A mixed methods rapid evaluation investigating the use of pulse oximetry in care homes across England to manage residents with COVID-19 and long-term health conditions: Study protocol

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Summary

Background and rationale

The majority of people living in care homes in England are over the age of 80, most have multiple long-term health conditions, and the majority are affected by physical disability and/or cognitive impairment. These factors explain, in part, the vulnerability to COVID-19 of older people living in care homes. Across England care homes are facing the increased burden of treating and monitoring residents with COVID-19, which is made difficult by the complexity of care residents require, regional disparities in integrated working alongside primary, community and secondary care teams, and an over-stretched workforce. There is emerging evidence that using pulse oximetry, a non-invasive and painless test that measures a person's oxygen saturation level, in community settings can accurately predict outcomes for individuals who have tested positive for COVID-19 with regard to mortality and intensive care unit (ICU) admission.

A number of models of care using pulse oximetry with people in their own homes were set up and implemented across primary and secondary care in England during the first wave of the pandemic (April to September 2020) which led to the national roll-out of COVID Oximetry @ Home; a service that involves pulse oximetry and the remote monitoring of patients with coronavirus symptoms. A mixed-methods evaluation of the COVID Oximetry @ Home programme is also being undertaken by

the BRACE and RSET evaluation teams in parallel to this study with a number of outputs already published.

Despite this, little is known about the use of pulse oximetry and remote monitoring for COVID-19 in care homes. Despite the growing evidence base and policy guidance on the implementation and delivery of pulse oximetry and remote monitoring services across the wider health sector, there is limited UK government guidance for care home staff when managing COVID-19 in a care home environment. It is to be hoped that with the roll-out of coronavirus vaccination, and the prioritisation of care home residents, the incidence of COVID-19 among care home residents will fall to low levels from mid-2021 onwards. Pulse oximetry will remain potentially valuable, however, for monitoring residents of care homes who do contract COVID-19 or its variants, or have other conditions for which hypoxia is a possible consequence, for example chronic obstructive pulmonary disease (COPD) and asthma.

This rapid evaluation will examine the views of care home staff and primary, community and secondary care staff to determine how pulse oximetry is currently being used and in which circumstances, including any facilitators or barriers, and how its use might be best supported by primary, community and secondary care teams. Lessons learned from this evaluation will be transferable to patients and residents living with a range of long-term health conditions, and may provide useful learning for remote health monitoring within social care more generally.

Aims

In view of the gaps in evidence we have identified through our scoping work and engagement with relevant grey and published literature, our rapid evaluation will seek to answer questions concerned with the use of pulse oximetry in managing COVID-19 and other health conditions in a range of care home settings across England. In particular, we will explore the views of care home staff and primary, community, and secondary care staff in relation to the use of pulse oximetry when managing COVID-19 in the care home environment.

Evaluation questions

In order to address our aim, the study seeks to answer the following evaluation questions:

EQ1: When and how is pulse oximetry being employed in care homes for managing the health care of residents with COVID-19 and other health conditions?

> EQ1.1: Which care home staff are involved in the set-up, delivery, and monitoring of pulse oximetry in care homes?
>
> EQ1.2: What support are care homes receiving from primary, community, and secondary care NHS teams with regard to the use of pulse oximetry; is that support appropriate; and are there any weaknesses in providing that support that might be rectified?

EQ2: What are the perceived benefits to residents (e.g. health-related outcomes, satisfaction with care received, hospital admission avoidance, impact on perceived anxiety) of using pulse oximetry in their care home?

EQ3: What are the experiences of staff using oximetry in care homes, including barriers and enablers and lessons learnt?

EQ3.1: What training have care home staff received to deliver pulse oximetry in a range of care home settings?

EQ3.2: What impact has the use of pulse of oximetry had on care home staff well-being and confidence?

EQ3.3: What are the challenges faced by care home staff in delivering pulse oximetry and associated monitoring?

EQ4: What are the views of senior care home staff and managers on the guidance and resource necessary to support and sustain the use of pulse oximetry in care homes?

EQ5: What are the experiences of the primary, community, and secondary care healthcare staff involved, of supporting the use of pulse oximetry in care homes, including where relevant as part of the national COVID Oximetry @ Home service?

Design and methods

Our evaluation comprises four work packages (WP):

- WP1: ***Scoping:*** interviews with key NHS leaders, care association directors and care home managers, engaging with relevant literature, co-designing the study approach and research questions with members from a user involvement group.
- WP2: ***A national online survey of care homes in England*** examining the application of pulse oximetry in care homes. Including analysis of data and testing findings with members from a user involvement group.
- WP3: ***Qualitative case studies*** by means of in-depth interviews with care home managers and staff, and with primary, community and secondary care healthcare staff who support care homes, at six purposively selected case study sites; including analysis of data and testing findings with members from a user involvement group.
- WP4: ***Synthesis, reporting and dissemination***.

Dissemination and outputs

We anticipate disseminating the findings of this evaluation project in a number of ways, including:

- A slide set, supported by infographics, summarising the overall findings of the rapid evaluation to stakeholders across the NHS and the care home sector, but may be of particular interest to: NHS England and Improvement's Older People and Person-Centred Integrated Care workstream and People Receiving Social Care workstream, the NHS COVID Oximetry @ Home programme (and various national and regional learning networks e.g. the Communities of Practice group, COVID Oximetry @ Home Learning Network), the National Care Association, the National Care Forum, the Nursing Homes Association, the Care Quality Commission, and the Enabling Research in Care Homes (ENRICH) NIHR Clinical Research Network.
- One or more papers published in high quality, peer-reviewed, academic journals.
- Publication of an article in primary and social care professional press such as Pulse, Health Services Journal, GP Online, or Care Management Matters.

- Oral and/or poster conference presentation(s) such as at the British Journal of General Practice (BJGP) conference, the Society for Academic Primary Care (SAPC) conference, Health Services Research UK, Future of Care conference, and the National Care Forum conference
- Disseminating findings through BRACE and RSET networks, national care home associations, the appropriate NHS and social care channels, and utilising the assistance of our user development group, the BRACE Health and Care Panel and BRACE Steering Group, and RSET Stakeholder Advisory Board. Given the impact of our findings on care home residents and their families, we will also disseminate to patients, carers and the organisations that represent them. We will work closely with National Voices as well as the Social Care Institute for Excellence and their membership community to do this.
- A final report submitted to the National Institute for Health Research, Health Services and Delivery Research Programme, to be published in the National Institute for Health Research Journals Library.

Study timeline

The study will take place over five months (January 2021 to May 2021 inclusive), assuming access to case study sites and the timely securing of necessary ethical approvals.

Funding

This project is funded by NHS England and Improvement through the Health Services and Delivery Research evaluation team funded by the National Institute for Health Research (RSET Project no. 16/138/17; BRACE Project no. 16/138/31).

Background and rationale

Care homes are a vital part of the health and social care system, with the sector providing care to 410,000 older people in the UK (Competition and Markets Authority 2017) as well as care to thousands of people with physical or learning disabilities. Care homes provide support to 6.5% of the UK population aged 60 years and over, and the proportion increases considerably amongst the oldest age groups (LMC 2020). The majority of people living in care homes in England have multiple long-term health conditions, and the most are affected by physical disability and/or cognitive impairment. Since the start of the COVID-19 pandemic in the UK in March 2020, evidence has emerged that risk of severe disease and death is known to be higher in people who are older and in those with certain underlying health conditions (PHE 2021). There is little evidence on numbers of residents in other care home types, such as those with a specialist focus on sensory disabilities, learning difficulties and homes for young people. Yet, this group is also likely to be at higher risk of mortality and adverse COVID-19 outcomes due to clinical and social vulnerabilities necessitating daily personal care and support (Gordon et al. 2020). Analysis by the Office for National Statistics (ONS), for the period 2 March to 14 July 2020, found disabled people (as defined) made up 59% of all deaths involving COVID-19 despite this group being only 16% of the UK population (ONS, 2020). An ONS research survey of 9,000 care homes in England found 56% had experienced at least one case of COVID-19 by July 2020 (ONS 2020). The care homes sector has seen demand increase for hospital discharge beds to support COVID-19 patients with high levels of dependence and acuity, who under other circumstances would have been discharged to their own homes (LGA 2020).

The 'at risk' nature of populations resident in care homes and their clinical observation needs with respect to the on-going pandemic make care homes an important setting to investigate the implementation of COVID-19 monitoring services for the management and treatment of the disease. It is to be hoped that with the roll-out of coronavirus vaccination, and the prioritisation of care home residents, the incidence of COVID-19 (or at least of severe disease) among care home residents will fall to low levels from mid-2021 onwards. Pulse oximetry will remain potentially valuable, however, for monitoring residents of care homes who have other conditions for which hypoxia is a possible consequence, for example COPD and asthma.

There is emerging evidence that using pulse oximetry, a non-invasive and painless test that measures a person's oxygen saturation level, in community settings can accurately predict outcomes for individuals who have tested positive for COVID-19 with regard to mortality and ICU admission (Inada-Kim et al, 2020). A number of models using pulse oximetry were set up and implemented across primary and secondary care in England during the first wave of the pandemic (April to September 2020), in combination with remote monitoring of patients considered at high-risk of deterioration at home. These models have mainly involved the following processes: 1) patient triage through NHS 111, GP practice, hot hub[1] (or emergency department (ED) for those in secondary care), 2) patient provided with pulse oximeter, patient information (including escalation warning signs and what to do) and mechanism for recording observations regularly (app or paper diary) (potential observations being symptoms, pulse, heart rate, temperature, oxygen saturation), 3)

[1] COVID-19 Hot Hubs are primary care facilities providing access to routine and urgent care for the local population who fall into defined categories. During the pandemic, hot hubs replaced prior primary care provision for the face to face and home management and treatment of underlying conditions, where there is a confirmed or suspected COVID-19 case.

patient receives regular monitoring calls from staff (either primary or secondary care depending on model of care). A national roll-out of remote home monitoring models was launched by NHS England in November 2020 called COVID Oximetry @ home; a service that involves pulse oximetry and the remote monitoring of patients with coronavirus symptoms. There has been no comprehensive delivery of COVID Oximetry@ home in care homes. However, some general practices, either independently or as part of the primary care network of which they are a member (i.e. with each primary care network having a clinical lead for care homes in their area), have introduced the use of pulse oximetry to monitor care homes' residents.

Although pulse oximeters may have been previously available in some nursing homes (care homes where qualified nursing staff are available), there is evidence that implementation of pulse oximetry in care home settings has been taking place against the backdrop of the pandemic, building on implementation of telemedicine systems for monitoring care home residents in other areas of health (Hendy et al. 2012, Inhealthcare 2020, LGA 2020, Rotherham CCG 2020). Yet evidence on the use of oximetry across the care home sector is sparse, with a lack of studies on implementation of pulse oximetry (and possible remote monitoring) for residents, impact (effectiveness) and analyses of staff experience of delivering care.

This mixed methods, rapid evaluation of the use of pulse oximetry and remote home monitoring in care homes in England will seek to address this gap by exploring the impact of the implementation by capturing the experiences of staff delivering such care to residents.

Why is this research important and needed now?

Scoping work, which included a review of relevant grey and academic literature, interviews with key experts and members of a user involvement group, conducted to inform the development of this protocol, highlighted some key gaps in the evidence base about oximetry remote monitoring in care homes:

- A paucity of evidence on which care homes settings are using pulse oximetry and remote monitoring. A number of sources from the literature referred to monitoring in older age care home facilities but with no distinction between skilled nursing facilities or residential care. We were unable to locate any evidence on the use of pulse oximetry and remote monitoring in care home facilities treating younger age group residents, including those with learning difficulties or physical disability.
- Lack of awareness from care home managers about the national COVID Oximetry@ home programme, which would support care home staff to use pulse oximetry to support residents.
- Variation in the types of staff currently deploying pulse oximetry in care homes.
- Limited reporting of how data captured in care homes about pulse oximetry is uploaded and if it entailed automated or manual methods of recording.
- Limited reporting of what training, IT packages, guidance tools and support are available to care home staff for managing residents with COVID-19 or other conditions warranting use of pulse oximetry, and for any subsequent escalation or de-escalation of cases.
- A paucity of evidence on the nature of care homes' relationships with local general practices (including Primary Care Networks), Clinical Commissioning Groups and NHS Trusts in relation to delivering pulse oximetry and remote monitoring.

- Little literature on cleaning, reconditioning, quality control, redistribution and storage of oximeters and wider technology such as IPads, mobile devices and computers used to record the data.
- No evidence on what data are collected to monitor service delivery of pulse oximetry, e.g. metrics on hospital admissions, emergency department use or frequency of primary care contacts.
- Unknown extent of strain on care home staff as a result of: limited access to COVID-19 testing to confirm case status of residents; drives to discharge patients into care homes to free up hospital capacity; atypical presentation of COVID-19 symptoms amongst care home residents leading to difficulties in diagnosis; lack of contact with community health care workers; and difficulties getting care home residents admitted to secondary care, especially in the early stages of the pandemic.

With growing policy support for the use of pulse oximetry in care homes, further evidence is needed on the challenges associated with the use and implementation of pulse oximetry in this setting and the support staff required to care for some of England's most vulnerable patients. The evaluation will provide needed and timely evidence on approaches to implementation and on the enablers and barriers faced by care home staff and wider NHS teams, which will have broader implications for the implementation of similar pulse oximetry and remote monitoring services delivered in the care home sector both for COVID-19 and for other health conditions; and may provide useful learning for remote health monitoring within social care more generally.

Project plan

Aims

The rapid evaluation will address two key aims.

Aim 1 is to understand how pulse oximetry is being used in care homes by care home staff and healthcare professionals (e.g. through remote monitoring services run by NHS), for which conditions, and in which circumstances. This includes the source of pulse oximeters, the nature of staff involved and their experience using pulse oximeters, the level of training received by care home staff to deliver pulse oximetry and remote monitoring, the recording and storing of data, pathways for escalation, and the level of support from primary, secondary and community NHS healthcare teams.

Aim 2 is to develop an understanding of how the use of pulse oximetry in care homes might be optimised including an understanding of resources, approaches and activities necessary to sustain its use. This includes support from national and regional bodies including Clinical Commissioning Groups, NHS Trusts and local authorities.

There are synergies between this evaluation of pulse oximetry in care homes and the mixed-methods evaluation of the COVID Oximetry @ Home programme also being undertaken by the BRACE and RSET evaluation teams. We will bring together findings from the two evaluations to better understand how pulse oximetry and remote monitoring can be delivered and supported outside hospital to help people with COVID-19 and other health conditions potentially leading to hypoxia.

Research questions for the evaluation

In order to address our aims, the study seeks to answer the following evaluation questions:

EQ1: When and how is pulse oximetry being employed in care homes for managing the health care of residents with COVID-19 and other health conditions?

> EQ1.1: Which care home staff are involved in the set-up, delivery, and monitoring of pulse oximetry in care homes?
>
> EQ1.2: What support are care homes receiving from primary, community, and secondary care NHS teams with regard to the use of pulse oximetry; is that support appropriate; and are there any weaknesses in providing that support that might be rectified?

EQ2: What are the perceived benefits to residents (e.g. health-related outcomes, satisfaction with care received, hospital admission avoidance, impact on perceived anxiety) of using pulse oximetry in their care home?

EQ3: What are the experiences of staff using oximetry in care homes, including barriers and enablers and lessons learnt?

> EQ3.1: What training have care home staff received to deliver pulse oximetry in a range of care home settings?
>
> EQ3.2: What impact has the use of pulse of oximetry had on care home staff well-being and confidence?
>
> EQ3.3: What are the challenges faced by care home staff in delivering pulse oximetry and associated monitoring?

EQ4: What are the views of senior care home staff and managers on the guidance and resource necessary to support and sustain the use of pulse oximetry in care homes?

EQ5: What are the experiences of the primary, community, and secondary care healthcare staff involved, of supporting the use of pulse oximetry in care homes, including where relevant as part of the national COVID Oximetry @ Home service?

Research design and methodology

Design

We propose a mixed methods evaluation combining qualitative and quantitative approaches to understand the current level of use of pulse oximetry in the care home sector and how that use might be optimised and supported in the future. The rapid evaluation comprises: 1) to scope and design the rapid evaluation as reflected in this protocol: scoping interviews, engaging with relevant literature, and co-designing the study approach and research questions with members from a user involvement group (completed as part of a workshop delivered in February 2021, see Appendix I); 2) a national, online survey of care home managers in England examining the application of pulse oximetry in care homes; 3) in-depth interviews with managers, staff and primary, community and secondary care providers at six purposively selected case study sites, including analysis of data and testing findings with members from a user involvement group; and 4) synthesis, reporting and

dissemination with policy makers, experts, academics and other key stakeholder groups to share and discuss findings. These four work packages (WP) are summarised in Table 1.

Table 1. Summary of work packages and how research questions will be addressed

Work package (WP)	Description	Evaluation questions
WP1: Scoping interviews, engaging with relevant literature, as well as co-designing the study approach and research questions with members from a User Involvement Group	To obtain an overview of the existing evidence on the use of pulse oximetry and remote monitoring in the care home sector and to inform the propositions to be tested through the national survey and interviews	EQ1 and EQ2
WP2: National online survey examining the application of pulse oximetry in care homes	A national online survey of care homes exploring the various aspects of pulse oximetry and remote monitoring use in care homes, including analysis of data and testing findings with members from a User Involvement Group	EQ1, EQ2, EQ3, EQ4, EQ5
WP3: In-depth interviews at six case study sites	A series of interviews with managers, and staff and at six purposively selected care homes, plus NHS staff supporting them, exploring in depth the use of pulse oximetry and remote monitoring. WP3 includes analysis of data and testing findings with members from a User Involvement Group	EQ1, EQ2, EQ3, EQ4, EQ5
WP4: Synthesis, reporting and dissemination with policy makers, practitioners, managers, academics and other key stakeholder groups to share and discuss findings	Share and discuss findings generated from data collection from WP2 and WP3 and develop recommendations for care homes, commissioners, healthcare providers and policy makers	EQ1, EQ2, EQ3, EQ4, EQ5

Method

The methods used in each of the evaluation work packages are described below. Work packages 1-3 all include working with a User Involvement Group.

User Involvement Group

Members of the study team will meet with a specially convened User Involvement Group consisting of: co-researchers who have worked on previous care home related studies, those who either have or are currently supporting a close family members in a care homes, and members of the BRACE Patient and Public Involvement Group, to discuss the 'what' questions (what is important to find out/know about?) and the 'how' questions (how is it best to gather this information). The User Involvement Group has already commented on our research questions, choice of methods and recruitment strategies, and we will seek its inputs to a number of study documents including (but not limited to): the participant information sheet, the consent form and the interview topic guide.

We will incorporate the Group's feedback into the study documents prior to data collection, while interpreting findings, and throughout the study. A minimum of three meetings will be held with the User Involvement Group: 1) prior to data collection/protocol and research instrument development, 2) nearing the end of data collection, and 3) sharing early findings and interpretation.

WP1: Scoping interviews, engaging with relevant literature, as well as co-designing the study approach and research questions with members from our User Involvement Group

Telephone scoping interviews with key experts

Members of the study team have completed a number of telephone interviews (N=7, using a semi-structured topic guide informed by the literature and revised iteratively following preliminary interviews) with key stakeholders which include key NHS leaders, representatives of national care associations, and a range of care home staff to: 1) gather their initial insights and views on the use of pulse oximetry and remote monitoring in care homes; and 2) help define the scope of the work regarding the maturity of the use of pulse oximetry before and during the COVID-19 pandemic. The topic guide and a summary of key themes and messages from our scoping interviews can be found in Appendices II & III respectively.

Engaging with relevant literature

As part of the scoping phase of the project and development of this protocol, the study team has engaged with relevant literature to:

- Collate published, including grey (i.e. research that is either unpublished or has been published in non-academic form), literature using a selective systematic approach to searching on the use of pulse oximetry and remote monitoring in care homes in the England
- Provide a descriptive summary of our findings
- Inform our study design, research questions, and methods.

In addition, members of the study team have established a study steering group with senior policy leads at NHS England and Improvement and policy directors from two national care associations who have supported the identification of research evidence and key experts related to the use of pulse oximetry and remote monitoring in care homes. The team will continue to identify and engage with literature during key stages of the study (data collection, analysis, and write up) supplemented with ongoing dialogue with key experts in this field.

Co-designing the study approach and research questions with members from a User Involvement Group

The research team will hold a minimum of three workshops (Ørngreen and Levinsen 2017) with members of a User Involvement Group established to inform the design of the project, as well as to obtain feedback on the research tools. Members of the User Involvement Group are: people working within or have previously worked in the care home sector; people with recent experience of relatives or loved ones residing in care homes; and academics who have or are currently completing research with care homes. The aim of the first workshop will be to share findings from the review of the literature and the scoping interviews with key experts, and to refine the study research questions, as well as the interview topic guide and staff survey which will be in WP2 and WP3.

A structured agenda will be prepared in advance of the workshop and will include time for presentation of findings from the review of the literature and scoping interviews, and as well as time for discussion and feedback related to the survey and topic guide. The project team will take detailed notes during the workshop, which will be used to further develop and refine the study design. A summary of the notes taken from group discussions and presentation slides will be shared with attendees for confirmation or correction following the workshop. Finally, further workshops will be held with the group when a draft set of results and emerging themes have been developed.

WP2: National survey of care homes

A survey will be distributed to the registered manager at each of the approximately 15,000 care homes in England. The main objective of the survey is to understand current practices of using pulse oximeters in care homes for COVID-19 and other conditions, and the extent to which care homes are receiving support and guidance for this from the NHS. This, in turn, will contribute to understanding the potential impacts of the use of pulse oximeters, and associated support, on: (1) outcomes for care home residents, such as extent to which they appear to be reassured, (2) the delivery of health and social care services in care homes, (3) the organisational workflow and workforce capacity of care home staff, and (4) residents' use of health care services including Emergency Department attendance and hospital admission.

The survey will be guided by a set of research questions, and will explore:

1. The conditions for which pulse oximetry are used (management of COVID-19 and other conditions),
2. The procedures and processes involved in the use of pulse oximetry (implementation, monitoring and whether and how they differ by type of care home setting and characteristics of residents),
3. The experiences of staff delivering pulse oximetry and their perspectives on residents receiving pulse oximetry (e.g. deciding which patients should receive pulse oximetry, taking readings, monitoring residents, deciding when to escalate residents to acute care, and working with NHS staff if appropriate),
4. Competencies (skills) and training needs of care home staff in the use pulse oximetry in care homes, and staff capacity to deliver pulse oximetry,
5. Staff knowledge and engagement with the NHS Covid Oximetry @ Home service in care home settings,
6. Expected impact on residents' attendance at hospital Emergency Departments, admission to hospital, or other use of health care resources,
7. Expected impact on residents' health outcomes.

Data collection

We will conduct an online survey with care home registered managers to capture experiences, engagement, use of pulse oximetry and potential challenges experienced as result of using pulse oximetry in different care home settings (i.e. nursing/residential/dementia-specific/learning disability home; large and small homes), models of care (digital and analogue), types of staff involved (professional background/skill mix of staff delivering the service), and characteristics of care home residents (See Appendix IV). Recruitment will be aided by forwarding a summary of the work (See Appendix V). Survey data will be analysed using descriptive statistics and univariate analyses.

The survey will aim to reach all registered care homes in England (c.15,000). The Care Quality Commission has agreed to distribute the survey via its fortnightly bulletin to all registered care homes in England. The Care Provider Alliance has agreed to back this up by means of separate communications to its members, which includes associations representing the majority of care homes in England. It is also anticipated that NHS England and Improvement, with whom the research team is in contact, will reach out to stakeholder associations to maximise co-operation and buy-in.

The survey questionnaire will be designed collaboratively with NHS England and Improvement and representatives from the Care Provider Alliance, informed by scoping interviews with key experts in a range of care homes and umbrella associations, and by feedback from discussion with the User Involvement Group. The survey will include a number of (predominantly) closed questions focused on documenting care home managers' experiences of implementing and delivering pulse oximetry services. To reduce burden and maximise response rates, the online survey will take no longer than 15-20 minutes to complete.

Once it has been approved by NHS England and Improvement and representatives from the Care Provider Alliance (in Word format), the survey will be placed online using SmartSurvey and piloted with a small number of care home registered managers identified by the project team. Pilot survey results and feedback will be analysed by the research team and the questionnaire revised accordingly. An updated survey link will then be shared with the Care Quality Commission. The survey will be in the field for at least two weeks to allow participants adequate time to respond. We will send a reminder via the Care Quality Commission to registered care home managers two weeks after the initial request.

Data analysis

The quantitative survey data will be analysed using statistical software. Analysis will include descriptive statistics, identifying ranges of responses, patterns and trends in the data, and (depending on the number of responses received), we will use univariate analyses to compare similarities and differences in experiences in the use of pulse oximetry in particular types of care home settings, and potential long-term implications of using pulse oximetry for a wide range of conditions.

The survey will be implemented online on the SmartSurvey website. SmartSurvey is a reliable tool that the research team is familiar with and which facilitates visually appealing surveys. It is General Data Protection Regulation 2018 and Data Protection Act 2018 compliant, with all data stored in the UK. Since the survey will be distributed via the Care Quality Commission, researchers will not have access to any contact details for care home managers (or other staff or residents). Data from the completed surveys will be stored securely using password protected spreadsheets to which only the RSET and BRACE researchers will have access.

WP3: In-depth case studies of staff experience based on interviews

The aim of this workstream is to explore the use of pulse oximetry in care homes using the experiences of a range of stakeholders involved in delivering this technology in care homes; the factors influencing this delivery, including the communication to care homes about use of pulse oximetry and the level of support offered by NHS England and Improvement, and by local primary and secondary care providers; the range of conditions where pulse oximetry is considered a

beneficial component of a resident's care (including those who have tested positive for COVID-19); any variation in its use across different care home settings (e.g. nursing or residential, size, location); perceptions of residents' experience; and finally, the potential to optimise the use of pulse oximetry and other remote monitoring approaches in the longer term. In order to achieve this, we will interview a range of care home staff, senior managers in the care home sector and related care associations; plus NHS healthcare professionals across primary, community and secondary care who are currently working with care homes; as well as senior policy leads.

We anticipate that interpretation of the data we collect will enable the study team to describe: the level of awareness of and engagement with pulse oximetry amongst care home managers and staff; the interaction with care providers in primary, community and secondary care settings; knowledge of escalation processes, contingency planning, etc.; including, where applicable, any information on care homes/residents that have stopped using pulse oximetry or had been offered it but declined participation.

The interview guide will be piloted at a workshop with our User Involvement Group and a small number of scoping interviewees to determine whether the topic guide is designed appropriately to answer our evaluation questions (see Appendix VI; Staff interviews topic guide). The interviews will be semi-structured, audio recorded (subject to consent being given), transcribed verbatim by a professional transcription service, anonymised and kept in compliance with the General Data Protection Regulation 2018 and Data Protection Act 2018.

The application of a theoretical lens to interpret qualitative data

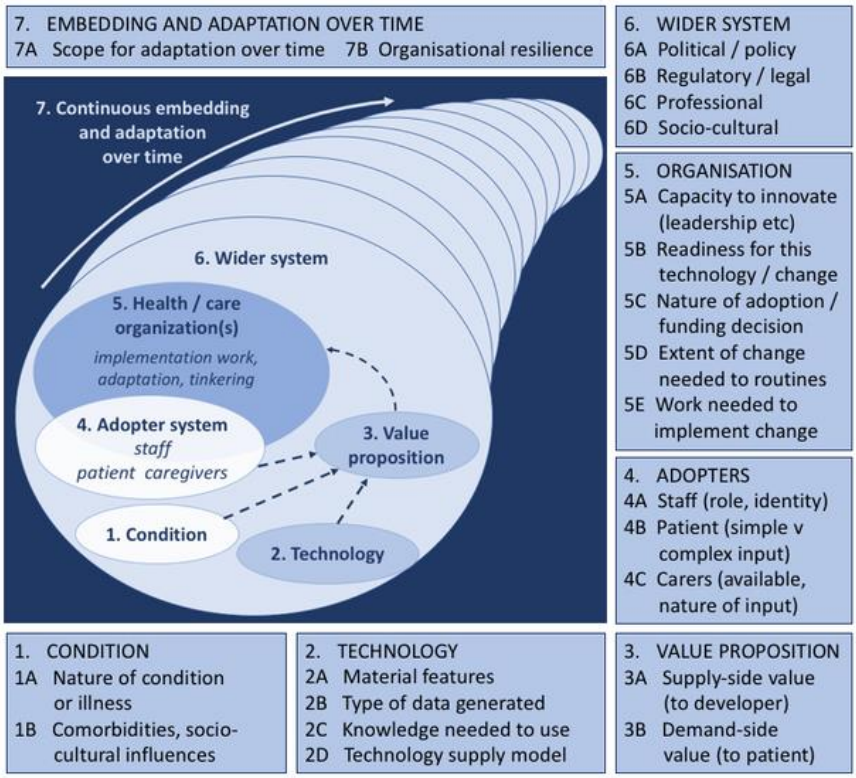
We will analyse any care home pulse oximetry use with regard to the social, economic and political context where it has been implemented, the multiple realities, assumptions and values that play a role in their implementation, the organisational structures that shape experiences of receiving and delivering care and the socio-political issues that frame the development, diffusion and use of technology (Lehoux and Blume 2000). This goes beyond an analysis of pulse oximetry in care homes solely as a technological innovation but also to consider dimensions such as: self-management, accountability and clinical responsibility, personalised care, inequalities in access to care and 'caring at a distance' (Greenhalgh et al. 2015, 2017; Powell et al. 2010).

We will use the Theoretical Domains framework as a lens for our interpretation of data to provide a comprehensive, theory-informed approach for extracting determinants of staff behaviour (cognitive, affective, social, political and environmental) related to the provision and use of pulse oximetry in care homes (Cane et al. 2012). Theoretical Domains framework can be used to identify determinants of health and social care professionals' and residents' behaviours and help to understand mechanisms of change, including how and in which contexts the implementation of new services can be effective (Atkins et al. 2017).

Greenhalgh et al. (2017) provide an example of a suitable framework with a socio-technical lens that incorporates non-adoption, abandonment, and challenges to the scale-up, spread, and sustainability (NASSS) of technologies for health and social care (see Figure 1). This includes the political, economic, regulatory, professional (e.g. medicolegal), and sociocultural context for service roll-out; as well as the expected and necessary changes/adaptations to staff working practices and the context for enabling more widespread use of the technology. The NASSS framework (informed by theory and evidence) describes the barriers to successful uptake of innovations and provides a guide

to the type of issues that should be considered by evaluators (Greenhalgh et al. 2017). We will use the NASSS framework as a sensitising device, to inform the development of questions in the interviews, and to help in the interpretation of findings alongside the Theoretical Domains framework. Researchers will come together as part of an online workshop once preliminary analysis of case study survey and interview data collection is complete, to synthesise data against the Greenhalgh et al. (2017) six domains while simultaneously providing a critique of staff behaviour in care homes to better understand mechanisms of change. By the end of the workshop, researchers will have developed a theory informed thematic framework that highlights the key learning emerging from data.

Figure 1: The NASSS framework for considering influences on the adoption, non-adoption, abandonment, spread, scale-up, and sustainability of patient-facing health and care technologies (Source: Greenhalgh et al. 2017)



Data collection

Data collection will follow a rapid qualitative research design involving teams of field researchers, participatory approaches, and iterative data collection and analysis (McNall and Foster-Fishman 2007). We will undertake semi-structured interviews with a purposive sample of stakeholders centring on six selected (care home) sites, with the aim of ensuring appropriate cross-site variation and giving opportunity to complete a significant number of interviews to achieve a depth of understanding to answer our evaluation questions, while enabling a rapid evaluation. Sites will be selected based on the principles of maximum variance, with the aim of selecting care homes that are, taken together, able to address many of the following criteria in combination: nursing, residential, and learning disability care homes, funding model, size, geographic location (with regard

to socio-economic deprivation), mechanism for remote monitoring (app, paper-based or both) (see Table 2). Recruitment of case studies will be facilitated by the National Institute for Health Research funded ENRICH (Enabling Research in Care Homes) facilitators, who will approach care homes on the study team's behalf across their clinical research network.

We will carry out interviews by telephone or using an online platform such as Zoom or MS Teams according to participant preference. Where possible an analysis of internal documents developed by these sites will also be conducted where it may support interpretation of interview data. The interviews will focus on capturing data relevant to the design and implementation of care home pulse oximetry monitoring models taking account of the impact of the COVID-19 pandemic and staff experiences of using pulse oximetry (including factors that acted as barriers and enablers, as well as the allocation of resources and access of support during implementation), and potential implications of pulse oximetry for care home residents who have tested positive for COVID-19.

Table 2. Sampling characteristics for study sites

Variables	***Description***
User group	Without dementia or learning disability With dementia With learning disability
Type of care home	Nursing Residential
Organisation size	Number of places
Mechanism for patient monitoring	Paper-based App
Geographic location	Urban Rural

Interview sampling

The interviews will be carried out with a purposive sample of study participants that will be designed in relation to the sampling framework outlined in Table 3 using snowball/convenience sampling (Ritchie et al. 2003). We will aim to carry out interviews with five staff members at each site with various levels of responsibility and experience (including managers, and care assistants or those employees involved in set-up, implementation and/or delivery of care using pulse oximeters) for a total sample of 37 interviews.

Table 3. Sampling framework for interviews with staff members

Participant category	**Number of interviews**
Senior managers from care home associations (e.g. Care England, National Care Association, Nursing Homes Association, National Care Forum)	Up to 4 (1 per association)
Care home manager	6 (1 per site)

Staff using the service – with nursing or medical training	Up to 3 (1 per site at 3 nursing homes)
Staff using the service – with no nursing or medical training (including those working day and/or night shifts)	Approx. 18 (approx. 3 per site)
Where relevant, NHS staff (primary, community or secondary care) supporting the care home's use of oximetry	Approx. 6 (0, 1 or 2 per site)
Total	**37 interviews**

Recruitment and consent processes for staff interviews

In the case of social care staff interviews, the researcher will contact potential participants, identified by the registered care home manager, via email and will send them a participant information sheet (see Appendix VII). Participants will then be given 48 hours to review the information and ask questions about the study. If the participant agrees to take part in the study, they will be asked to sign the consent form electronically and return it to a member of the study team (see Appendix VIII). The researcher will then arrange a time to carry out the interview over the phone or an online platform (Zoom or MS Teams) at a time convenient for the participant.

Interview process and data analysis

It is anticipated that interviews will last 45–60 minutes and completed by participants both during and after working hours (whichever is considered most appropriate to the participant). Given the short timeframe of this project, we will adopt a pragmatic approach to qualitative analysis which will enable comprehensive analysis of the data but with a more rapid timescale than traditional qualitative analysis. Interviews will be audio-recorded and transcribed verbatim. Data collection and analysis will be carried out in parallel and facilitated through the use of Rapid Assessment Procedure (RAP) sheets as explained in Vindrola-Padros et al. (2020c). RAP sheets will be developed per site to facilitate cross-case comparisons and per population (to make comparisons between sub-groups). The categories used in the RAP sheets will be based on the questions included in the interview topic guide, maintaining flexibility to add categories as the study proceeds. A meeting will be held, attended by all researchers, to develop and establish themes drawn from the data and research questions. Interviewers will complete a RAP sheet following each interview, noting key points from the data under the agreed categories. Researchers will frequently discuss categories, adding them to the RAP sheets as required. A sample of transcripts will be reviewed and verbatim quotes from the text applied to the RAP sheets as relevant. Once all interviews have been completed, an interpretation and analysis (online) workshop will be held, attended by all researchers, to establish a framework of themes.

The RAP sheets mentioned above will be developed at site level (one RAP sheet for each care home site). Findings on local barriers and facilitators to implementation and staff experiences will inform the interpretation of findings on service design, delivery and costs. Quantitative data on resource allocation will be understood in relation to qualitative data on staff experiences of planning and delivering services. Data will be tested/confirmed in an online workshop with key stakeholders and the study steering group (including NHS England & Improvement, care provider associations, and

members of the user involvement group) and then integrated in a report with findings from the Phase II COVID Oximetry @ home study to provide an understanding of the mechanisms of organisational impact of COVID Oximetry @ home. Interim updates on emerging findings will be shared with NHS England and Improvement and Care Provider Alliance representatives in progress meetings during the project.

WP4: Synthesis, reporting and dissemination with policy makers, experts, academics and other key stakeholder groups to share and discuss findings

The final set of findings from care homes will be synthesised and conceptualised within the wider pulse oximetry and remote monitoring context, particularly in relation to the rapidly changing COVID-19 and care home sector environment.

We anticipate that results from this evaluation project will be written up and widely shared with key stakeholders in a number of forms, both at the draft and final write-up stages. Outputs are anticipated to include:

- A slide set, supported by infographics, summarising the overall findings of the rapid evaluation to stakeholders across the NHS and the care home sector, but may be of particular interest to: NHS England and Improvement's Older People and Person-Centred Integrated Care workstream and People Receiving Social Care workstream, the NHS COVID Oximetry @ Home programme (and various national and regional learning networks e.g. the Communities of Practice group, COVID Oximetry @ Home Learning Network), the National Care Association, the National Care Forum, the Nursing Homes Association, the Care Quality Commission, and the Enabling Research in Care Homes (ENRICH) National Institute for Health Research Clinical Research Network.
- One or more papers published in high quality, peer-reviewed, academic journals.
- Publication of an article in primary and social care professional press such as Pulse, Health Services Journal, GP Online, or Care Management Matters.
- Oral and/or poster conference presentation(s) such as at the British Journal of General Practice conference, the Society for Academic Primary Care conference, Health Services Research UK, Future of Care conference, and the National Care Forum conference
- Disseminating findings through BRACE and RSET networks, national care home associations, the appropriate NHS and social care channels, and utilising the assistance of our user development group, the BRACE Health and Care Panel and BRACE Steering Group, and RSET Stakeholder Advisory Board. Given the impact of our findings on care home residents and their families, we will also disseminate to patients, carers and the organisations that represent them. We will work closely with National Voices as well as the Social Care Institute for Excellence and their membership community to do this.
- A final report submitted to the National Institute for Health Research, Health Services and Delivery Research Programme, to be published in the National Institute for Health Research Journals Library.

Project timetable

The study will take place over five months (January 2021 to May 2021), assuming timely access within our care home sites for both survey and interview data collection, obtaining necessary ethical and governance approvals, and any changes necessary in relation to COVID-19. Figure 2 shows the overall study timeline and the key milestones for the project.

Figure 2: Study timeline and key milestones

	Jan-21	Feb-21	Mar-21	Apr-21	May-21
Scoping interviews and engagement with relevant literature (WP1)					
Protocol and research instrument development (WP1)					
Pilot research instrument (WP1)					
Approach and identify organisations for survey dissemination and six case study sites for interviews (WP2&3)					
Survey and interview data collection (WP2&3)					
Analysis and synthesis of findings (WP4)					
Writing NIHR report and dissemination (WP4)					

Project management, governance and delivery

Project management and quality assurance

This proposal has been reviewed by the BRACE Director (Prof Judith Smith), RSET Director (Prof Naomi Fulop) and independently by Prof Russell Mannion (University of Birmingham). The co-principal investigators, Prof. Robin Miller (University of Birmingham) and Jon Sussex (RAND Europe), will be responsible for the overall delivery and quality assurance of this project. The co-investigator, Dr Manbinder Sidhu (University of Birmingham), will be responsible for the day-to-day management and coordination of inputs by members of the research team. Dr Jenny Bousfield, Dr Barbara Janta (both RAND Europe), Dr Ian Litchfield and Jamie-Rae Tanner (both University of Birmingham) will conduct data collection, analysis and writing up the research.

We will apply the following project management principles and processes: ensuring clarity of team members' roles, and the delegation of tasks and reporting duties; internal team meetings and catch-ups; and use of project planning tools (such as Gantt chart, timesheets, internal monitoring reports). RAND Europe's approach to project management is guided by its ISO 9001:2015 certification and is seen as fundamental to the successful and timely delivery of the evaluation. Weekly team video meetings will be held with the research team to update progress and address any arising issues promptly. The project team will report to the BRACE and RSET Executive teams, Steering Groups, and National Institute for Health Research Health Services and Delivery Research secretariat as and when required. We describe potential risks and mitigation strategies in Table 4.

All reports and other deliverables will be peer-reviewed by BRACE and RSET Directors (Prof Judith Smith and Prof Naomi Fulop) and colleagues drawn from the following: BRACE's academic critical friends (Professors Mary Dixon-Woods, University of Cambridge, and Russell Mannion, University of

Birmingham), members from the BRACE and RSET Steering Groups, and with user and patient involvement groups across both rapid evaluation centres.

Table 4: Potential risks and mitigation strategies

	Risk	Impact	Likelihood	Mitigation
WP1, 2 and 3	Increased demand on care home managers as a result of the Covid-19 pandemic and the rollout of the vaccination programme	High	High	The project team is aware of the demanding work pressures of care home managers. We are working collaboratively with a range of care home umbrella associations / networks to maximise co-operation and buy-in. Care homes and participants in WP3 will be given a financial incentive. Interview schedules will be piloted to ensure participation burden is minimised.
WP1, 2, 3, and 4	Loss of key staff	High	Low	There is a large project team, in the event of one member leaving there is capacity and resources for this person to be replaced from the wider team or to bring other researchers in.
WP2	Low response rates from survey of care home managers Low quality of survey data	High	High	There is a risk that the study team encounters a low response rate from care home managers completing surveys, and that surveys are partly completed. To minimise burden on respondents and encourage completion, the surveys will be kept short and research instruments will be piloted to ensure they are clear and relevant to respondents. If needed, in order to increase the response rate, the survey instrument may be kept open longer than originally planned.
WP1, 2, 3, and 4	Relatively short timeline for study – delays could arise	High	Medium	An effort has been made to plan the study in a way that makes best use of the time available to ensure there is sufficient time to complete each survey implementation task. The project leader will closely monitor progress and ensure any issues arising are dealt with immediately so study can stay on schedule. The study team has experience of delivering projects successfully in a limited timeframe.
WP3	Non-engagement from case study sites to complete interviews	High	Medium	Dr Manbinder Sidhu has built relationships with ENRICH (NIHR funded clinical research network that facilities research in care homes) who have began processed to identify case study sites. Team members will have ongoing meetings with site delegation teams/gatekeepers, to discuss the contribution required from each party for the duration of the evaluation. Only a small number of care homes are needed for inclusion in the study.

WP3	Inability to recruit participants for interview	High	Medium	There is a risk the study may be delayed in recruiting participants because it will be the responsibility of the care homes to identify participants on behalf of the study team. At each care home, the project team will identify a key point of contact regarding the care home's participation and will be in regular contact with them. The team will produce detailed, descriptive information sheets to inform potential participants of the importance of the evaluation, why we have asked them to take part, their involvement, and associated risks and benefits.
WP1, 2, and 3	Loss of data	High	Low	Although unlikely that data loss would occur, the University of Birmingham, University College London and RAND Europe have resilient, well-tested IT systems with data from all computers backed up in multiple locations which would enable the recovery of any lost data on local servers. The study team will conform to the appropriate storage of consent forms and audio files according to the General Data Protection Regulation (GDPR) guidelines.

Ethical issues and approvals required

We will seek appropriate governance and research ethical approval from the University of Birmingham (as the sponsor), NHS Health Research Authority and local NHS Research and Development approval to recruit participants and collect data, as required. Principal investigators and project managers will refer to the Health Research Authority Defining Research Table and Decision Tool where it provides guidance on how to determine whether a project falls under the category of 'research' or 'service evaluation'. For further clarification, the project manager will contact Dr Birgit Whitman, Head of Research Governance and Integrity, University of Birmingham.

Our team has experience conducting research with local authorities and care providers, staff working with service users, and service users and carers (see Table 5). There are some key ethical considerations for this study. The first is addressed in Table 4 (potential risks and mitigation strategies) and relates to sensitive and appropriate contact and approaches with care providers. Other considerations include the completion of interviews with staff of care homes during the COVID-19 pandemic and national vaccination roll out. Interviews will be conducted by telephone or via video to remove any risk of viral transmission.

Before and during the COVID-19 pandemic, the research team has developed extensive experience in conducting online qualitative data collection, including interviews and focus groups with healthcare professionals and patients. Some of the challenges and our proposed mitigation strategies for conducting online interviews are:

- Challenges building rapport and trust with the interviewee (Iacono et al. 2016): The researchers will ensure to spend a few minutes at the start of each interview asking the interviewee more informal questions to ensure that they feel comfortable. In addition, an information sheet outlining the project and the topics of discussion will be sent to the interviewee ahead of time (McGrath 2018).
- Understanding non-verbal cues (Iacono et al. 2016): Where possible, the interviews will be conducted via video to support the reading of non-verbal cues. If interviews need to be conducted by phone, at the interviewee's request, the researchers will ensure extra effort is placed on active listening and speaking to the interviewee instead of using body language.
- Technology challenges (e.g. poor internet connection, poor image quality): The interviewers will test their internet connection and video quality ahead of conducting interviews. If the interviewee is facing technical difficulties, the interview could be switched to telephone (a back-up phone number will be provided to all interviewees). If interviewees are not experienced in the video platform, the researchers will offer a 10-minute walk-through ahead of the interview.

Participant consent

We have sought the advice and guidance of the Health Research Authority and University of Birmingham research ethics and governance team when devising our approach to taking informed consent. Participants will be asked to provide electronic consent for both surveys and interviews. Participants completing the survey will complete necessary questions on the online survey platform. Interview participants will provide electronic signatures on a consent form. Electronic signature can be one of: stylus or finger drawn signature, a typed name, a tick-box and declaration, a unique representation of characters or a fingerprint scan.

We will provide an information sheet via email to each participant, which will detail the study's aim, design, risks, benefits, who they may contact if they have further questions, and their right to withdraw from the study at any point without giving a reason.

Confidentiality

Data stored on research team laptops will be both password and bit locker protected. Electronic data will be held securely on a restricted access network. The study team will limit the amount of paper-based data and work on electronic files; however, where there is any paper-based data it will be stored in a locked filing cabinet at the University of Birmingham. Participant identifier codes will be stored separately from the anonymised interview transcripts.

Data storage

The project team will store data at the University of Birmingham for up to five years after data collection is complete (or until it is no longer necessary). Data will then be archived in accordance with University of Birmingham research governance processes.

Indemnity and insurance

The University of Birmingham holds the relevant insurance cover for this study, as confirmed via the BRACE contract with the National Institute for Health Research.

Sponsor

The University of Birmingham will act as the main sponsor and guarantor for this study.

Funding

BRACE, including this evaluation, is funded by the National Institute for Health Research, Health Services and Delivery Research programme (HSDR16/138/31).

Research team

Table 5 presents the team members and their corresponding roles and expertise.

Table 5: Study team members

Team member	Role and contribution	Relevant expertise
Prof Robin Miller	Professor of Social Work and Social Care at the University of Birmingham, Co-Principal Investigator	Senior researcher with experience of investigating within the contexts of social and primary care services, working collaboratively with practice and policy partners, and involving people with lived experience in research and impact.
Jon Sussex	Senior Research Leader at RAND Europe; Co-Principal Investigator	Senior health services researcher at RAND Europe, with over 30 years' experience in health and social care research and consultancy.
Prof Naomi Fulop	Professor of Health Care Organisation & Management in the Department for Applied Health Research, University College London, Co-investigator	Internationally renowned health services researcher with expertise in applying organisational and social perspectives, using qualitative and mixed methods, to understand change and improvement in health care, both at different levels of the system, as well as locally, nationally, and internationally.

Team member	Role and contribution	Relevant expertise
Dr Jennifer Bousfield	Analyst at RAND Europe; project conception, data collection, analysis, facilitation of project workshops, writing of reports/dissemination	Jennifer has a background in research on health and social care topics. This includes research on health, symptomatology and daily living in older adults with and without a diagnosis of dementia, and more recently, research on COVID-19 home monitoring (including in care home settings). She has extensive experience of project managing research studies and collecting and analysing qualitative data. She was recently the project manager and researcher on a study of social inclusion and mental health, which included conducting and analysing interviews and focus groups with staff, service users and carers.
Dr Alys Griffiths	Senior Research Fellow at Leeds Beckett University	Alys is a mixed-methods dementia care researcher, with a specific interest in the evaluation of complex interventions in care home settings.
Dr Barbara Janta	Senior Analyst at RAND Europe; project conception, data collection, analysis, writing of reports/dissemination	Barbara is an applied social scientist with over 10 years of experience of leading and managing research projects for a variety of EU and UK clients. Her areas of expertise include work and employment, including analysis of working conditions of healthcare workers. She has extensive experience in designing and implementing online surveys, and analysing primary and secondary survey data.
Dr Ian Litchfield	Research Fellow at the University of Birmingham; project conception, data collection, analysis, facilitation of project workshops, writing of reports/dissemination	Ian is an experienced mixed-methods researcher working in health service delivery. He has developed, implemented and evaluated service improvements in a variety of primary and secondary care settings, using quantitative and qualitative methods including rapid evaluation and experience-based co-design. His work has been funded by NIHR, The Health Foundation and the National School of Primary Care. Recent projects include the implementation and evaluation of the RCGP's patient safety toolkit and the use of patient reported outcomes in primary care.
Dr Manbinder Sidhu	Research Fellow at the University of Birmingham, Co-Investigator and project manager; project scoping, data collection, analysis, writing of reports/dissemination	Manbinder is an applied social scientist with 10 years' experience of health research with the NHS and third sector organisations. Manbinder has extensive experiences using a range of qualitative methods and application of theory. He was the project manager and a team member for two completed BRACE evaluations titled "The early implementation of primary care networks in the NHS in England: a qualitative rapid evaluation study" and "Vertical integration of GP practices with acute hospitals: a qualitative rapid evaluation study".
Jamie-Rae Tanner	Public Health Registrar at the University of Birmingham; project conception, data collection, analysis, facilitation of	Jamie-Rae has a background in health care commissioning and service development. This includes statistical research, quantitative and qualitative data analysis, project management and policy development across a number of health and social care organisations including Clinical Commissioning Groups,

Team member	Role and contribution	Relevant expertise
	project workshops, writing of reports/dissemination	Local Authorities, NHS care providers and academic institutions.
Dr Cecilia Vindrola	Senior Research Fellow at the Department of Targeted Intervention, University College London, Co-investigator, analysis, writing of reports/dissemination	Medical Anthropologist interested in applied health research and the development of rapid approaches to research. She works across five interdisciplinary teams (including RSET), applying anthropological theories and methods to study and improve healthcare delivery in the UK and abroad. She has written extensively on the use of rapid qualitative research and currently Co-Directs the Rapid Research Evaluation and Appraisal Lab (RREAL) with Dr Ginger Johnson.

Summary of Appendices

I. Summary of the BRACE and RSET user involvement group workshop

II. Topic guide for scoping interviews

III. Summary of key themes and messages from scoping interviews

IV. Staff survey

V. Study summary

VI. Staff interviews topic guide

VII. Participant information sheet

VIII. Consent form

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Appendix I. Topic guide for scoping interviews

Summary of the BRACE and RSET User Involvement Group Workshop

The implementation and use of pulse oximetry in care homes across England to manage residents with COVID-19 and other conditions

Wednesday 10th February 12.30 -13.30, on ZOOM

Facilitated by: Dr Manbinder Sidhu, Dr Ian Litchfield, and Jamie-Rae Tanner

Attended by:

Alison Meakin: qualified nurse by professional background with a focus on palliative care. Co researcher on a number of social care research studies.

Denise Tanner: academic in in the Department Social Work and Social Care, University of Birmingham; a former Trustee of a charitable care home, recent experience of her father being resident in a care home.

June Sadd: a service user who has worked on various research projects and is a member of the BRACE Patient and Public Involvement (PPI) group. Experience as a lay person contributing to Care Quality Commission (CQC) inspection.

1. Introduction

MS presented the agenda for the workshop and gave an introduction to the COVID Oximetry @ Home programme and our evaluation which will evaluate staff experiences of the use of pulse oximetry in care home settings.

2. The scope of the work

The five broad questions driving the work were presented and a number of observations were made by the group:

Questions- seem to be worded for those using pulse oximetry already and could be rephrased in a way that makes it more explicit that the study team also plans to include the staff experiences where pulse oximetry is not widely used (if at all).

Process over outcomes- The group noted a greater focus on processes involved over resident's outcomes. A focus on benefits of using pulse oximetry for care homes who are currently using this method may encourage them to consider how it could support them in their work. However, members of the team explained the aim of the evaluation is not to increase uptake of pulse oximetry but to understand the current scale of adoption and implementation of pulse oximetry in the care home sector. However, members of the study team understood this consideration should be taken into account especially when sharing findings with senior NHS leads.

Language - All questioned the use of the word 'management' in describing the care of residents with COVID-19 or any other conditions. They felt this indicated a 'top-down' approach and preferred the

use of the word 'support' and this better reflects the nature of relationships care home staff may have with residents.

The role of residents in the work – The absence of the residents' voice was noted by the group. It was explained that the lengthy ethical approval process for vulnerable participant's vs the time constraints of the work meant that we were unable to include residents in this particular evaluation. This did not preclude a follow-up study specifically to explore resident's experiences and outcomes related to health and well-being.

Capturing the opinion of residents' family and carers – Whether or not we would capture opinion of residents' family and carer's perspectives was raised. It was noted by DT that there may be reassurance to be gained for relatives if an objective measure (i.e. saturation) could be communicated when asking after a resident or otherwise from the fact that it was one of the parameters being observed. For some family members knowing such information may help address (to some extent) anxiety/emotional unrest that may be experiencing due to a lack of contact with residents.

3. The content of the questionnaire and the topic guide

The use of pulse oximetry – JS asked whether residents could refuse to engage with pulse oximetry (where residents have capacity to consent or not) and whether the use of pulse oximetry is embedded in resident personalised care plans.

Training- there were a number of questions with regard to care home staff training to deliver pulse oximetry:

- Are car home staff being trained in their own time or during time allocated during the working day? Are care home staff paid to complete training?
- Are short to medium term agency staff also provided training?
- What standard do care home staff need to meet in order to pass training? Or, is training delivered without assessment?
- Do they have the opportunity to reflect and ask questions (as opposed to a 'tick-box' approach facilitated by online training)?
- What is the content of the training and does it cover specific elements such as silent hypoxia or infection control?
- Could the study team ask for copies of any training documentation (e.g. Standard Operating Procedure documents) as part of the in depth case study site work package?

Do Not Resuscitate – It was suggested that we ask about Do Not Resuscitate as these protocols have changed during the pandemic and whether pulse oximetry has informed any changes

4. Recruitment of care homes for the survey

Survey dissemination - The intention and nature of using the CQC as an avenue for survey dissemination was described and familiar concerns were expressed regards communicating the independence of the evaluation from the regulatory body. Therefore, members of the group expressed the study team ensured the branding and background information with regard to the study makes it explicit that this is an independent evaluation.

Private homes – It is possible private homes might be the least likely group to describe any perceived shortcomings regards the use of pulse oximetry compared to other care home settings.

5. Recruitment of care home staff for interviews

The identification of an appropriate range of care home staff to partake in interviews was discussed and a number of issues were raised:

Agency staff – Has the study team made allowances for agency staff to be interviewed as part of our sample?

Turnover of staff - Care home staff may have a number of roles across care homes (i.e. working at two or more care homes) and may have a range of experiences specific to each home. Does the topic guide explicitly capture the range of perspectives care home staff may share during an interview? (e.g. the phenomenon of individuals potentially saying "this place is great - but the last place!...")

Shiftwork - Will the study team capture the different experiences between staff working different shifts (days/nights/weekends)?

Candid responses – Members of the group recommended that we ask, where possible, for care home staff to be interviewed in their own time (if they prefer) away from the care home allowing greater opportunity to reflect on their experiences and speak more frankly.

Appendix II. Topic guide for scoping interviews

Scoping interview questions

Introductions

Brief description of the study proposal, quantitative and qualitative packages, timelines, approach route via Associations, etc:

About you and the care home where you work

1. Please tell us about your care home – number and types of residents, number and types of staff (approx.) – and what is your role specifically?

First impressions of the proposed study

2. What would ***you*** like to know about how other care homes and other residents are using PO for Covid-19 and other conditions?
3. What are your thoughts about our research questions and choice of methods?

Recruitment/ encouraging participation

We aim to survey the registered managers of all care homes in England, or at least those covered by the member associations of the Care Providers Association:

4. How feasible do you think it would be to get managers to complete a short survey, and potentially take part in a short interview via telephone/Zoom? survey at this time?

5. Is there any way we could circumvent/prepare for particular challenges?

6. Similarly, where relevant, how might we best ensure that care home chain head offices are 'on-side' with the survey? What might be the best way to build relationships with care home managers to facilitate recruitment?

For the qualitative part of our study we will be selecting 6 care home sites to conduct qualitative interviews with managers. We aim to include care homes with a range of characteristics (i.e. different care home settings – nursing, residential; models of care - digital and analogue monitoring; small and large care homes; chains and independent homes; service user characteristics - i.e. younger as well as older, learning disability, etc):

7. Are there any other characteristics you think we should consider?

8. Are there any particular providers (or care home groups) that you think we should include as one of our sites? Are some better suited? Prior participation in research studies? Have an interest in PO for Covid-19?

Themes/ questions to be asked

4. What, specifically, should we ask about/what would you hope to see covered in the survey and interviews? What do you think is most/least important to know (because we will want to keep the questionnaire short and may not have room to cover everything)?

<u>We are currently thinking about including questions on the following:</u>

- *Relationships with local general practices (PCNs), CCGS, Trusts*
- *Questions about processes of PO use in care homes*
    - *Deciding which residents should receive PO*
    - *Training of staff and residents to use PO*
    - *Flagging deterioration/ escalation processes*
    - *Communication, and interface, with the NHS*
    - *Who takes the readings, carries out monitoring, etc.*
- *Staff experiences of the use of PO*
- *Training and support desired/received - Use of pulse oximeters*
- *Awareness of the CO@h service itself*
- *Engagement with national CO@h guidance on delivery*
- *Impact of the use of PO for Covid-19 on workloads*
- *Managers' views on how their staff and residents are responding to PO use*
- *Perceived potential impact of PO use (e.g. reducing mortality and morbidity)*
- *Data collection and use*
- *How is equipment cleaned, reconditioned, quality checked and redistributed*

5. To help inform the development of our interview materials, we have a few queries. As far as you know:
    - What's the current staffing arrangement to deliver the service?
        - I.e. Which types of staff decide who requires PO?
        - Which types of staff take PO readings?
        - Who monitors residents who require PO?
        - Do care home staff receive training on PO?
        - Does this vary between days/nights/weekends?
        - If yes, who provides training and how (e.g. infection control, and remote delivery methods needed)
    - How was CO@h introduced? Any learning from delivery in primary and secondary care?
    - Are you collecting any data on the use of PO for COVID-19?
    - Was PO used specifically to deliver CO@h or more generally to support residents i.e. what was the aim of using PO?
    - What criteria do you use when deciding when to use PO for other conditions? (i.e. what criteria area used)
    - Is there a difference in terms of who takes PO readings and monitors residents for COVID-19 vs other conditions?

    - As far as you know, are GPs still visiting care homes? We assume this is likely to vary across England.
    - What is support from the NHS for PO use likely to look like?
    - Is the NHS providing care homes with additional PO?
    - Is there an industry norm for sizes of care homes? E.g. small, medium, large based on a threshold of bed numbers?

Likely barriers and facilitators to the use of CO@h in care homes

6. Based on your experience, what do you think are the main barriers to the use of PO in care homes, for a) COVID-19, b) other conditions?
7. Based on your experience, what do you think are the main facilitators to the use of PO in care homes? (i.e. what helps it to be used successfully)?
8. Do you have any other thoughts or considerations?

Many thanks for your time

Appendix III. Summary of key themes and messages from scoping interviews

Key messages and themes	Descriptions	Evaluation questions where key messages and themes are covered.
What we should cover in our evaluation	• Training • Confidence in pulse oximetry use in care home staff • Support of care home staff in using pulse oximetry • Systems for care staff communicating concerns about residents and about pulse oximetry use • Practicality of taking readings, recording readings, and processes for escalation • Obtaining pulse oximetry, cleaning and returning (if necessary) pulse oximetry • Communication and relationships between care homes and the NHS • Workforce set-up and resources	EQ3, EQ4, and EQ5
Reflections on the focus of our study	• Importance of evaluating pulse oximetry use in care homes, given the burden of COVID-19 in this setting • Support for the focus of our research, particularly our broader focus on the use of other conditions (in addition to COVID-19), and to exploring remote monitoring in care homes and the community • Clarification of the other conditions that pulse oximetry might be used for	EQ1, EQ2, and EQ5
Reflections on our methods	• Support for our proposed methods, specifically, collecting data with a range of care home staff, from different care homes settings (e.g. residential, nursing, learning disability and older adults) • Although this is a challenging time for care homes, several care home professionals we spoke with felt that care home managers and other staff would be interested in taking part in research on this topic • Incentives for participants should be considered	Addressed as part recruitment and data collection strategies
Key learning about the care home setting	• There is likely to be a lot of variation across care homes in terms of pulse oximetry use, and their awareness of the CO@h programme • There are likely to be differences in the way that pulse oximetry is used in residential and nursing homes	EQ3, EQ4, and EQ5

	• Resources for care home staff in the use of pulse oximetry are being developed and recently launched (e.g. webinars and videos), but prior to this there has not been much information • When care home staff are empowered to use pulse oximetry, this can help support GPs in their role and improve the resilience of care systems • Some interviewees felt that most care home staff are likely to be able to use pulse oximetry with residents, but they need the right support and training	
Other considerations	• Although NHS colleagues are distributing information to care homes about pulse oximetry and the CO@h programme, messages are not always getting through to care home managers and staff; sensitivity is required in speaking with care homes about the programme. • Care homes are under a lot of pressure with the recent rise in cases and new variants, as well as the vaccination roll out, therefore, the research team will not start data collection until early March when the timing may be better for care homes.	EQ1, EQ3, and EQ5

Appendix IV Staff survey

Potential topics/questions for survey with managers in care homes

Respondent ID: XXX

Group of questions	Type of questions
Care home characteristics	- What category of care home do you manage? *(Select from: nursing, residential)* - Which groups of residents live at the care home you manage? *(Select all that apply: younger/working age adults; older residents; learning disabilities; physical disabilities; dementia; sensory disabilities; complex needs)* - What size is your care home? *(free-text box for number)*
Use of PO	- Do you use pulse oximeters routinely in your care home? *(Select from: Yes/No)* - How long have you been using them for? *(Select from less than 12 months, 1-2 years, 3-5 years, more than 5 years)* o If less than 12 months, were PO brought in specifically in response to Covid-19? *(Select from: Yes/No)* - If you have been using them for more than 12 months, what conditions was this for? o *(Select all that apply: chest infection/pneumonia; COPD; asthma; emphysema; cystic fibrosis; heart attack/heart failure; anaemia; lung cancer; other – please specify)* - Where did you get your PO from? *(Select from: already in the home; provided by the NHS; purchased by the care home; other – please specify)*
Experiences of using PO in care homes	- Currently, how challenging have your staff found carrying out the following for residents needing PO *(Select from: Not at all, a little, somewhat, very):* o Deciding which patients should receive PO o Finding equipment when needed o Cleaning PO o Taking PO readings o Monitoring patients (e.g. using the app/paper-based system) o Deciding when to escalate patients (i.e. when to call an ambulance) o The IT systems you are using (if relevant) o Working with other services (if relevant)
Training and support	- Currently, do you feel that you have enough staff capacity to use PO in your care homes? *(Select from: Yes, No, Unsure)* - Which of your staff have received training for the following? *(Staff across the top: care home assistant practitioner; carer worker; care home nurse; registered manager; other – please specify. Training down the side: deciding when to take PO readings; how to take PO readings; monitoring resident progress; escalating patients where necessary; cleaning PO; storing PO; returning PO; use of IT systems – please specify)* - Overall, do you feel that your staff who use PO with residents require any further training or support in respect to using PO? *(Yes, No)*
Support	- Do you get support from the NHS for the following *(Select from: yes, no for each)*: o Use of PO o Training in the use of PO

	○ Escalation ○ Communicating readings to NHS
Impact of the use of PO	- At this present point in time, to what extent do you think the use of PO for residents is having a positive impact on the following? *(Select from: strong negative impact, negative impact, no impact, positive impact, strong positive impact, unsure)* ○ Reassuring residents ○ Reassuring staff ○ Reducing residents' mortality ○ Reducing severity of illness ○ Early identification of cases of deterioration ○ Reducing attendance/reattendance to ED ○ Reducing hospital admissions ○ Reducing length of stay in hospital ○ Other – please specify - At this present point in time, what impact do you feel the use of PO with residents with has had on the following *(Select from: strong negative impact, negative impact, no impact, positive impact, strong positive impact, unsure)* ○ Your workload ○ Your staff's workload ○ Your job satisfaction ○ The job satisfaction of your staff ○ Your stress levels ○ The stress levels of your staff
Engagement and experiences of residents	- To what extent do you agree with the following statements: ○ Residents have felt reassured by the use of PO ○ Residents have felt anxious by the use of PO - Are there any types or groups of residents facing barriers in the use of PO? ○ If yes, which groups? *(Select all that apply: BAME, residents with learning disabilities, older adults, non-English first language, cognitively impaired, other – please specify)*
Link with NHS service for remote monitoring	- Are you aware of a local NHS service that provides remote monitoring of Covid-19 for residents? *(Select from: Yes/No)* - Has your use of PO been part of that service? *(Yes/No)*
Open text question	- Is there anything else you'd like to tell us about your experience of the use of PO for residents in your home(s)? *(Please write in the box below)*

Appendix VI. Study summary

Summary of the rapid evaluation of the implementation and use of pulse oximetry in care homes across England to manage residents with COVID-19 and other conditions

Why take part in this study?

This rapid national evaluation seeks to capture the experiences and views of care home managers about using pulse oximetry and remote monitoring with care home residents in England. Your involvement in this study is vital to spread understanding of, and learn from, the impact and consequences of using pulse oximetry and remote monitoring in care homes.

The study's findings will be used to share experiences across the care home sector and inform future NHS support to care homes using pulse oximetry to help to monitor patients considered to be at high risk of hypoxia, whether due to COVID-19 or any other condition, so as to: 1) avoid unnecessary hospital admissions (appropriate care at the appropriate place); and 2) escalate cases of deterioration at an earlier stage to avoid ventilation and ICU admission. The findings will be made publicly available, including a summary specifically for care homes, and the research team will provide feedback to NHS England and Improvement on how the NHS can further support care homes. This will benefit care home residents, staff and the wider health and social care system.

How will the study be done?

The research team will collect data from care home registered managers using a survey, combined with a more in-depth investigation of care home staff experiences across six selected sites based on interviews. The total duration of the study will be approximately four months but your involvement will only be for the survey and/or interview you agree to complete.

What will happen if I decide to take part in the study?

You will be asked to complete a short online survey (paper format available upon request). A few people are also being asked to complete a short interview with a member of the study team. In that case, we may ask you to identify other members of staff in your care home who might be suitable for interview. Interviews will be conducted over the phone or via video call. All information gathered will be treated as confidential and anonymised for analysis.

Are there risks to taking part in the study?

There are no risks from participating in this study.

Who is organising and funding the research study?

The study is funded by NHS England and Improvement and is being carried out by the BRACE Rapid Evaluation Centre based at University of Birmingham and RAND Europe Community Interest Company, supported by the Rapid Service Evaluation Team (RSET) based at University College London and the Nuffield Trust.

Who do I contact if I want more information about the study?

Please contact Dr Manbinder Sidhu at the University of Birmingham m.s.sidhu@bham.ac.uk if you would like further information about this study.

THANK YOU FOR READING THIS INFORMATION AND FOR CONSIDERING HELPING WITH OUR STUDY

Appendix VI. Staff interviews topic guide

(Care home staff plus wider stakeholders)

Interview topic guide_Senior Staff (Managerial and supervisory roles e.g. registered care home manager; lead nurse)

1. Can we start with a description of your current role?
    a. *Length of time in your current role in the care home (and in relation to any use of oximetry)*
    b. *Key responsibilities in the care home (and again in relation to any use of oximetry)*

2. Are you aware of the NHS CO@H initiative?
    a. *How did you become aware of it?*
    b. *From which organisation(s)? (e.g. CCGs, NHS England, National Care/Nursing Home Association)*
    c. *What communication/information did you receive (Content, clarity?)*
    d. *What support were you offered?*

For those senior staff/care homes aware of CO@H and decided to take part or declined to be involved in the initiative:

3. What factors influenced your decision
    a. *Level of support (any offered? Who by? (e.g. CCG, local GP practices, secondary care facilities) What was its nature?*
    b. *Resident factors (complex health issues, unable to consent, reluctance of family etc)*
    c. *Staff factors (time pressures, training, additional responsibility)*
    d. *Any other?*

4. Which factors would make you reconsider your decision?
    a. *Support*
    b. *Resource*
    c. *Consistent communication/information about the service*
    d. *Demonstrable benefit*
    e. *Any other?*

For those senior staff in care homes using oximetry to manage covid or other conditions

5. For which conditions do you use oximetry with your residents?
    a. *COPD pneumonia; COPD; asthma; emphysema; cystic fibrosis; heart attack/heart failure; anaemia*

6. What were the factors that persuaded you to use oximetry in your care homes?

a. *Benefit to residents*
b. *Support from CCG/local GP practice/secondary care facility/community care providers*
c. *Staff capability (experienced, medically qualified)*
d. *Staff capacity (able to take-on, accept additional responsibility)*
e. *Organisation wide guidance*

7. When did you first begin using oximetry in your care home and how did it develop over time?
    a. *When did oximetry start and become fully operational in your care home?*
    b. *Who led the introduction of oximetry (care home staff, general practitioners, practice nurse, other primary/secondary care providers)?*
    c. *Approximately how often are oximetry readings taken by staff?*
    d. *Which NHS organisations have supported the use of oximetry in your area/care home/chain of care homes – how helpful was this involvement?*
        - *Primary care, secondary care, others*
        - *Working with/integration with NHS 111 and ambulance service*
        - *Involvement of NHS colleagues/organisations at regional level*
        - *Involvement of NHS colleagues/organisations at national level*
        - *Involvement of non-NHS organisations?*
    e. *Has any learning from other care homes using oximetry in other parts of the country been incorporated?*
    f. *What is the nature/extent of partnership working to design/develop/deliver the use of oximetry in care homes?*
        - *Advice/messaging from care associations?*

8. From your perspective what are the benefits of using oximetry and its main features?
    a. *Which residents are being served (characteristics)?*
    b. *Availability of other services at community or primary care level for Covid-19 relevant to testing, diagnosis, mental health*

9. From your perspective what are the main benefits of using oximetry
    a. *Minimise patient mortality and morbidity*
    b. *Early identification of cases of deterioration*
    c. *Minimise attendance/reattendance to ED*
    d. *Reduced length of stay in hospital*
    e. *Minimise risk of escalation to secondary care emergency departments*
    f. *Reduce severity of symptoms*
    g. *Prevent the spread of Covid within care homes*
    h. *Other*

10. What are the processes involved in using oximetry?
    a. *Which residents are involved e.g. as advised by primary care, application, and referral processes? (variation by age, ethnicity, deprivation)*
    b. *Purchasing and distribution of pulse oximeters to patients (which pulse oximeters used (NHSEI or purchased their own)); what proportion of pulse oximeters were returned and re-used*
    c. *Resident information and training*
    d. *Resident monitoring (who is involved, what was monitored, and how)*
    e. *Mechanisms used for resident data reporting (i.e. app, paper-based)*
    f. *Are any tools used for flagging deterioration*

g. *Escalation processes (including any criteria and thresholds, safety netting)*
h. *Signposting to wider services*
i. *Who is involved in any decision to stop using oximetry and who is notified*
j. *What are the criteria used in any decision to stop using oximetry*

11. What is the current staffing arrangement used to deliver your oximetry?
    a. *Number of staff/ pay grades*
    b. *Rota*
    c. *Responsibilities*
    d. *Any new additional staff been recruited to manage oximetry e.g. working with volunteers to deliver oximeters*
    e. *Redeployment of staff working elsewhere within the organisation*
    f. *Training non-clinical staff to complete resident monitoring activity*
    g. *Impact on staff morale/job satisfaction*
    h. *Key changes which staff have noticed in their everyday working practices/current workload*

12. What data are you collecting to monitor the outcomes of using oximetry?
    a. *Have these data been linked to other data sources?*
    b. *Who is able to access these data?*
    c. *How have these data helped you to monitor progress against your expected outcomes? How else have you used these data?*
    d. *May you share your thoughts about the quality of the data being recorded and concerns, if any, about missing data?*
    e. *Can you describe the nature of data you are collecting on resident safety concerns or any oximetry related 'near misses'?*
    f. *Have there been changes to the data you've collected since beginning to use oximetry in your care home? If yes, why were changes made? If no changes have been made, may you explain why?*

13. What data or information, if any, would you have liked to have collected, but couldn't? Why?

14. Can you share any concerns about resident safety and/or near misses that have occurred since you began using oximetry? Please provide examples of instances if possible.

15. Have there been any occasions of residents (or staff?) being unable to take part and/or dropping out? If yes, can you describe such instances and how you addressed them?

16. Have there been any other barriers to implementing pulse oximetry?

17. What impact, if any, has the introduction of oximetry had on the following:
    a. *Residents and carers and the management of their condition*
    b. *Delivery of the service within your own organisation*
    c. *The wider health and care system*

18. What are the lessons learnt from implementing oximetry during the pandemic?
    a. *Benefits of oximetry and areas of good practice*
    b. *Limitations of oximetry*
    c. *Sustainability of oximetry*
    d. *Areas that need to be improved*
    e. *Transferability of oximetry between different conditions?*

19. Has the use of oximetry been adapted from other conditions to be used for Covid-19? If yes how did that work in comparison?
    a. *If not, why?*
    b. *If yes, what have you done differently to manage Covid?*
    c. *What are the factors that act as barriers and facilitators in the implementation of oximetry in managing patients with Covid?*

20. What advice would you give colleagues, similar to yourself, attempting to implement oximetry in other care homes and in other areas of the country?

21. Is there anything else you think we should know that I have not asked you?

Interview topic guide_ Staff delivering care

22. Can we start with a description of your current role?
    a. *Length of time in current role (and involved in using oximetry in your care home)*
    b. *Key responsibilities of current role – (and in relation to oximetry)*
    c. *Are there any other care home staff supporting the monitoring (or any other part of the delivery) of oximetry?*
    d. *Are there any volunteers supporting oximetry? - What organisation are they working for? How did their involvement come about? How has their involvement changed (if at all) during the pandemic (or has it been curtailed)?*

23. For which conditions do you use oximetry with your residents?
    a. *COPD pneumonia; COPD; asthma; emphysema; cystic fibrosis; heart attack/heart failure; anaemia*

24. How would you describe the aims of using oximetry and its main features?
    a. *Characteristics of residents*
    b. *Where is the support for oximetry located e.g. primary, secondary, community care?*
    c. *Are there any other services at community or primary care level for Covid-19 relevant to testing, diagnosis, mental health?*

25. May you describe your experience of using oximetry with residents?
    a. *Referral processes – which residents are you allocated?*
    b. *Using pulse oximeters with residents*
    c. *Any provision of resident information and training – are relatives/family carers/care staff etc involved?*

d. *Resident monitoring (what was monitored and how?)*
e. *Approximately how often are oximetry readings taken by staff?*
f. *Mechanisms used for resident data reporting (i.e. app, paper-based)*
g. *Tools for flagging deterioration*
h. *Escalation processes (including any criteria and thresholds, safety netting)*
i. *When the resident is discharged to the home from hospital*
j. *Signposting to wider services*
k. *Who is involved in any decision to stop using oximetry and who is notified*
l. *What are the criteria used in any decision to stop using oximetry*

26. Can you describe the nature of your engagement with residents that used oximetry?
    a. *Has there been any tailoring of the service to meet specific needs/requirements of certain residents?*
    b. *Do you feel residents received all of the necessary information? Do you feel they understood and retained the information?*
    c. *How did residents engage with oximetry? Did some residents choose not to engage?*
    d. *Did residents appear comfortable/confident in you using the oximeter and recording observations?*
    e. *Did any residents/family members appear anxious/need reassuring at any stage?*
    f. *How would you describe your experience engaging with family members of residents?*

27. Can you share any concerns about resident safety and/or near misses that have occurred since using oximetry? Please provide examples of instances if possible.

28. Describe how you felt when you learned about the use of the [name of remote monitoring platform] to treat residents and your care home's planned use for its implementation?
    a. *Confidence in your own technological/digital literacy/capability*
    b. *Previous experience of using a new technology to manage/care/support residents (e.g tablets video platforms for relatives?)*
    c. *Have their attitudes changed towards the use of digital platforms since using remote home monitoring?*

29. Can you describe the training you have received to deliver oximetry to residents? What further training would you like?
    a. *Familiarity with any oximetry competency framework/any other framework or skills requirement- does this cover all needs?*
    b. *Confidence about delivering oximetry to residents*
    c. *Concerns about the nature of training received (or lack of)*
    d. *Desire for greater oversight*
    e. *Working through patient scenarios with members of the team*

30. What skills, from your usual role, have been useful when delivering oximetry to residents?

31. Describe the experience of working with new and/or existing members of staff either within (or external) to the Home to deliver the model?
    a. *Challenges and tensions (e.g. working remotely, communication with new colleagues etc…)*
    b. *Positives taken from delivering other services in the past*

    c. *Level of comfort with (and satisfaction/enjoyment of) individuals with other skill sets*

32. Can you describe the nature of support and guidance you received (if any) during the set up and delivery of the service from within the Home or from external organisations?
    a. *Support from whom?*
    b. *What type of support received?*
    c. *Accessibility of support*

33. What were your perceptions of using pulse oximetry remotely to manage a patient's health?
    a. *Level of confidence*
    b. *Any tensions/ need for reassurance?*
    c. *Familiarity with digital platforms (or lack of); particularly remote consultations*
    d. *Enhanced communication skills to undertake difficult conversations with health care professionals remotely*

34. What advice would you give colleagues, similar to yourself, attempting to implement oximtery in other areas of the country?

35. Is there anything else you think we should know that I have not asked you?

Appendix VII. Participant Information Sheet

A rapid service evaluation of the implementation and use of pulse oximetry in care homes across England to manage residents with COVID-19

Participant information sheet for staff interviews

What is the study about?

In England, Covid Oximetry @ Home (CO@H, also referred to as 'virtual wards') has been implemented during the COVID-19 pandemic to monitor patients considered high-risk who can be safely be managed at home to: 1) avoid unnecessary hospital admissions (appropriate care at the appropriate place), and 2) escalate cases of deterioration at an earlier stage to avoid ventilation and ICU admission. This rapid national evaluation seeks to capture the experiences of stakeholders implementing and delivering CO@H in care homes.

The study is being undertaken by two national Rapid Evaluation Centres: BRACE (based at the University of Birmingham and RAND Europe) and RSET (based at University College London and the Nuffield Trust). It is funded by the National Institute for Health Research (NIHR), NHS England and NHS Improvement.

You have been sent this information sheet because we are inviting you to take part in a short telephone or video interview with a member of the research team. The interview will take approximately 30-45 minutes, and all information that you provide will be securely stored, treated in confidence and reported anonymously.

Before you decide if you are willing to be interviewed it is important for you to understand why the evaluation is being done and what it will involve.

What is the purpose of this evaluation?

This rapid service evaluation of CO@H in care homes in England will seek to understand the factors influencing the design, implementation and/or delivery of the service from the perspective of key stakeholders. This includes (but not limited to): senior members of care associations, care home managerial and delivery staff and those supporting the implementation in primary, secondary and community care. The data will focus on six sites and we will share our findings with PHE, NHSE&I, participating sites, and across the care home sector.

What will happen if I decide to take part in the interview?

A member of the research team will contact you to arrange a time for the interview. You will be asked to complete and return a consent form in advance of the interview. The interview will be voluntary, conducted over the phone or via video call, and will around 45 minutes. During the interview, we will ask you questions about your experience of delivering or coordinating care through CO@H. We will take notes during the interview and an audio-recording will also be made using a digital voice recorder. Recorded interviews will be transcribed (written up) and the tape will then be wiped clean. All information gathered will be treated as confidential by the study personnel and anonymised for analysis.

How long will the study last?

The total duration of the study will be approximately six months but your involvement will only be for the interview you agree to take part in.

Can I stop being in the study?

You can withdraw from the study up to 14 days after the date that your interview took place. If you decide to withdraw from the study, any data you may have provided will be destroyed following UK Data Protection Act (2018) and General Data Protection Regulation (GDPR) 2018 guidelines.

What risks can I expect from being in the study?

This is a very low risk study. Sites will be anonymised when reporting the study findings, but the information you provide during the interview will remain anonymous. The information obtained from surveys will be stored securely and managed in accordance with the UK Data Protection Act (2018) and General Data Protection Regulation (GDPR) 2018 and in accordance with the University College London, RAND Europe, and University of Birmingham's policies for data storage and management. Identifiable data (your name and contact details) may be stored at the named organisations. All data will be stored on password-protected computers and servers, and will only be accessible to members of the research team. Hard copies of research data will be shredded and electronic data will be destroyed after 20 years. Shredded data will be securely disposed of in confidential waste. We will ensure that any personal information gathered for this research study is kept confidential, unless we learn of serious risk to patients or staff from the information disclosed.

Furthermore, you may find the interview upsetting as you recall uncomfortable and painful events. You are reminded that you can withdraw from the interview at any point.

Are there benefits to taking part in the study?

There will be no direct benefit to you from participating in this study. However, the information that you provide will help inform the development and delivery of Covid Oximetry @ Home and potentially remote home monitoring models for other conditions for care home residents.

What other choices do I have if I do not take part in this study?

You are free to choose not to participate in the study. If you decide not to take part in this study, there will be no penalty to you.

What are the costs of taking part in this study? Will I be paid for taking part in this study?

There are no costs to you for taking part in this study. You will not be paid for taking part in this study.

What are my rights if I take part in this research study?

Taking part in this study is your choice. You may choose either to take part or not to take part in the study. No matter what decision you take, there will be no consequences to you in any way.

Who can answer my questions about the research study?

You can talk to a member of the research team if you have any questions about the study or what taking part would involve. The contact details for the research team can be found below.

Giving consent to participate in the research study

You may keep this information sheet if you wish. We will be using information from you in order to undertake this study and University of Birmingham will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. The University of Birmingham team will keep identifiable information about you for 20 years after the study has finished. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. To

safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information by contacting the study team (contact information can be found at the end of this document).

Who is organising and funding the research study?

The study is carried out by the NIHR Rapid Service Evaluation Team (RSET) based at UCL and the Nuffield Trust and the NIHR BRACE Rapid Evaluation Centre based at University of Birmingham and RAND Europe.

Who has reviewed the research study?

The study has been classified as a service evaluation and approved by the University of Birmingham and University College London Research Ethics Committees (REC) [INSERT REFERENCE NUMBERS].

What will happen to the findings?

The findings will be used to inform future development of COVID Oximetry @ Home and potentially other remote care home monitoring models including the use of oximetry for other conditions.

Will the study findings be shared with those who took part?

The study findings will be made publicly available. Once published, you will be able to access the findings on the BRACE and RSET websites.

"What if there is a problem" or "What happens if something goes wrong?"

If you wish to complain, or have any concerns about any aspect of the way you have been approached or treated by members of staff you may have experienced due to your participation in the research, please contact Dr Manbinder Sidhu, University of Birmingham m.s.sidhu@bham.ac.uk Any complaints raised during this time will be dealt with in accordance with the University of Birmingham Research Practice Guidelines.

CORE RESEARCH TEAM

Co-Principal Investigators:
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THANK YOU FOR TAKING THE TIME TO READ THIS INFORMATION AND FOR CONSIDERING HELPING WITH THE STUDY

Appendix VIII. Consent form

Title of Project: A rapid service evaluation of the implementation and use of pulse oximetry in care homes across England to manage residents with COVID-19

Please initial box

I have read and understand the Participant Information Sheet (v.XX, DATE 2021) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐

I understand that my participation in an interview is voluntary and that I am free to withdraw at any time without giving any reason, without my employment or legal rights being affected. If I want to withdraw my data after this interview, I can do so up to two weeks from the date of this interview. ☐

I understand that information I provide during this interview may be used (anonymised fully) in future publications of this research. The project team will not directly attribute quotes to me by name. A pseudonym will be provided to protect my identity. ☐

I understand an audio recording of the interview will be made and stored anonymously and that these recordings will then be transcribed for the purpose of providing an accurate record of the interview. ☐

I understand that data collected during the study may be looked at by individuals from University College London (UCL), the University of Birmingham, RAND Europe, or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data collected in this study. Data will be treated as strictly confidential and handled in accordance with the data protection legislation (GDPR and DPA 2018). ☐

I agree to take part in the above study. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Researcher	Date	Signature