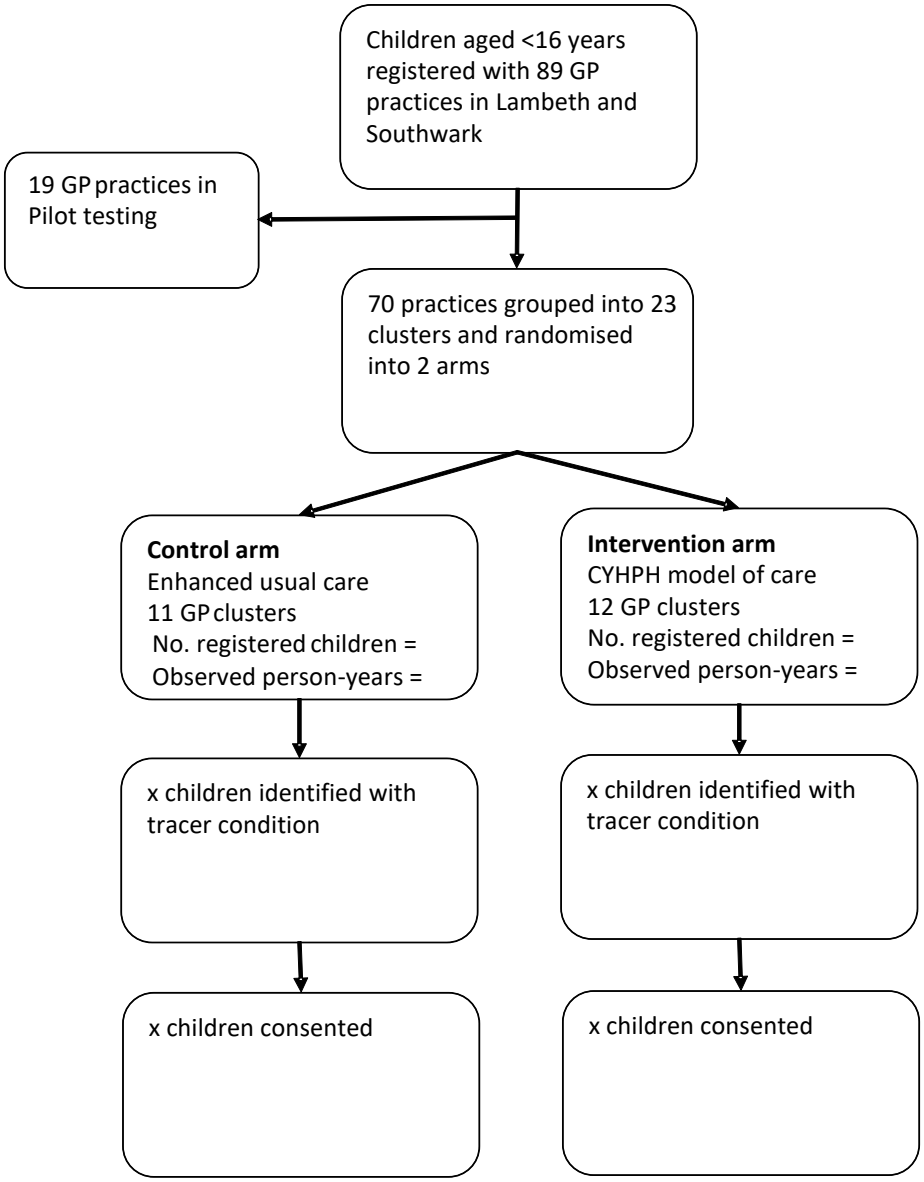
Subpopulations:

- Asthma
- Eczema
- Constipation

Note (as above): Self-report of tracer condition by parent/carer/CYP is acceptable. We will not confirm these against primary care data.

8.6 Flow diagram and summary of reasons for leaving the cohort

Figure 1: Example flow diagram of patients included in the analysis



Summary of reasons for leaving the cohort for Health Service Use Populations

Separately from the diagram above, we may report numbers of children exiting the trial population before the end of the trial period, by arm, and the reason (e.g. 16th birthday, no longer registered with a participating GP practice).

9. LISTING OF OUTCOME MEASURES

This section lists outcome measures. They are defined in detail in subsequent sections.

9.1 Primary and secondary health service use

Activity data collected on all CYP's contacts with the health care system

1. **Non-elective admission rates (Primary outcome)**
2. Primary care consultation rates
3. Primary care outpatient appointment referrals
    a. All
    b. Referrals relating to tracer conditions
4. Emergency department attendance
5. Outpatient appointment attendances
    a. All
    b. Appointments relating to tracer conditions
6. Ambulatory care sensitive admissions
7. Proportion of non-elective admissions that are ambulatory care sensitive
8. Rate (sum per patient-year) of non-elective admissions and outpatient appointment attendances, combined

9.2 CYP physical and mental health outcomes (Consenting patients)

These will be measured as part of the CYPHP clinical service at baseline, and asked independently to the clinical service at follow-up.

9. Mental health and wellbeing using the Strengths and Difficulties Questionnaire (SDQ) (all patients)
10. Asthma severity using the Asthma Control test (Asthma patients)
11. Constipation severity as measured by CYPHP Constipation Score (Constipation patients)
12. Eczema severity using the Patient Oriented Eczema Measure (Eczema patients)

9.3 CYP health-related quality of life and parental well-being outcomes (Consenting patients)

Quality of life and well-being will be derived from parent responses to the following questionnaires (measured via patient portal after informed consent).

13. **PedsQL (Primary Child Outcome)**
14. CHU-9D – Estimates of quality adjusted life years (QALYs) the Child Health Utility

Parental mental wellbeing measures will be derived from parent responses to the following questionnaires (measured via patient portal after informed consent*)*

15. **Warwick Edinburgh Mental Wellbeing scale (main carer) (Primary Parent Outcome)**
16. A School & Work Absence questionnaire

9.4 Primary care quality measures

Asthma

1. Proportion of CYP aged 5 years and over with asthma have a recorded personalised action plan.
2. Proportion of CYP aged 5 years and over with asthma have asthma review over a 12-month period.

3. Proportion of CYP aged 5 years and over with asthma have asthma control monitored at their asthma review.
4. Proportion of CYP aged 5 years and over with asthma have documented height at their asthma review.
5. Proportion of CYP who receive treatment in an emergency care setting for an asthma attack are followed up by their GP within 30 working days of discharge.
6. Proportion of CYP with asthma prescribed a spacer
7. Proportion of CYP with asthma have psychosocial assessment in addition to physical severity

Constipation

1. Proportion of CYP with diagnosed constipation receive oral macrogols as first-line treatment.
2. Proportion of CYP starting maintenance therapy have their first treatment review by a healthcare professional within 6 weeks.
3. Proportion of CYP with asthma have psychosocial assessment in addition to physical severity

Eczema

1. Proportion of CYP with atopic eczema are offered treatment based on recorded eczema severity.
2. Proportion of CYP with atopic eczema are prescribed sufficient quantities (250–500 g weekly) from a choice of unperfumed emollients for daily use.
3. Proportion of CYP of children with atopic eczema who have a repeat prescription of moderate/very potent topical steroids
4. Proportion of CYP with atopic eczema have psychosocial assessment at every eczema consultation.

10. HEALTH SERVICE USE OUTCOME DEFINITIONS AND ANALYSIS METHODS

10.1 Non-elective hospital admission (NEA) rates (Primary population outcome)

We will determine non-elective admissions from admitted care data, of CYP aged <16 years, registered with Lambeth and Southwark GP practices, admitted to St Thomas's, Guy's or King's College Hospitals. Admitted patient care is recorded in episodes. An episode is a record of an individual patient's care with a single consultant, within a hospital provider, and forms all or part of an overall hospital spell (an admission). Each episode contains data on the patient (age, area of residence and registered GP practice code); on the episode of care (the date of admission and method of admission - whether the admission was elective or non-elective); and clinical information. Diagnoses for each patient are recorded using the International Classification of Diseases, 10th edition (ICD-10) and the information is divided into the primary diagnosis (main problem treated) and various secondary diagnoses (including comorbidities and complications). Procedures performed during an episode are coded using the Office of Population, Censuses and Surveys Classification of Surgical Operations and Procedures, 4th revision (OPCS4).

We will select the dominant episode record for each admission and check for duplicate data using a combination of patient ID (pseudonymised) and admission date. We will calculate length of stay (days) as the date of discharge–date of admission.

A non-elective admission is an unplanned event and occurs when a consulting clinician determines a child's presenting condition is serious and requires immediate hospital care. Children who have well managed health conditions are less likely to experience a non-elective admission.

A non-elective admission is determined in Admission Method field as codes 21-25, 2A, 2B, 2D, 28. (See table in Appendix.)

NEA rates

Non-elective hospital admission (NEA) rate will be measured as number of events per patient-year in each GP practice.

The numerator is the number of NEA per GP practice and denominator is person-years of GP registered population under age 16. The numerator will be taken from GSTT and KCH data.

The denominator will be calculated from the Primary Care data extracts of individual level data, as these allow us to determine the 'time at risk' (i.e. time under observation per participant). Using these data, we can also access individual patient-level covariates (i.e. we can adjust for age, sex, IMD and IDACI score per patient, as described in section 15). This approach will be used for all rate-based outcomes.

Alternatively, the denominator could come from NHS Digital "Patients Registered at a GP Practice" but these data do not include patient-level covariates. Therefore we have decided to use the Primary Care data to estimate the observed number of patient-years.

10.2 Primary care (GP and nurse consultations)

A primary care consultation is a health contact between a primary care clinician and a child/young person.

Data

The primary care consultations will be extracted from Lambeth and Southwark primary care administrative systems (EMIS). Extractions will take place every quarter (3 months). See Data and reporting guidelines document for more details.

Consultation type

A contact can be face-to-face or via telephone, text or video. A contact can be in the practice surgery, out of hours or in another location such as the child's home. Consultation types that will be included in our count of consultations are listed in Appendix. Note that the listing of consultation types may not be exhaustive. If additional types are identified in the data set, a decision will need to be made on inclusion/exclusion prior to unblinding.

Staff roles

A consultation with a primary care clinician can be with a GP, nurse or other health care provider. Staff roles that will be included are listed in Appendix.

Primary care consultation definition and rates

Only consultations that meet both criteria will be included in our definition of a primary care consultation: a) the consultation type is for a consultation between a CYP and a clinician (see Appendix), and b) the staff role is meets our definition (see Appendix) for a primary care clinician.

The rate of primary care consultation rates will be measured as count per patient-year. Numerator (count) and denominators (population) will change depending on the evaluation analysis.

10.3 Outpatient appointment referrals from primary care

An outpatient appointment referral occurs when a primary care clinician decides a child needs specialist care. These referrals are recorded in EMIS as Read/SNOMED codes.

Outpatient appointment referral rates

The rate of Outpatient appointment referral rates will be measured as count per patient-year.

10.3.1 Referral to General Paediatrics

These are defined using the terms in Appendix. This outcome will be used for the "Health Service Use Population-level population" (as defined in section 8.1).

10.3.2 Referral to General Paediatrics and Tertiary services related to the tracer conditions

Rationale: If CYPHP is improving health, or through offering early intervention for asthma/eczema/constipation, we hypothesize there will be fewer tertiary service referrals for these conditions, as well as fewer referrals to general paediatrics. Referrals related to the tracer conditions are defined in Appendix. This outcome will include the referrals to General Paediatrics (defined in 10.3.1), and in the terms relevant to tracer conditions, listed in Appendix. This outcome will be used for "Health Service Use Population-level population" (as defined in section 8.1).

10.3.3 Referral to tertiary services related to the tracer conditions

These referrals are defined in Appendix. These will be reported as separate outcomes for each tracer condition, using the relevant subpopulation for that tracer condition.

10.3.4 All Outpatient Referrals

We will also analyse an outcome including all outpatient referrals, to account for possible increase in referrals due to the detection of unmet need.

10.4 Emergency department (ED) attendance

An ED attendance is a child's health contact at the emergency departments at St Thomas's, Guy's or Kings College Hospitals.

Include:

- Self-referral when the parent or carer feels the child's condition is serious enough to warrant emergency care
- GP referred
- Attendance at Guy's Hospital Urgent Care Centre (Department type 3)
- Attendance at St Thomas's (ED Department type 1 (a consultant-led 24-hour service))
- Attendance at KCH

Exclude:

- Planned attendances, attendance category = 2 (Unplanned Follow-up Emergency Care Attendance for the same or a related clinical condition and within 7 days of the First Emergency Care Attendance at the same Emergency Care Department), Follow-up Accident and Emergency attendance – planned

ED attendance rates

The rate of ED rates will be measured as count per patient-year.

10.5 Outpatient appointment attendances

The rate of Outpatient appointment attendances will be measured as count per patient-year.

We will consider two sets of outpatient attendances:

10.5.1 Attendance of General Paediatrics Outpatient appointment

These are defined using the terms in Appendix. This outcome will be used for the "Health Service Use Population-level population" (as defined in section 8.1).

10.5.2 Attendance of General Paediatrics Outpatient and Tertiary services related to the tracer conditions

Rationale: If CYPHP is improving health, or through offering early intervention for asthma/eczema/constipation, we hypothesize there will be fewer general paediatrics and tertiary service referrals for these conditions. These attendances are defined in Appendix. This outcome will be used for "Health Service Use Population-level population" (as defined in section 8.1).

10.5.3 Attendance of tertiary services related to the tracer conditions

These attendances are defined in Appendix. These will be reported as separate outcomes for each tracer condition, using the relevant subpopulation for that tracer condition.

10.5.4 All Outpatient Attendances

We will also analyse an outcome including all outpatient attendances, to account for possible unintended consequences of intervention.

10.6 Ambulatory care sensitive admissions

Ambulatory care sensitive (ACS) conditions are conditions where effective primary care and case management can help prevent the need for hospital admission.

10.6.1 Standard definition of ACS admissions

ACS chronic conditions, in CYP, are asthma, diabetes and epilepsy. ACS infectious illnesses are vaccine-preventable conditions, gastroenteritis, lower and upper respiratory tract infection, and urinary tract infection in all children (Cecil 2018, AHRQ, NHS Digital). These admissions will be extracted using ICD-10 codes listed in Appendix, recorded in the primary diagnosis of patient records.

10.6.2 ACS admissions definition including eczema

Due to the clinical emphasis of CYPHP on eczema (along with asthma and constipation), we plan an additional analysis which includes eczema in the list of ACS conditions defined above.

10.7 Proportion of non-elective admissions that are ambulatory care sensitive

Use definition above to define ACS admissions.

10.8 Summary of non-elective secondary care use

All non-elective secondary care health service use:

- Non-elective admissions
- Outpatient appointment attendances

Summarised as

- Rate: Number of activities per patient-year

- Cost of activities, based on a unit cost per activity type – cost as proxy for impact on system and family

10.9 Health Service Use Analysis Methods

The population analyses will assess the effects of the CYPHP model on health service use for CYP with any (or no) health condition.

Main analysis: cRCT Intervention vs. control analysis

- Populations: See section 8
- Time period: See section 7
- Comparator: Study arm (Intervention vs Control)
- Endpoints: Rates of health service use (listed and defined in sections 9-10)
- Summary statistics: estimate of intervention effect, estimates of covariate coefficients, 95% confidence intervals, p-values

  Formal analysis: Multi-level Poisson regression model
- Individual level covariates: age, sex, IMD 2015, IDACI 2015, Borough
- Cluster level covariates: IMD 2015, IDACI 2015, baseline rate of health service use endpoint, number of CYP under 16 per cluster, Rate of paediatric OP referrals 2015-16, Borough
- Data structure:
  Individual data:
  Pt Identifier, Cluster, Study arm (Intervention/Control), Number of HSU events during observation period, Observation time (days), Rate of HSU events during trial, Age at baseline, Sex, IMD 2015, IDACI 2015, Borough of GP registration, Number of HSU events during baseline period, Length of baseline period (days), Baseline rate of HSU events
  Cluster data:
  IMD 2015, IDACI 2015, baseline rate of health service use endpoint, number of CYP under 16 per cluster, Rate of paediatric OP referrals 2015-16, Borough

11. PARTICIPANT-REPORTED OUTCOME DEFINITIONS AND ANALYSIS METHODS

11.1 Tracer condition analysis – Primary child outcome – PedsQL

The Pediatric Quality of Life Inventory (PedsQL) is a brief measure of health-related quality of life in children and young people. This will be completed at baseline and each follow up. In all instances, the outcome for analysis will be parent-reported and child-related. However, where appropriate, child-reported outcomes will also be collected and reported.

Age versions: 0-12 months, 13-24 months, 2-4 years, 5-7 years, 8-12 years, 13-18 years

For 0-12 months and 13-24 months:
Subscales: Physical Functioning, Physical Symptoms, Emotional Functioning, Social Functioning, Cognitive Functioning

Summary scores: Physical health summary score (mean of physical functioning and physical symptoms), Psychosocial Health (mean of emotional, social, and cognitive scales), Total Score (mean of all scales)

For age 2+:
Subscales: Physical functioning, Emotional functioning, Social functioning, School functioning

Summary scores: Physical health summary score, Psychosocial Health (mean of emotional, social, and school scales), Total Score (mean of all scales)

Mismatch of questionnaire version and participant age: Treat as missing any questionnaires for ages 8+ completed by children age 0-4 at baseline.

Total score: Sum of items divided by the number of items answered for all scales.

- Items: There are 21-45 items in the PedsQL, depending on age of CYP; each item assigned value of 0, 25, 50, 75, 100.
- Missing data: use the mean value for items within the subscale. If more than 50% missing in a subscale, exclude the participant's data.

To combine data across ages:

- Check distribution of scores; transform if needed.
- Convert scores to z-scores (number of SDs above/below the trial mean).
- Analyse follow-up z-score, adjusted for baseline z-score for individuals.

Primary Outcome: Total Score at 6-month follow-up

Secondary outcomes from PedsQL: Physical Health score, Psychosocial Health score, same analysis method.

11.2 CHU-9D

Completed by: parent/carer of CYP with constipation

Ages: Designed for ages 7+ but used for all participants.

Versions: Proxy version

Scoring criteria: 9 questions with different weights; no missing data allowed.

11.3 Tracer condition analysis – Primary parental outcome – WEMWBS

Warwick Edinburgh Mental Wellbeing Scale

Version: 14-item scale (long version)
Scoring: 14 items, scored 1 to 5 on likert scale, for total score range 14-70.

Missing data: Mean of completed items used as the value for the missing responses, for maximum of 3 missing items.

11.4 Mental health and wellbeing - Strengths and Difficulties Questionnaire (SDQ)

Completed by: all

Versions: Ages 2-4 (MedSciNet study database), 4-17 (Health Check Portal & MedSciNet study database); At baseline everyone does the age 4-17 version in the Health Check/Portal (which is

only slightly different than the age 2-4 version). Questionnaire differences (Age 2-4 vs Age 4-17):

1. Often argumentative with adults → Often lies or cheats
2. Can stop and think things out before acting → Thinks things out before acting
3. Can be spiteful to others → Steals from home, school, or elsewhere

3-part likert scale, 25 items (5 items in each of 5 subscales), each item scored 0-2

Outcomes:

- Total difficulties score (20 items; excludes prosocial subscale)
- 5 subscale scores: Emotional, conduct, hyperactivity, peer, prosocial
- Externalizing score (conduct and hyperactivity) and Internalizing score (emotional and peer)

Missing items – For any of the 5 sub-scales, if at least 3 of 5 items are completed then the scores can be scaled up pro rata. If any of the sub-scales is missing 3 or more items, the Total Difficulties score will not be calculated.

SDQ impact
4-part likert scale, 5 items, scores 0-10
2 age versions – 4-17 on portal (baselines), 2-4 and 4-17 on MedSciNet (follow-up); one minor difference: classroom learning → learning.

11.5 Asthma severity - Asthma Control test

Completed by: parent/carer of CYP with asthma
Version: Adult 12-60+

Scoring criteria: 5 items on 5 part likert scale, each scored 1-5, for a total score 5-25. No missing data allowed.

11.6 Eczema severity - Patient Oriented Eczema Measure

Completed by: parent/carer of CYP with eczema

Version: Children (proxy completion version)

7 items on 5-part likert scale, score 0-28. Maximum of one item missing, and assigned score 0.

11.7 Constipation severity - Bespoke CYPHP Constipation Score

Completed by: parent/carer of CYP with constipation

Participants are split into 2 groups:

- Toilet trained (TT) children - 7 questions.
- Non-TT children – omit final 2 questions; 5 questions posed.

Scoring is the same, regardless of group:

Q1: How often does your child open their bowels?

- 0 points if answer 3+ times/week
- 2 points if answer Twice or less

Q2-Q7, answers and points ():

- Never (0)
- Occasionally (1)
- At least once (2)

Scoring criteria for Health Check Triage: Points are summed from all completed questions.

The Bristol Stool chart is also displayed and participants are asked to identify their child's usual stool type (from 1 to 7). This is not used for scoring the questionnaire but will be summarised as a separate outcome measure.

11.8 A School & Work Absence questionnaire

- How many days of school has your child missed due to ill health or attending health-related appointments in the past three months?
    - Number of days
    - Other responses
        - My child is too young to attend school
        - My child is school age but does not attend school for health reasons
        - My child is school age but does not attend school for other reasons
        - I can't answer this question
- How many days of work have you missed in the past three months due to your child's illness or healthcare appointments?
    - Number of days
    - Other responses
        - I am not working because of my child's health needs
        - I am not working for other reasons
        - I can't answer this question

We will report the number of missing days, and also treat the outcome as binary (any absence or no absence). The binary outcomes will be analysed using logistic regression and with chi-squared tests.

11.9 Analysis Methods

Analysis (for 6-month and 12-month follow-up): Random-effects regression models. Covariates at individual level: participant age group, sex, IMD 2015 quintile, IDACI 2015 quintile, Borough, and the baseline questionnaire outcome score. Covariates at cluster level: mean IMD 2015, mean IDACI 2015, number of children under 16 years, rate of paediatric OP referrals 2015-16, and the mean baseline questionnaire outcome score.

11.10 Intracluster correlation and regression models

Above we have described planned random-effects regression models, to account for clustering by randomised GP cluster. However, when we observe minimal correlation within clusters, these models are not appropriate, and we will report results from standard regression models, controlling for both the individual-level and cluster-level covariates described above.

12. PRIMARY CARE QUALITY INDICATOR OUTCOME DEFINITIONS AND ANALYSES

Objective

Trial objective: To compare health care quality provided to children with asthma by CYPHP intervention practices compared with EUC practices.

Primary care quality indicators for asthma, eczema and constipation were taken from national guidelines[3-5] and published literature,[6] and were selected by clinician consensus on relevance to CYP and whether the indicator was measurable using coded primary care data and/or audit of primary care data, including notes.

12.1 Asthma Quality Indicator Definitions

For determining annual action plan creation or amendment, annual asthma review, asthma control test and documented height, each child will be observed for 450 days from the later date of 1) when asthma was first identified or 2) the start of the study (April 2018). The follow-up time was extended to more than 12 months, to allow for any disruption that may occur during COVID lockdown.
Prescribing a spacer is not an annual event and we will investigate spacer prescribing any time after the asthma was first identified.

12.2 Asthma Quality Indicator Statistical Analysis

We will use multi-level (random effects) logistic regression (at an individual child level), clustering by GP hub (cluster).

13. PARTICIPANT AND CLUSTER CHARACTERISITIC VARIABLE DEFINITIONS

13.1 Observed, Measured, or Reported Variables – Participant level

- Gender (all populations)
- Age (all populations)
- Ethnicity (all populations)
  Ethnicity codes were categorised in 5 ethnic groups.
  Read code match table was developed from published code lists.[7]
- Health Check Social Question responses (tracer condition populations only)

13.2 Deprivation measures – Participant level

- Deprivation variables (all populations)

- IDACI 2015 national decile
- IDACI 2019 national decile
- IMD 2015 national decile
- IMD 2019 national decile

Derived using Lower super output area (LSOA)
Output areas (OA) are geographic areas created for Census data. There are, on average, around 1500 people living within each LSOA. Within our data a participant's LSOA will be determined by their postcode. The patient's LSOA will be used to determine a participant's level of deprivation (IMD & IDACI).

13.3 Derived Variables – Cluster level

- CYP population age <16 per GP cluster (routinely collected data)
- Paediatric OP referrals 2015-2016 per GP cluster (routinely collected data)

14. PARTICIPANT AND CLUSTER CHARACTERISITIC REPORTING

14.1 Baseline characteristics and balance between trial arms

The following restriction and stratification factors were used in the randomisation: IMD, IDACI, CYP population, OP referrals at baseline, Borough.

Demographic and clinical baseline characteristics and trial randomisation restriction and stratification factors at randomisation or recruitment will be summarised descriptively. We will report the number and percentage in each group for all categorical variables (**gender, age group, ethnicity, Health Check social questions, IMD decile, IDACI decile, Borough of GP registration**) and mean, SD, median, IQR, and range for all continuous variables (**age, CYP population <16 per GP cluster, Paediatric OP referrals 2015-2016 per cluster**). No significance testing will be carried out due to the randomised nature of the study.

15. EQUITY OF OUTCOMES ANALYSES

Some interventions, although they are beneficial overall, can widen inequality gaps. CYPHP aims to reduce inequality gaps.

Objective: To examine the impact of the CYPHP model of care on gradients (or variation) in health service use, physical and mental health, condition symptoms, health-related quality of life, parental well-being, and school/work absence.

To determine the impact of CYPHP on inequality gaps, we will examine differential intervention (moderator) effects, by adding an interaction term between between measures of social disadvantage (listed below) and the study arm (intervention/control) variable, to the models estimating the impact of CYPHP on the study outcomes (listed below).

Measures of social disadvantage:

- IMD quintile (treated as ordered categorical variable)
- IDACI quintile (treated as ordered categorical variable)
- Ethnicity (Categories: White, Black, Asian, Mixed, Other)
- Health Check questionnaire responses regarding:
  - Housing concerns
  - Enough food for family

- Struggle to pay bills
- Parental mental health concerns

Outcomes: Health service use rates, PedsQL, CHU9D, ACT, POEM, Constipation, WEMWBS, SDQ, school/work absence

These will be explored with separate models, each model including one measure of disadvantage, as we expect these measures of disadvantage to be highly correlated. However, for ethnicity and parental mental health concerns, we plan to also adjust for socioeconomic status, to assess if there is an additional effect of these factors beyond their correlation with socioeconomic status, using IMD, IDACI, and/or a Health Check measure.

16. PROCESS EVALUATION ANALYSES

A process evaluation is being conducted in parallel, to understand the implementation of CYPHP and variation across the study, e.g. across GP practices. We intend to repeat analyses to take into account the results of the process evaluation, e.g. analysing the variation in impact of CYPHP, on the outcomes presented here, across practices with different levels of engagement/implementation.

17. TRIAL ARM ASSIGNMENT

We will analyse the data on an intention-to -treat principle, in our primary analysis. Therefore, for data collected from individual consenting participants, these will be analysed according to the cluster the participants were originally assigned to at the date of consent, regardless of whether they have moved practices (including to a practice assigned to another cluster) or their assigned practice has merged with a practice assigned to another cluster.
For health service use outcomes, the assignment will be based on the GP practice, which may change through the study period.
In addition, we intend to conduct secondary per-protocol analyses. Per-protocol analyses will be carried out to examine the impact of the intervention taking into account engagement with the respective clinical services of the EUC and universal services, and services specific to patients with tracer conditions.

18. PROTOCOL DEVIATIONS

18.1 Protocol changes related to COVID-19 Pandemic

Due to the COVID-19 pandemic, there was a trial pause, 12MAR2020 – 04JUL2020. Any individual consented data collection that occurred during the pause was repeated after the pause. Also, for participants enrolled in the study before the pause, the time points for follow-up data collection after the pause were delayed by the length of this pause, to ensure all study participants had the opportunity to be exposed to the intervention (or control) for the relevant time periods (6 months and 12 months) before follow-up data collection. Data collected during the pause may be used for secondary analyses. See appendix for diagram.

18.2 Other Protocol Deviations

Deviations to the CYPHP evaluation's approved protocol will be listed in the study report.

19. STATISTICAL SOFTWARE

Statistical analysis will be carried out by the trial statistician(s)/programmer(s), primarily using R code.

20. TIMING AND REPORTING OF INTERIM AND FINAL ANALYSES

Population Analysis

- Reporting Q4 2021

Tracer Condition Analysis (Consented group)

- Baseline data collection
    - recruitment completes Dec 2020
    - data collection completes Dec-Mar 2021
    - report Q2 2021
- Final analysis 1 (6 month follow-up)
    - data collection completes Jun 2021-Sept 2021
    - report Q4 2021
- Final analysis 2 (12 month follow-up)
    - data collection completes Dec 2021-Mar 2022
    - report Q2 2022

21. DATA QUALITY AND MISSING DATA

Data cleaning methods will be described in the Data Management Plan.

Consenting participants completing the trial:
We will report the number of participants providing data at the 6 month and 12 month follow-up time points:

x out of N (y%) continued participating in the trial up to z-month follow up,

where N is the number consented.
The numbers withdrawing and lost to follow-up will also be reported.

Questionnaire data completeness:
Data completeness in terms of return rate will be summarised, by frequency and proportion of forms returned (observed) out of those expected.

We will assess all questionnaires to look for missing items. Data completeness will be assessed and summarised with completion rates for baseline demographics and each questionnaire at both time points reported. This will help to identify any potential bias in the completion of follow-up data.

We may also present this split by cluster and other stratification factors if missing data is excessive (>20%).

Missing data assumptions:
1. Initially all analyses will be performed on complete cases, under the assumption of missing completely at random.

2. Where data is >5% missing, multiple imputation may be conducted, and would be the preferred method for treating missing data. This assumes data is missing at random (weaker assumption than missing completely at random).

22. REFERENCES

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23. APPENDICES

23.1 Table of Outcomes and Populations

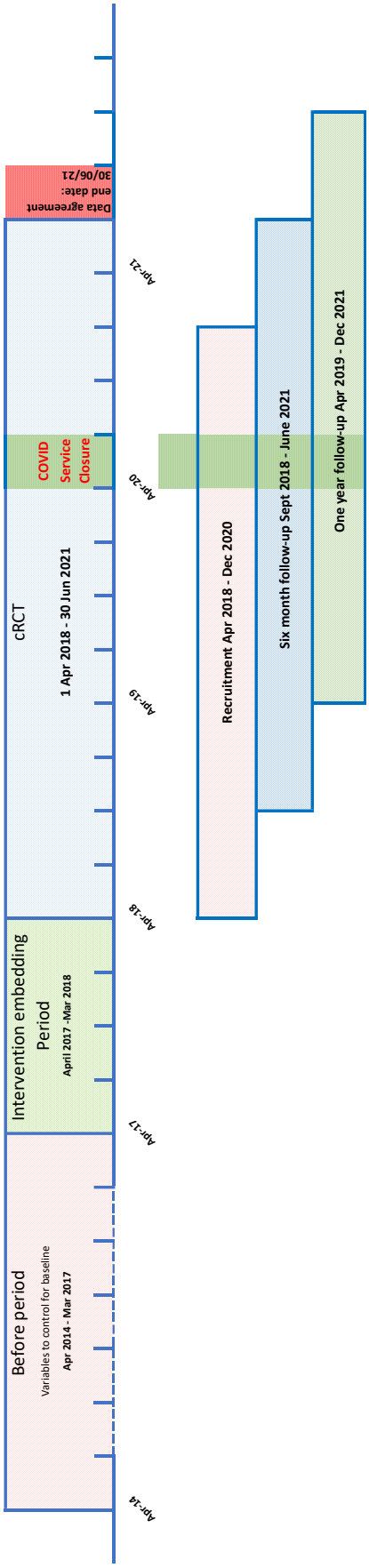
See excel file.

23.2 Ethnicity categories in CYPHP Health Check

A – White – British
B – White – Irish
C – White – Any other White background
D – Mixed – White and Black Caribbean
E – Mixed – White and Black African
F – Mixed – White and Asian
G – Mixed – Any other mixed background
H – Asian or Asian British – Indian
J – Asian or Asian British – Pakistani
K – Asian or Asian British – Bangladeshi
L – Asian or Asian British – Any other Asian background
M – Black or Black British – Caribbean
N – Black or Black British – African
P – Black or Black British – Any other Black background
R – Other Ethnic Groups – Chinese
S – Other Ethnic Groups – Any other ethnic group
Z – Prefer not to say

These are also recorded with evaluation questionnaires at follow-up.

23.3 Study Time Periods diagram



23.4 Tracer Condition Population definitions

See Excel file.

23.5 Health Check Triage Thresholds

Participants with scores in the following ranges meet the symptom threshold to be offered CYPHP services (per the CYPHP Clinical Services Triage Document – August 2020 v 2.0):

- ACT 19 or below
- Constipation symptoms checklist score 3 or more
- POEM score 8 or more

23.6 Admission Method codes relating to non-elective admissions

Admission Method codes relating to non-elective admissions

Code	Description
21	Accident and emergency or dental casualty department of the Health Care Provider
22	General Practitioner: after a request for immediate admission has been made direct to a Hospital Provider, i.e. not through a Bed bureau, by a General Practitioner: or deputy
23	Bed bureau
24	Consultant Clinic, of this or another Health Care Provider
25	Admission via Mental Health Crisis Resolution Team (available from 2013/14)
2A	Accident and Emergency Department of another provider where the patient had not been admitted (available from 2013/14)
2B	Transfer of an admitted patient from another Hospital Provider in an emergency (available from 2013/14)
2D	Other emergency admission (available from 2013/14)
28	Other means, examples are: - Admitted from the Accident and Emergency Department of another provider where they had not been admitted - Transfer of an admitted patient from another Hospital Provider in an emergency - Baby born at home as intended

23.7 Primary Care consultations Inclusion/Exclusion Criteria

See excel file.

23.8 Primary Care Staff roles Inclusion/Exclusion Criteria

See excel file (same file as above).

23.9 Outpatient referrals from Primary Care

See excel files (2).

23.10 Outpatient attendances

See excel file.

23.11 Ambulatory care sensitive admission ICD-10 codes

Description	**ICD-10 codes**
Chronic conditions	
Asthma	J45, J46
Diabetes	E10-E14
Epilepsy	G40, G41
Acute infections	
Lower respiratory tract infections	J10.0, J11.0, J11.1, J12-J16, J18.0, J18.1, J18.9, J21
Upper respiratory tract infections	H66, H67, J02, J03, J04.0, J06, J31.2
Dehydration and gastroenteritis	E86, K52.2, K52.8, K52.9, A02.0, A04, A07.2, A08.0, A08.1, A08.3, A08.4, A08.5, A09
Urinary tract infections	N10-N12, N13.6, N15.9, N30.0, N30.8, N30.9, N39.0
Other	
Vaccine-preventable diseases	A35-A37, A80, B05, B06, B16.1, B16.9, B18.0, B18.1, B26, G00.0, M01.4

23.12 COVID Service/Trial Pause diagram

See excel file.