STUDY PROTOCOL

Study Title: Optimising the feasibility and acceptability of a multi-component, digital health intervention to improve outcomes for people with chronic obstructive pulmonary disease

Short title: EDGE2

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Chief Investigator Signature:

Peter Watkinson is Medical Director of Sensyne Health (formerly Drayson Health) which has sole license to the EDGE platform. Lionel Tarassenko is the Chair of Sensyne Health's Scientific Advisory Board. David Clifton is Research Director of Sensyne Health. Any conflicts of interest which arise will be managed according to the standard University of Oxford rules and protocol.

Confidentiality Statement

This document contains confidential information that must not be disclosed to anyone other than the Sponsor, the Investigator Team, HRA, host organisation, and members of the Research Ethics Committee, unless authorised to do so.

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1. SYNOPSIS

A linkage of in-hospital data with data captured by basic IT systems used for home monitoring of patients with COPD (i.e. tablet computers and monitoring devices). EDGE2 builds upon EDGE[1] and will comprise:

- An exploration of using a tablet computer (the EDGE system) in clinical pathways in patients presenting with a COPD exacerbation/pulmonary infection in the hospital-to-home setting
- The integration of data collected whilst in-hospital (as part of usual care) with data captured via a tablet computer
- Obtaining data to inform the development of predictive algorithms which may provide early responses to changes in clinical condition and potentially avoid hospital admissions.

Study Title	A cohort study of a multi-component digital health intervention to improve outcomes for people with chronic obstructive pulmonary disease	
Short title	EDGE2	
Study Design	Prospective cohort study with long-term mortality/hospital follow-up (5 years)	
Study Participants	**Cohort 1:** Patients aged ≥40 years with a clinical diagnosis of COPD **Cohort 2:** Health professionals involved in delivering respiratory care	
Planned Sample Size	**Cohort 1:** Up to 200 patients (minimum 100), up to 30 of whom will also take part in three interviews **Cohort 2:** Up to 15 health professionals will take part in an interview *please see appendix F for details of socially distanced procedures	
Planned Study Period	May 2019-2027	
	Objectives	**Outcome Measures**
Primary	To determine the feasibility of integrating hospital data with ad-hoc data collected at home.	Obtaining 80-90% of patients in whom data can be obtained and matched from the in-hospital system and the EDGE system. Obtaining 80-90% of patients where there is sufficient data from the different sources to provide

		clinically relevant data for use across the care pathway.
Secondary	**1.** To determine the impact of the intervention. **2.** To link patient data obtained in-hospital and within the community (at home) to inform monitoring and the development of predictive algorithms. **3.** To validate/test physical function performance with monitoring data and assess feasibility of completing the physical function assessment in hospital.	Outcome measures include: • SGRQ-C (respiratory questionnaire for COPD) • EQ-5D (quality of life) • MGL scale (medication adherence) • Smoking status • Number of hospital admissions • Number of ICU admissions • Number of contacts with health professionals (GP, respiratory nurse) • Use of prescribed and over-the-counter medications, using self-report data, prescribing data and (in a sample) medication monitoring devices • Physical function (sit-to-stand test) • Costs of the digital intervention • Patient death • Patient hospital episodes • Process measures: COPD care bundle (including but not restricted to: identify patient access to rescue packs, attendance at smoking cessation sessions and access to a self-management plan)

	4. To determine the acceptability of the EDGE system. **5.** To determine the feasibility of implementing the EDGE system within existing health care practices and systems.	Qualitative interviews

2. ABBREVIATIONS

BRC	Biomedical Research Centre
CI	Chief Investigator
CRF	Case Report Form
CRT	Community Respiratory Team
CTRG	Clinical Trials & Research Governance
GCP	Good Clinical Practice
GP	General Practitioner
HCP	Health Care Professionals
HRA	Health Research Authority
ICF	Informed Consent Form
NHS	National Health Service
NIHR	National Institute for Health Research
PI	Principal Investigator
PIL	Participant/Patient Information Leaflet
R&D	NHS Trust R&D Department
REC	Research Ethics Committee

SD	Socially distanced
SOP	Standard Operating Procedure

3. BACKGROUND AND RATIONALE

New technologies bringing together novel approaches to monitoring, internet-based communication and predictive algorithms offer the potential for major advances in health care delivery. Digital health care, also termed telehealth or m-health, recognizes the potential for addressing problems associated with increasing numbers of people with long-term conditions, a requirement to support people in their own homes, and provide a much greater focus around self-management. New technologies can focus attention on delivery of care at a wider scale and lower cost.

Central to efforts to deliver digital health solutions are systems that obtain and make available data already captured during NHS care. Such systems can inform predictive algorithms to personalize help and advice, and where appropriate, provide alerts to patients and clinicians. Alerts could identify cases where additional assessment is perhaps needed or where treatment could be escalated to help the patient. Better monitoring, by bringing together clinical data from hospital admissions, accessing electronic health record data and capturing home-monitoring data is an ambitious, but deliverable means to identify individuals at risk of condition deterioration.

Building on the NIHR funded SEND project that has created a secondary care environment allowing capture of clinical measurements across the organisation[2], and the EDGE programme that captures data in a home setting[1,3], the NIHR Oxford BRC EDGE2 programme will focus on a cohort of individuals with chronic obstructive pulmonary disease (COPD) following hospital attendance/admission for an exacerbation or pulmonary infection with the aim of improving management of COPD across the hospital-to-community interface. Future potential applications of this system are to reduce readmissions and encourage early treatment of patient deterioration.

Hospital episodes of COPD are well characterized with over 4,000 COPD emergency admissions (many for exacerbations) in the Oxford University Hospitals between January 2013 and April 2017. Of patients admitted, approximately 1 in 4 are re-admitted within 3 months; highlighting that efforts to target the prevention of hospital re-admissions are warranted. Prior to the EDGE project[1], daily community data was not available over longer periods of time. Therefore, bringing the in-hospital and the community data-sets together in this study (EDGE2) will guide assessment of an individual's "usual state" based on prior-data at the point of hospital attendance/admission, during their hospital stay as well as following hospital discharge to inform personalized models to guide care.[4,5] In addition, new monitoring devices will be used with the intention of informing future studies developing enhanced algorithms. The

frequency and specific method with which data will be captured will be counterbalanced to minimise patient intrusion whilst simultaneously maximise measurement precision.

EDGE2 will explore the feasibility of linking data collected during hospital attendance/admission and from the community. To build on EDGE findings, additional monitoring devices will be incorporated into the EDGE platform and qualitative insights will help inform the development of an advanced EDGE platform for future use. How the additional data collected may improve established clinical pathways for COPD management will be considered. The findings of this study will inform subsequent studies looking at producing predictive algorithms to support clinicians (physician-led) and establish the best (most efficient) modes of monitoring clinical state in the COPD population.

Data collection will take the form of in-hospital data, tablet data, monitoring data as well as qualitative investigations (both patients and health professionals involved in delivering respiratory care to capture qualitative insight into tablet use and integration within clinical care). Key deliverables include proof-of-concept for data collection across the in-hospital to community continuum, establish acceptability and feasibility for an extended EDGE system and ultimately capture data that will inform future clinical trials and roll-out of these approaches within digital health care.

4. SOCIALLY DISTANCED STUDY PROCEDURES (2020 PROTOCOL ADDITION)

Due to the COVID-19 global health pandemic there is an on-going need to ensure that research activities can continue with little to no face-to-face contact. People with COPD are a vulnerable cohort that continue to require frequent discussions with and assessment from members of the community respiratory team (CRT). At a time when many patients do not feel comfortable seeing their care-team face-to-face, EDGE2 presents a unique opportunity for the Oxford Respiratory health team to be able to remotely monitor their patients in addition to allowing the study objectives to be delivered. The EDGE system was developed with eventual deployment into a care pathway in mind, but the current research protocol designed pre-COVID includes a number of procedures that, whilst addressing secondary aims, render the study as currently designed impossible to deliver at a time when social distancing and rigorous infection control must be maintained. The procedures presented in Appendix F: Socially Distanced Study Procedures, serve to adapt the study design to avoid face-to-face contact whilst also making the system practical for use by the CRT to monitor their patients. These adaptations, including the increased duration of follow up, will allow the research to recommence safely and collect study data whilst also supporting the delivery of patient care.

Where relevant procedural changes may be in effect thus resulting in a change to the protocol outlined below, these areas will be marked with a reference to the applicable section of Appendix F.

5. OBJECTIVES AND OUTCOME MEASURES

Objectives	Outcome Measures	Time points of the outcome measures
Primary To determine the feasibility of integrating hospital data with ad-hoc data collected at home	Obtaining 80-90% of patients in whom data can be obtained and matched from the in-hospital system and the EDGE-2 platform. Obtaining 80-90% of patients where there is sufficient data to provide clinically relevant data for use across the care pathway.	Initiation of data linkage will take place upon provision of consent. In-hospital data will be retrieved from point of hospital attendance/admission to the point of hospital discharge.
Secondary **1.** To determine the impact of the intervention. **2.** To link patient data obtained in-hospital and within the community (at home) to inform monitoring and the development of predictive algorithms. **3.** To validate/test physical function performance with monitoring data and assess feasibility of completing the physical function assessment in hospital.	• SGRQ-C (respiratory questionnaire for COPD) • EQ-5D (quality of life) • MGL scale (medication adherence) • Smoking status • Number of hospital admissions • Number of ICU admissions • Number of contacts with health professionals (GP, respiratory nurse) • Use of medications, prescribed and un-prescribed via self-report, prescribing data and (in a sample) medication monitoring devices • Physical function (sit-to-stand test) • Costs of the digital intervention	These outcome measures will be captured at baseline and ~52 weeks; apart from: **Physical function assessment**[1]: This will be completed at baseline (either during hospital admission (if feasible) or at recruitment home visit, within ~6 weeks of discharge), plus within ~4 weeks (if recruited in hospital), ~12 weeks, ~24 weeks, and ~52 weeks from the date of consent.

[1] Physical function assessments will not be completed if socially distanced procedures are in effect. Please see Appendix F for details.

	• Patient death • Patient hospital episodes Process measures: • COPD care bundle (including but not restricted to: access to rescue packs, attendance at smoking cessation sessions, access to a self-management plan)	**Death**: This will be identified at ~4 weeks, ~12 weeks, ~24 weeks, and 52 weeks after the date of consent and up until 5 years after the date of consent from the Office of National Statistics (directly obtained via NHS Digital). **Hospital episodes**: This will be identified up until 5 years after the date of consent from Hospital Episodes Statistics (directly obtained via NHS Digital).
4. To determine the acceptability of the EDGE system. **5.** To determine the feasibility of implementing the EDGE system within existing health care practices and systems.	Qualitative interviews	**Qualitative interviews with patients[2]:** Three interviews will be conducted with up to 30 participants after discharge. This will take place either within ~4 weeks (if patient consented in hospital) or within ~6 weeks (if patient agrees to give

[2] Where socially distanced procedures are in effect timepoints and method of contact will be altered accordingly. Please see Appendix F for details.

		consent after discharge), between ~26 and ~34 weeks, and at ~52 weeks after discharge (or earlier in the event the participant declares their intention to withdraw). Interviews either take place during a visit by the clinical research team or in a separate visit as soon as possible around this. Withdrawal interviews may also be conducted with participants who decide to withdraw from the study and are not taking part in the interviews previously mentioned. **Qualitative interviews with health professionals**: These will be conducted at a time and place convenient to healthcare staff.

6. STUDY DESIGN

EDGE2 is a 12-month cohort study and has an overarching aim to establish a model for a clinical system that can be integrated into current patterns of clinical care. The data collection procedures will capture valuable data to inform future studies that aim to identify (support a response to) early changes in

clinical condition e.g. possible patient deterioration. Looking ahead, this could help de-risk self-management by patients accessing monitoring tools at home to gain a greater awareness of their condition (which may reduce the chance of hospital re-admission). EDGE2 will explore proof-of-principle for combining hospital and community data. A flow chart for the study design is provided in Appendix A.

Up to 200 patients diagnosed with COPD will be recruited after presenting with a COPD exacerbation or pulmonary infection.

Baseline assessment:

Briefly, patients will be asked to complete several questionnaires as well as complete a physical function assessment[3] (sit-to-stand test, if the participant is physically capable), either whilst they are still in hospital or after discharge by a member of the clinical research team. Further details are provided in **Section 8.4** and enclosed with this application is a copy of the baseline questionnaire.

In-hospital data:

In-hospital data will come from the databases of the Oxford University Hospitals Clinical Information Systems, which are used for routine patient care and clinical governance (see Appendix B). Hospital data will only be obtained for patients taking part in EDGE2 who will have provided consent for the researchers to access this data.

Intervention:

Briefly, patients will take part in the intervention until ~52 weeks from the date of hospital discharge (or date of consent if recruited using SD procedures. Please see Appendix F for more details). The intervention will consist of a tablet computer and monitoring devices to capture oxygen saturation, physical activity and medication. As part of the EDGE self-management approach, the tablet computer will ask patients to answer details about their clinical condition whilst in hospital and following discharge (in the event a patient provides consent to take part after discharge, they will only be asked to answer the questions from this point forward). Members of the research team may telephone participants for study-related reasons during the 12 months. Up to 20 patients will also take part in two interviews; the first at the 4 week contact, if consented in hospital or, if consented after discharge, at the consenting visit (within ~6 weeks after discharge). A subset of a further 10 patients will also be interviewed at ~18 and ~32 weeks. The final interview will take place at the 12-month follow up contact (or earlier in the event of withdrawal) for all participants. If it is not possible or appropriate to conduct the interview during a scheduled home visit by the clinical research team, a separate visit will be made to the

[3] Physical function assessments will not be completed if socially distanced procedures are in effect. Please see Appendix F for details.

participant for the purpose of conducting an interview[4]. Participants who are not taking part in these interviews may be interviewed briefly in the event they withdraw, to find out reasons for doing so. Further details are provided in **Section 8.5**.

Follow-up assessments:

Briefly, the clinical research team will contact patients whilst taking part in the study to check how they are getting on, ask patients to complete questionnaires as well as ask the patients to complete a physical function assessment (sit-to-stand test)[5]. Members of the research team may telephone participants for study-related reasons in between these visits/contacts. Further details are provided in **Section 8.5.1** and enclosed with this application is a copy of the follow up questionnaire to be completed at ~52 weeks.

Other important aspects:

Data recorded by the monitoring devices will be regularly uploaded (e.g. daily or weekly) to the tablet computer via Bluetooth. The clinical research team will monitor data collected by the tablet computer at regular intervals to ensure data from the questionnaires/monitoring devices is logged as expected. If data transfer does not happen as intended or the data that is transferred suggests a lack of use, a member of the research team will telephone the patient to prompt data transfer or encourage wear (as appropriate). If the issue cannot be resolved over the telephone, an additional visit may be made to the participant to attempt to resolve it. The data will be reviewed by the research team at weekly intervals to ensure data is being transmitted and to review the data received in relation to the data from the oxygen saturation, symptom diary and mood diary modules. Safety alerts will be specified to ensure that major changes in health status are verified with a participant and communicated to an appropriate clinician.

The CRT will have access to the data recorded by the EDGE app and will regularly review the data and will be able to use the data to better inform the management of their patients who are also participants. The CRT may refer any concerns regarding data collection to a member of the research team or may contact the patient directly.

Weather and pollution data will also be collected so these conditions can be accounted for within the analyses. Weather and pollution data will be obtained for the geographical area aligning with the postcode provided by patients at baseline.

Patients' mortality status and hospital episode statistics (including hospital admissions, A&E attendances and outpatient appointments) will be recorded up until 5 years following date of consent. This data will

[4] All interviews will be conducted by phone or video call if socially distanced procedures are in effect. Please see Appendix F for details.
[5] Physical function assessments will not be completed if socially distanced procedures are in effect. Please see Appendix F for details.

be accessed directly from NHS Digital. Note: NHS Digital retrieve the data from the Office for National Statistics and Hospital Episodes Statistics for mortality and hospital episodes, respectively.

Interviews with patients and health professionals:
Interviews will be conducted with up to 30 patients and 15 health professionals. Further details are provided in **Section 8.5.1** and **Section 8.6** and proposed patient/health professional topic guides are enclosed with this application. Alternative socially distanced procedures are outlined in appendix F.

7. PARTICIPANT IDENTIFICATION

7.1. PARTICIPANTS

7.1.1. COHORT 1 (PATIENTS)

Study participants will be patients aged ≥40 years with a clinical diagnosis of chronic obstructive pulmonary disease (COPD) who has had an acute hospital attendance/admission for an exacerbation or pulmonary infection in the last 3 months.

7.1.2. COHORT 2 (HEALTH PROFESSIONALS)

Study participants will be health professionals who are involved in delivering respiratory care in the primary care, secondary care or community setting.

7.2. INCLUSION CRITERIA

7.2.1. COHORT 1 (PATIENTS)

- Patient is willing and able to give informed consent
- Aged 40 years or older
- A clinical diagnosis of chronic obstructive pulmonary disease recorded in their medical history
- Current or ex-smoker
- Acute hospital attendance/admission for an exacerbation of chronic obstructive pulmonary disease or pulmonary infection in the last 3 months
- Able to complete questionnaires (electronic or paper) and use the tablet computer
- Post-discharge destination not a medical facility or prison
- Lives in Oxfordshire or surrounding counties
- Able to adequately understand verbal and written English.

7.2.2. COHORT 2 (HEALTH PROFESSIONALS)

- Participant is willing and able to give informed consent
- Involved in delivering respiratory care in the primary care, secondary care or community setting
- Able to adequately understand verbal and written English.

7.3. EXCLUSION CRITERIA

7.3.1. COHORT 1 (PATIENTS)

The participant may not enter the study if ANY of the following apply:

- Present another significant lung disease e.g. lung cancer or cystic fibrosis
- Present with chronic heart failure defined by the New York Heart Association classification system as severe (Grade IV)
- A life expectancy of less than twelve months or on a palliative pathway.

8. STUDY PROCEDURES

See Appendices C, D and E for study flow diagram and matrices of procedures and measures.

NOTE: SOCIALLY DISTANCED PROCEDURES

Due to pandemic restrictions study procedures may differ from the processes given below. Please see Appendix F for full socially distanced procedure details.

8.1. RECRUITMENT

8.1.1. COHORT 1 (PATIENTS)

Clinical staff will use routinely collected hospital data to identify patients who meet the eligibility criteria.

Upon identifying a potentially eligible patient, the clinical research staff will approach potential participants with verbal information about the study whilst they are in hospital. If potential participants are interested in finding out more information, written information (patient information leaflets) will be provided. The patient information leaflet provided to potential participants will detail: the exact nature of the study; what it will involve for the patient; and the implications and constraints of the protocol. This information leaflet will not assume any prior knowledge of COPD, exacerbations/infections or use of monitoring devices (e.g. pulse oximeter). All individuals expressing an interest in participating will be given the opportunity to ask any questions they may have. Following receipt of the patient information leaflet and an explanation of the study, potential participants will be asked if they would like to consider

taking part. Where patients wish to consider further, they will be re-visited later that day or on another day. In the event a patient expresses an interest in taking part in the study, a member of the clinical research team will conduct an eligibility assessment.

8.1.2. COHORT 2 (HEALTH PROFESSIONALS)

Healthcare professionals involved in the care of patients with COPD or a pulmonary infection will be identified by members of the EDGE2 study team and through qualitative work with EDGE2 patient participants. They will be approached to take part in an interview. Individuals will be provided with an information leaflet and invited to ask any questions. Potential participants will be given appropriate time to consider whether they wish to take part or not. The research team will take an iterative but sensitive approach to the recruitment and management of these interviews. It is important to gather the views of a range of healthcare professionals while remaining mindful of the potential burden of taking part in our qualitative work.

8.2. SCREENING AND ELIGIBILITY ASSESSMENT

8.2.1. COHORT 1 (PATIENTS)

Patient screening and eligibility assessment will take place whilst the patient is at the hospital. Patients will be initially screened by the in-hospital clinical team or the clinical research team by filtering patient identifiable data. The clinical research team will subsequently assess the patient for eligibility if they have expressed an interest in taking part. All potential participants expressing an interest in taking part will have an eligibility assessment before providing consent. In the event that patients are involved in other studies, we will enrol these patients if it is judged that burden from participation is not greater than they will be able to cope with.

8.2.2. COHORT 2 (HEALTH PROFESSIONALS)

The clinical research team or qualitative researcher will initially approach the health professionals. Potential participants expressing an interest in taking part in the qualitative work will be screened by either the clinical research team or the qualitative researcher to determine eligibility.

8.3. INFORMED CONSENT

8.3.1. COHORT 1 (PATIENTS)

The clinical research staff will visit interested patients whilst they are in hospital to confirm eligibility. If the patient is interested in providing consent to take part and to complete the baseline assessment whilst in-hospital, written consent will be obtained. If the patient is interested in taking part but not whilst in-hospital, written consent-to-contact the patient after discharge will be obtained. For this latter

group of patients, patients will be asked whether they are still interested in taking part. If they are, a home visit will be arranged as soon as the potential participant feels well enough to undertake the visit, but within ~6 weeks of discharge, where written consent to take part in the study will be obtained by a member of the research team. Informed consent will be sought to approach patients for participation in the interview study (brief overview is provided in the main participant information leaflet). Informed consent will be completed electronically or via pen and paper. Consent procedures will include a dated signature. Consent must be obtained before any study procedures commence. A copy of the signed informed consent form will be shared with patients, a copy kept in their medical records (if consented in hospital) and the original kept with study documentation.

We will ensure patients have sufficient time to consider taking part in the study. In line with other studies aiming to recruit people with COPD during a hospital stay, there is a limited opportunity for approaching people from when their condition improves to discharge. We will therefore provide information about the study, discuss and obtain consent to take part or consent-to-contact after discharge (if the potential participant is willing) at the same visit. We will ensure that the participant is fully aware that they may withdraw if they subsequently change their mind.

In the event the patient has not read the information, does not have an adequate understanding of the study or would like more time to decide, additional time will be provided to ensure informed consent/consent-to-contact can be obtained. Potential participants will be allowed as much time as wished to consider the information, and the opportunity to question the Investigator or other independent parties to decide whether they will take part in the study. Informed consent will be obtained from all patients participating in the study and patients will not be included in the study if they are incapable of providing (or are unwilling to provide) informed consent.

It will be explained as well as clearly stated in the patient information leaflet and consent form that the patient is free to withdraw from the study at any time for any reason without prejudice to future care, without affecting their legal rights, and with no obligation to give their reasons for withdrawal. Should there be any subsequent amendment to the final protocol, which might affect a patient's participation in the study, continuing consent will be obtained using an amended Consent Form which will be signed by the patient.

8.3.2. COHORT 2 (HEALTH PROFESSIONALS)

Participants will be asked to complete a consent form. It will be verbally explained, and clearly stated in the participant information leaflet and consent form, that the interview discussion will be audio recorded. In addition, participants will be reminded that they are free to withdraw from the study at any time for any reason and with no obligation to give their reasons for withdrawal. Any data they have

provided up until that time may be included in the final dataset. Participants will be informed that the audio file will be de-identified at the point of transcription.

8.4. BASELINE ASSESSMENTS FOR COHORT 1 (PATIENTS)

At the baseline visit, patients will be asked to complete several questionnaires and a physical function assessment (if feasible to do so), each of which are described below. For the purposes of clarity, baseline assessments will be conducted at the time of the recruitment visit which may be before discharge or within ~6 weeks after discharge. The assessments in hospital may be done in a separate visit if the patient is not feeling well enough, or it is inappropriate timing, to complete the questionnaire or physical function assessment immediately after consent.

Questionnaires: The Medical Research Council Dyspnoea (level of breathlessness) scale[6], the EQ-5D-5L (generic health status questionnaire)[7], St George's Respiratory Questionnaire-COPD (SGRQ-C),[8] and Morisky Green Levine scale (MGL scale)[9] will be completed. In addition, questions relating to demographics (including: age and sex), smoking status, previous hospital/ICU admissions as well as previous contacts with healthcare professionals and medication/oxygen use. These will take approximately 20 minutes to complete.

Physical measures: A physical function assessment will be carried out by the patient in the presence of the research nurse (only if it is deemed feasible and appropriate to do so). If it is feasible to do so, patients will be asked to complete a sit-to-stand (STS) test.[12,13]

The STS test involves patients standing up and sitting down repeatedly from a chair for approximately 1 minute. Patients will be asked to complete the sit-to-stand transitions without using their arms for support but will be allowed to stop and rest during the test as much as they need to (but the timer will continue to run). During this assessment, patients will be asked to wear monitoring devices to monitor heart rate, oxygen saturation and steps. The physical function assessment will take approximately 15 minutes to complete (including rest pre- and post-test as well as provision of instructions).

If they have not already done so (i.e. when completing the consent-to-contact form) the clinical research team will also collect patients' contact details (i.e. home address, telephone numbers and GP name/surgery postal address) so they are able to contact them during the study period. The clinical researchers will also access the patients' hospital records to identify past hospital/ICU attendances and admissions. Patients will also receive a tablet computer, the monitoring devices and respective chargers.

8.5. INTERVENTION

Patients who consent to take part in the study will be provided with a tablet computer during their hospital stay or at a home visit after discharge (depending on when consent to take part is obtained). The tablet computer will run the EDGE mHealth application[1]. Patients will also be provided with monitoring devices (e.g. Nokia/Withings Go and Nonin) to capture oxygen saturation, heart rate and physical activity (movement). Minor changes will be made to the existing EDGE system so that it communicates with the monitors and offers up-to-date information to patients. The monitoring devices will be commercially available, CE marked and will be used in accordance with intended usage as specified by the manufacturers. They will collect data and transfer this to the tablet via Bluetooth at regular intervals (e.g. daily). A member of the research team will telephone participants in the event any technical or well-being concerns are raised, whilst monitoring the incoming data. These telephone calls will likely be sporadic and brief. For instance, if data transfer does not happen as intended or the data that is transferred suggests a lack of use, a member of the research team will reach out to the patient to prompt data transfer or encourage wear (as appropriate). If any technical concerns cannot be resolved over the telephone, additional visits may be made to participants to attempt to resolve the issue in-person.

Patients will be shown how to use the tablet computer and monitors upon entry into the study, either in hospital or after discharge. They will also be provided with a manual providing brief, clear and concise instructions about the mHealth application and tablet computer (see enclosed patient monitor manual). This manual will also include contact details for the clinical research team in the event technical or other relevant queries arise.

Patients will use the tablet computer to provide details about their clinical condition (i.e. COPD symptoms) as soon as they would like to once they have received the system. Patients will also be encouraged to wear a wrist-worn physical activity monitor to collect a profile of their physical activity. To monitor oxygen saturation and heart rate, patients will be asked to wear the pulse oximeter every day for a brief period after completing the COPD symptom diary on the tablet computer. Instructions on how to wear the pulse oximeter will be available to patients on the tablet computer.

Patients may use the tablet computer as frequently/infrequently as they would like to as we are interested in their level of acceptability of this technology whilst at hospital (if applicable) and at home. However, we will ask patients to complete a daily COPD symptom diary (as used in EDGE[1]). This will include answering questions about their chest, feelings of breathlessness, phlegm production as well as inhaler/oxygen use. The other questionnaire already housed on the EDGE tablet computer is for emotional wellbeing (mood) which patients will be asked to complete every 4 weeks. The mood questionnaire will involve 4 items (the Patient Health Questionnaire two-item measure PHQ-2 and the General Anxiety Disorder two-item measure GAD-2).[14] If either the depression (GAD-2) or anxiety score

(PHQ-2) is >1 then the relevant full questionnaire i.e. PHQ-8 (which does not include a question on self-harm)[15] and/or GAD-7[16] will be presented for completion. This pathway is based on NICE Guidance.[17]

All questionnaires will be clearly accessible via the tablet computer and will involve patients responding to multiple choice questions. Patients will be asked to charge the tablet and monitoring devices as and when required using cables or batteries provided by the clinical research team.

The tablet computer, in addition to acting as a means of eliciting questionnaire and monitoring data, will also offer access to videos (e.g. to demonstrate appropriate inhaler technique) and other educational information about COPD as well as prompts and reminders about self-care.

The tablet computers and monitors will be returned to the clinical research team ~52 weeks after discharge or consent (if consent was given after discharge) or earlier in the event of withdrawal.

8.6. SUBSEQUENT CONTACTS FOR COHORT 1 (PATIENTS)

NOTE: SOCIALLY DISTANCED PROCEDURES

Due to pandemic restrictions study procedures may differ from the processes given below. Please see Appendix F for full socially distanced procedure details.

Telephone call within 10 working days of discharge

All patients will receive a telephone call within 10 working days of discharge, regardless of whether they provide consent to take part in hospital or consent to be contacted after discharge.

For those who give consent to take part in hospital, the clinical research team will use this telephone call to check how the participant has been getting on, and to schedule the next contact (within ~4 weeks after discharge). If the participant has indicated on their consent form that they may be willing to be interviewed they will be asked whether they are still interested, and if they are, this will be arranged during this phone call.

For patients who give consent to contact after discharge, the clinical research team will use this telephone call to check if the patient is still interested in taking part. If they are, the clinical research team will schedule the next contact within ~6 weeks after discharge, at their home. During this call the patient may be asked whether they would be interested in taking part in qualitative interviews. If they express interest they will be offered the interview at the time of their first home visit or in a separate subsequent contact. This is to avoid over-burdening the participant during the initial visit.

First home visit within 4-6 weeks after date of discharge

This will be scheduled to happen as close to the day as intended but they will be scheduled to fit in with patients' availability.

Within ~4 weeks: For participants who have already given consent to take part by this point, the clinical research team will check how the participant is getting on, answer any queries that the participants might have, ask participants to answer questions (including about their COPD care bundle) and to complete a physical function assessment (sit-to-stand test). If a participant is not able to complete a physical assessment then the contact may instead be made by telephone.

Within ~6 weeks: For patients who have expressed a continued interest in taking part, this contact will involve obtaining consent and completing the baseline assessment (described in **Section 7.4**).

Home visit ~12 weeks after date of discharge

This visit will last up to 75 minutes. This will be scheduled to happen as close to the day as intended but will be scheduled to fit in with participants' availability. This contact will be scheduled by the clinical research team. A member of the research team may telephone a participant ahead of the contact to confirm the day/time is still convenient. The clinical research team will check how the participant is getting on, answer any queries that the participant might have, ask the participant to answer questions and to complete a physical function assessment (sit-to-stand test). If a participant is not able to complete a physical assessment then the contact may instead be made by telephone.

Home visit ~24 weeks after date of discharge

This visit will last up to 75 minutes. This will be scheduled to happen as close to the day as intended but will be scheduled to fit in with participants' availability. This contact will be scheduled by the clinical research team. A member of the research team may telephone a participant ahead of the contact to confirm the day/time is still convenient. The clinical research team will check how the participant is getting on, answer any queries that the participant might have, ask the participant to answer questions (including the follow up questionnaire) and to complete a physical function assessment (sit-to-stand test). After the intervention period participants will be asked to return the tablet computer and monitors to the clinical research team. If it is not in-person, patients will be asked to return these items via post (packaging will be provided by the clinical research team).

Interviews with participants at the first home visit (within ~4 or ~6 weeks of discharge) and last home visit (~24 weeks after discharge)

Up to 20 participants will be invited to take part in interviews which are anticipated to last 45 to 60 minutes to explore their contextualised use of the tablet computer whilst at hospital and at home. A further 10 participants will also be interviewed at ~18 and ~32 weeks. Participants will be purposively sampled to gather the views of a range of people. Participants will be visited by a qualitative researcher twice over the course of the study. Firstly, during the within ~4–week home visit if they consented to take part in the study in hospital, or at the time of their first home visit (within ~6 weeks post discharge) if they consented to take in the study part post-discharge. If this cannot be arranged or it is deemed to be inappropriate (e.g. too much for the participant to do in a single visit), a separate visit will be made to conduct the interview with the participant. All interview participants will have a final interview at the ~52-week contact. Again, if this cannot be arranged or is deemed inappropriate a separate visit made be arranged. A separate consent form will be completed by patients wishing to take part prior to starting the first interview. The contextual interviews will be guided by a topic guide which will focus on experiences, usage and acceptability of the technology and this topic guide will develop over time. The guide will be flexible to allow the research team to explore issues identified by patients, as well as explore new themes that emerge during data analysis.

Ad-hoc study-related telephone calls or home visits

A member of the research team will regularly monitor incoming data entered by participants. In the event the data is not being received as anticipated or another technical concern arises (such as a concern the batteries in pulse oximeter need changing), a member of the research team will contact the participant to discuss this and try to resolve the situation over the telephone. If it cannot be resolved by telephone, a home visit may be arranged and completed by a member of the research team. Participants may also be contacted concerning the data they are returning should the data suggest their condition may be of clinical concern (see Section 5.0 for details). In the event a member of the CRT is reviewing the data and identifies a need to contact a participant they may either contact the participant directly or liaise with a member of the research team who will then make contact.

Withdrawal interviews

If a participant has consented to be approached to take part in the qualitative element to EDGE2 and decides to withdraw, the participant will be asked if they are happy to complete a withdrawal interview around the point of withdrawal. Participants may end up having the second interview sooner than the final visit in the event they decide to withdraw from the study (in-person or by telephone). Participants not taking part in the interviews but who did provide consent to be approached about the interviews may be invited to take part in a withdrawal interview (by telephone).

Collection of mortality/hospital episode statistics data

Up until 5 years following the date of consent, patients' mortality status (date and cause of death will be collected, if applicable) and hospital episode statistics (including hospital admissions, A&E attendances, and outpatient appointments) will be obtained via NHS Digital's Data Access Request Service. Note: NHS Digital access this data via the Office of National Statistics and Hospital Episode Statistics but the researchers obtain this data directly from NHS Digital. This will not involve any direct interaction with the patients. An application and data sharing agreement will be in place with NHS Digital to ensure the secure transfer for this data. All patients consenting to take part in EDGE2 will consent to the researchers accessing this information from NHS Digital.

8.7. PROCEDURES FOR COHORT 2 (HEALTH PROFESSIONALS)[6]

Interviews with up to 15 health professionals will each last 30 minutes. Topic guides will focus on understanding perceptions of the EDGE system e.g. usability and level of integration within existing clinical pathways.

9. DISCONTINUATION/WITHDRAWAL OF PARTICIPANTS FROM STUDY

9.1. COHORT 1 (PATIENTS)

It will be verbally explained, as well as clearly stated in the patient information leaflet, that participants are free to withdraw from the study at any time for any reason without prejudice to future care, without affecting their legal rights, and with no obligation to give their reasons for withdrawal.

Given the relative complexity of the study design, there are several options of 'withdrawal' for patients upon expressing notice of withdrawal. These are as follows:

1. Discontinue use of the tablet computer, no subsequent study contacts, and permission to continue to access medical records and monitor mortality/hospital episodes.

2. No further contact from the study (discontinue use of tablet computer and no subsequent study contacts), no new data can be extracted from medical records, but existing data can continue to be processed. Permission to continue to monitor mortality/hospital episodes.

3. No further contact from the study (discontinue use of tablet computer and no subsequent study contacts), no new data can be extracted from medical records and all existing data (where possible to identify the patient's record) will be destroyed. Monitoring mortality/hospital episodes is not permitted.

[6] Where socially distanced procedures are in effect interview formats may differ. Please see appendix F for more details.

If a participant gives consent to be approached about taking part in the interviews, and subsequently is selected to take part in the interviews, they will be asked to take part in a withdrawal interview in the event they decide to withdraw at any point after their first interview (either in-person or by telephone). Similarly, if a participant gives consent to be approached about taking part in the interviews, and subsequently is not selected to take part in the interviews, they will be asked to take part in a withdrawal interview in the event they decide to withdraw before the ~52 week follow up contact (by telephone).

9.2. COHORT 2 (HEALTH PROFESSIONALS)

It will be verbally explained, as well as clearly stated in the participant information leaflet, that participants are free to withdraw from the study at any time for any reason. Health professionals wishing to withdraw from the study may do so before or during the interview. It will be explained when consent is taken that should they wish to withdraw after the interview has taken place it may not be possible to delete the data they have provided because the audio-file transcripts will be de-identified.

10. DEFINITION OF END OF STUDY

The end of study is the point at which all the data has been entered and queries resolved after the 5 year follow up period.

11. PATIENT AND DATA SAFETY

11.1. POTENTIAL RISKS AND BURDENS TO PARTICIPANTS

It is unlikely that the use of the tablet computer will lead to any harm. However, we will monitor the system and identify any unanticipated safety issues. In addition to using the tablet computer, participants will have multiple research contacts; contacted within 10 working days of discharge and within ~4-6 weeks, and after ~12, ~24 and ~52 weeks following the date of consent.

It is anticipated that by monitoring their COPD symptoms (e.g. cough and phlegm) more closely, patients may feel more anxious about their condition. Educational components contained within the tablet computer will be incorporated to assist in COPD self-management. In addition, patients will have access to the clinical research team whilst taking part.

Taking part in an interview may lead to patients talking about sensitive or upsetting issues. Although this research does not focus on a sensitive topic, some patients may experience emotional distress. If this does occur, the researcher will allow the patient to recover and then proceed when the participant is willing and able to. The researcher would also encourage the patient to inform their carer and/or healthcare professional, if this is appropriate. As the research involves patients living with a respiratory

condition, patients may experience breathlessness when talking for long periods. If this situation arises, the researcher will allow the patient time to recover their breathing and only continue if/when the patient feels able to. The researcher will also encourage the patient to contact their respiratory nurse if their breathlessness is worse than normal.

It will be explained before the start of the interview that everything said during the meeting will remain confidential and will not be disclosed beyond the research team unless there is an over-riding legal or public interest in disclosure to an appropriate authority, for example a safeguarding duty.

Members of the non-clinical research team at the University of Oxford will liaise directly with NHS Digital to obtain data pertaining to patient mortality (e.g. date and cause of; originally noted by the Office of National Statistics or 'ONS') and hospital episode statistics (e.g. hospital admissions, A&E attendances and outpatient appointments; originally noted by the Hospital Episodes Statistics or 'HES') over 5 years following date of discharge from hospital. This will only be conducted for patients who have consented to take part in EDGE2. NHS Digital will request minimal information (e.g. NHS identifier and date of birth) to extract relevant data.

Amalgamation of datasets is classified as ‘high risk’ by the Information Commissioners Office because a breach in data security could result in exposure of an increased amount of personal data than a single dataset. To minimise risk only data that is required to answer the research objectives will be collected and risk will be sufficiently mitigated through using a study ID number to anonymise the incoming data. In accordance with information governance policy, datasets will be securely stored on a server behind the NHS firewall and/or on a restricted local sever managed by the University of Oxford. All data will only be accessible to authorised members of the study team. Patient identifiers will never be stored with any study data and any published/reported results will be entirely anonymous.

12. STATISTICS AND ANALYSIS

12.1. DESCRIPTION OF STATISTICAL METHODS FOR OUTCOME MEASURES

A combination of quantitative and qualitative data analysis will be conducted.

12.1.1. QUANTITATIVE DATA ANALYSIS

Descriptive statistics will be used to summarise the baseline characteristics of patients. The primary outcome will involve descriptive statistics in the form of frequency, spread of data (mean and standard deviation or median and interquartile range), proportion (%) and/or range of values (confidence intervals). It will also involve exploratory analysis to look at the number of days data was received compared with the expected number.

Statistical methods to analyse the data will include repeated measures analysis of (co)variance and linear regression for continuous variables. Effects will be assessed by analysis of sub-groups defined by smoking status, hospital admission history, COPD severity (e.g. FEV_1). Covariates will include weather conditions (e.g. temperature) and patient demographics (e.g. age or sex). Further additional exploratory analysis will look at number of days of tablet exposure (and use) whilst at hospital, the number of days data was received from the tablet compared with the expected number, as well as general tablet computer use.

Additional exploratory use of data: We will add in iterations of predictive algorithms to the system used in EDGE2, record the findings, and then analyse their performance in samples.

12.1.2. QUALITATIVE DATA ANALYSIS

The interview data with patients and health professionals will be audio-recorded, transcribed and analysed using a reflexive thematic analysis approach. Transcription will be completed by an experienced transcriber, with any personally identifiable information removed and replaced. This data will be imported into software (such as NVivo12) to facilitate storage, organisation and analysis.

12.2. THE NUMBER OF PARTICIPANTS

No sample size calculation has been completed for this cohort study because the primary outcome is to determine the feasibility of integrating hospital data with ad-hoc data collected at home. Up to 200 patients (100 as a minimum) has been drawn up as a target sample size so we can recruit a sizeable sample of patients which will allow the researchers to identify how data linkage fares between patients.

It is anticipated that up to 30 patients living with COPD will take part in interviews and up to 15 health professionals will participate in interviews.

13. DATA MANAGEMENT

13.1. SOURCE DATA

Source data will be supplied directly by patients for several Case Report Forms (CRFs), including but not limited to the baseline questionnaire, follow up questionnaire and patient contact details form. Alongside this, source documents (including but not limited to secondary care records/notes and NHS Digital datasets) will be used to obtain relevant data (e.g. admissions to hospital and mortality) to complete the other CRFs (e.g. hospital record extraction form). Data will also be supplied by digital devices (including the wrist-worn activity monitor and pulse oximeter) worn/used by the participants. All data and associated documents will be stored according to information governance guidelines.

13.2. ACCESS TO DATA

Direct access will be granted to authorised representatives from the Sponsor and host institution for monitoring and/or audit of the study to ensure compliance with regulations. Access to the data collected from participants via the tablet computer will be given to CI-approved members of the CRT holding a contract with Oxford University Hospitals NHS Trust, to provide greater insight into their patient's health over time. This may be beneficial during the remote management of CRT patients.

13.3. DATA RECORDING AND RECORD KEEPING

Each participant will be assigned a study identity code number for use on CRFs, other study documents and electronic databases. CRFs in a physical form will be treated as confidential documents and held in a secure location (locked cabinet/draw in a secure authorised-personnel only building) and only accessible by research personnel in accordance with regulation. CRFs in an electronic form will be treated as confidential documents and held securely on password protected University or NHS computers. Upon entry into the CRF, data will be manually entered into the trial database and exported for analysis. CRFs will be restricted to personnel approved by the Chief Investigator and recorded on the delegation of duties log in the trial master file.

The investigator will ensure the creation of a separate confidential record of patients' identifiable information (e.g. names, dates of birth and local hospital number or NHS number) to allow identification of participants enrolled in the study, in accordance with regulatory requirements and for follow-up (as necessary). Inherently identifiable data (e.g. consent forms and transfer forms) will be held separately from de-identified data.

All qualitative data will be stored securely on a password protected University computer, separately from the quantitative trial database. Audio recordings from the interviews will be shared electronically (via a password protected, secure website) to transcribe the files verbatim. Transcripts will be sent from the transcriber directly to the researcher electronically. Audio recordings will be deleted by the transcriber as soon as they have completed transcription of each file. The research team will keep an electronic copy of the audio recordings until all transcription, data collection and analysis are complete. Analysis of the qualitative data will make use of coded names where the name of the individual taking part in the interview is mentioned.

Mortality (cause and date of) and hospital episode statistics obtained via NHS Digital will be kept on University of Oxford servers.

The Chief Investigator will maintain all records and documents regarding the conduct of the study. These will be retained for 20 years or for longer, as required. If the responsible investigator is no longer able to maintain the study records, a second person shall be nominated who will take over this responsibility.

The trial master file and study documents held by the Chief Investigator shall be securely archived at secure archive facilities at the University of Oxford. This archive shall include all study databases and associated encryption codes (as appropriate).

14. QUALITY ASSURANCE PROCEDURES

The study may be monitored, or audited in accordance with the current approved protocol, GCP, relevant regulations and standard operating procedures. In an effort to abide by quality assurance principles, trial conduct will be subject to the audit of the trial master file for inclusion of essential documents including: permissions to conduct the trial, CVs of trial staff and training received, local document control procedures, consent procedures and recruitment logs, adherence to procedures defined in the protocol (e.g. inclusion/exclusion criteria), adverse event recording and reporting and accountability of trial materials (as appropriate).

Monitoring of trial data shall include confirmation of informed consent, source data verification, data storage and data transfer procedures, as well as back-up and disaster recovery of any local databases and validation of data manipulation. Entries on CRFs may be verified by inspection against the source data. The trial database will also be checked for any potential discrepancies/errors during the data entry process. Any corrections will be noted by the investigators.

15. ETHICAL AND REGULATORY CONSIDERATIONS

15.1. DECLARATION OF HELSINKI

The Investigator will ensure that this study is conducted in accordance with the principles of the Declaration of Helsinki.

15.2. GUIDELINES FOR GOOD CLINICAL PRACTICE

The Investigator will ensure that this study is conducted in accordance with relevant regulations and with Good Clinical Practice.

15.3. APPROVALS

The protocol, informed consent form, participant information leaflet and data collection questionnaires will be submitted to an appropriate Research Ethics Committee (REC), and HRA for written approval. The Investigator will submit and, where necessary, obtain approval from the above parties for all substantial amendments to the original approved documents.

15.4. REPORTING

The Chief Investigator shall submit once a year throughout the study, or on request, an Annual Progress report to the REC Committee, HRA (where required) host organisation and Sponsor. In addition, an End of Study notification and final report will be submitted to the same parties.

15.5. PARTICIPANT CONFIDENTIALITY

The study staff will ensure that the participants' (patients and health professionals) anonymity is maintained. The participants will be identified only by a participant ID number on all study documents and any electronic database (except the tablet computer web interface that will also include the participant's NHS number as a secondary identifier for clinical purposes. These data are hosted on NHS servers), except for the consent form and other inherently identifiable forms used to gather participant contact details (e.g. the Study Reply Form), and a separate confidential record will be created that encloses participants' names, dates of birth, home addresses and study identity code number. The latter will be an encrypted database kept separately from all other study data and will kept only long enough to allow for patient follow up. All documents will be stored securely and only accessible by study staff and authorised personnel, determined by the Chief Investigator. The study will comply with the General Data Protection Regulation 2018 and Data Protection Act 2018 which requires data to be de-identified/pseudo-anonymised as soon as it is practical to do so.

15.6. EXPENSES AND PARTICIPANT BENEFITS

Reasonable travel expenses for any visits additional to normal care will be reimbursed on production of receipts, or a mileage allowance provided as appropriate. Follow up contacts made by the research nurse will be made to the patient whilst at home (if they feel comfortable with this arrangement) in an effort to limit the opportunity for patient expense and to help minimise patient burden.

15.7. TRIAL PARTICIPATION

All participants will continue to receive the standard care offered to all COPD patients by their usual care provider (respiratory nurse and/or GP). This will be made clear to potential participants in the participant information leaflets as well as explained verbally during the process of obtaining informed consent. It will also be made clear that the decision to participate or not (or provide consent to participate and subsequently wish to withdraw) will not in any way affect the standard of care and treatment usually received by these patients.

16. FINANCE AND INSURANCE

16.1. FUNDING

The study will be funded by the NIHR Oxford Biomedical Research Council under the Technology and Digital Health Stream and by the Engineering and Physical Sciences Research Council.

16.2. INSURANCE

The University has a specialist insurance policy in place which would operate in the event of any participant suffering harm as a result of their involvement in the research (Newline Underwriting Management Ltd, at Lloyd's of London). NHS indemnity operates in respect of the clinical treatment provided.

16.3. PUBLICATION POLICY

The Investigators will be involved in reviewing drafts of the manuscripts, abstracts, press releases and any other publications arising from the study. Authors will acknowledge that the study was funded by the NIHR Oxford Biomedical Research Centre and the Engineering and Physical Sciences Research Council.

17. DEVELOPMENT OF A NEW PRODUCT/ PROCESS OR THE GENERATION OF INTELLECTUAL PROPERTY

Ownership of IP generated by employees of the University vests in the University. The protection and exploitation of any new IP is managed by the University's technology transfer office, Oxford University Innovations.

18. FEEDBACK TO PARTICIPANTS

Participants will be informed of the trial results through an information sheet prepared for a lay audience made available on the department's website.

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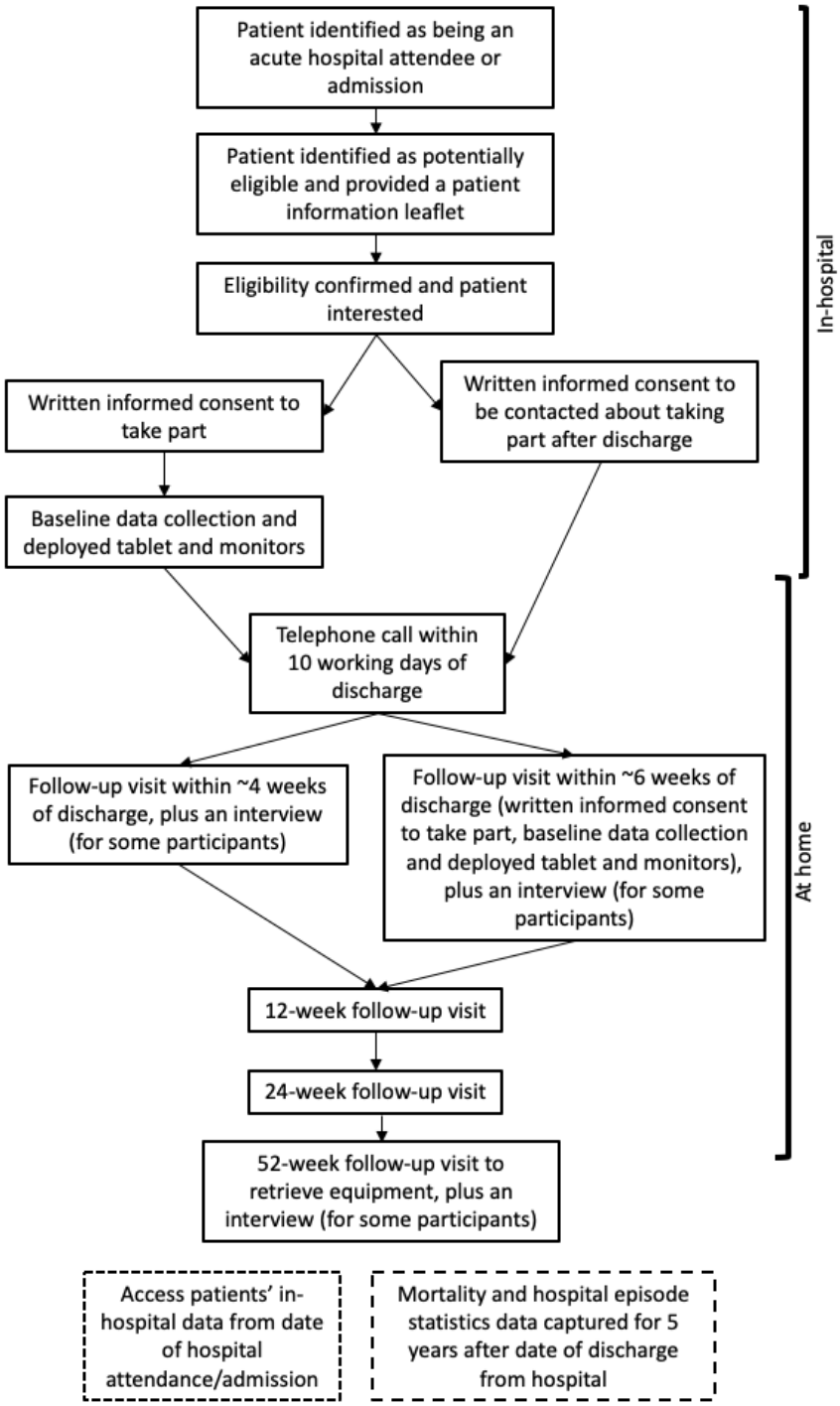
20. APPENDIX A: STUDY FLOW CHART FOR COHORT 1



21. APPENDIX B: HOSPITAL DATA

The following example categories of data are held in the SEND/HAVEN databases*:

1. Electronic Patient Record database

2. Patient Administration System database

3. Vital signs database

4. Radiology database ("PACS")

5. Pathology ("LIMS") database (laboratory values including blood gases)

6. Theatre Management Systems databases.

7. The Trust's Data Warehouse

8. The Trust's Clinical Data Repository

9. Intensive Care Audit Database (ICNARC)

10. The Trust's Cardiac Arrest Audit Database

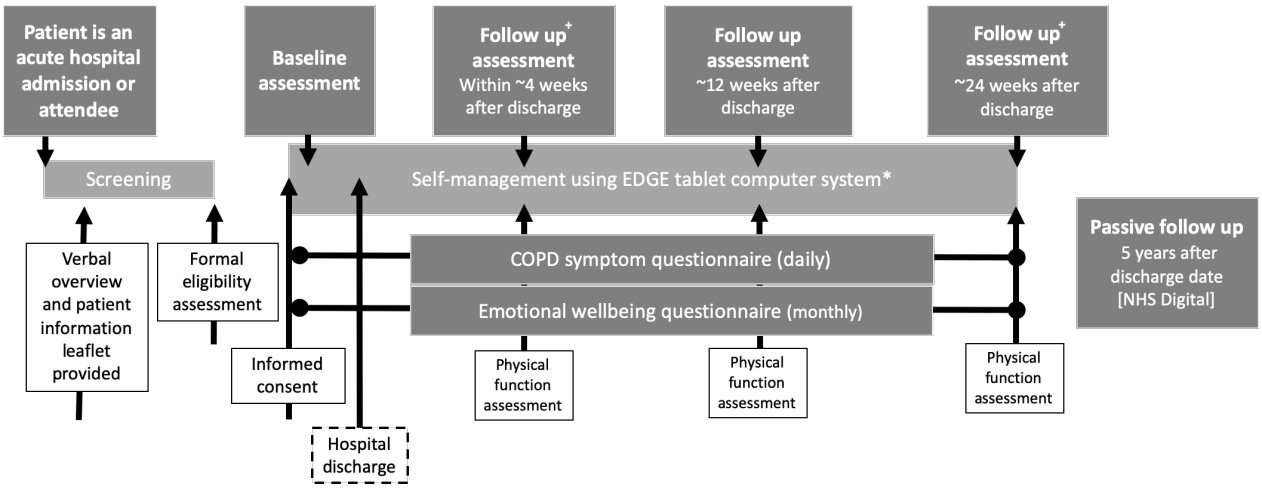
11. The Trust's blood transfusion database ("Bloodtrack")

12. The Trust's intensive care patient record database

**We will only use data from patients who have consented.*

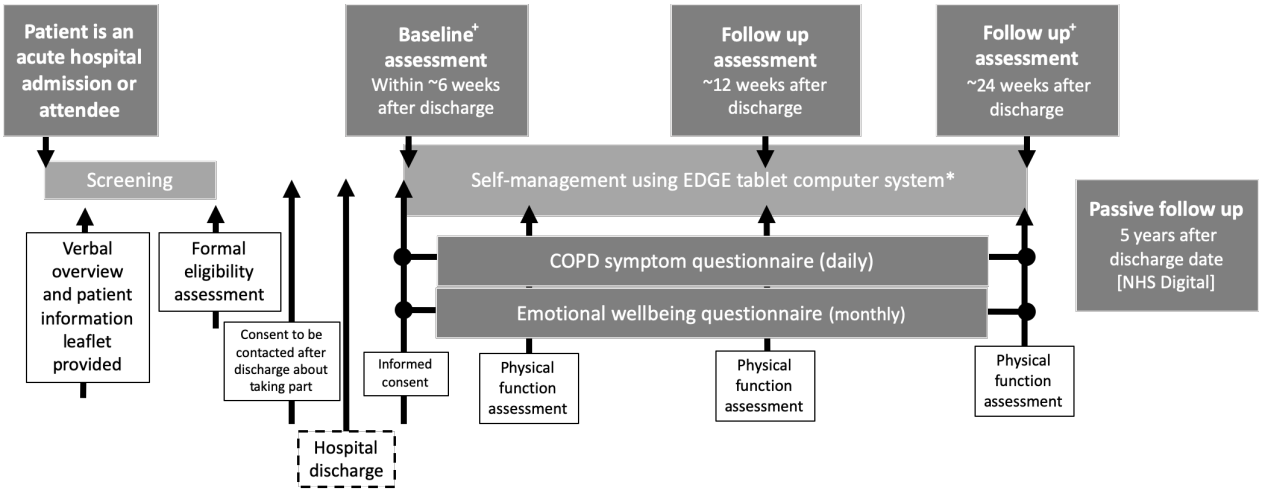
22. APPENDIX C: SCHEDULE OF STUDY PROCEDURES FOR COHORT 1

For patients who give consent to take part whilst they are in hospital:



+Patient interviews (n=up to 20) will take place at the within ~4-week and ~24-week contact after hospital discharge (unless withdrawn, in which case it will take place at an ad-hoc timepoint)
*Access to the tablet system will start from provision of consent but the 6 months will start from the point of hospital discharge

For patients who give consent to be contacted about taking part after discharge:



+Patient interviews (n=up to 20) will take place at the within ~6-week and ~24-week contact after hospital discharge (unless withdrawn, in which case it will take place at an ad-hoc timepoint)
*Access to the tablet system will start from provision of consent but the 6 months will start from the point of hospital discharge

23. APPENDIX D: PROCEDURES MATRIX

Procedures	During screening	At baseline (either in hospital or within ~6-weeks of discharge)	An ongoing procedure	At the within ~4-week assessment	At the ~12-week assessment	At the ~24-week assessment	At the ~52-week assessment	5 year passive follow up
Approach potentially eligible patients	x							
Conduct an eligibility assessment	x	x						
Obtain informed consent		X [prior to baseline if using verbal consent]	x [for health professionals and patients undertaking interview]					
Collect contact details		x	x [if details change]					
Collect medical history		x						
Ask patients to complete the questionnaires		x					x	
Linkage of patients' in-hospital data		x	x					
Access hospital records		x					x	
Ask patients to complete a physical function assessment (sit-to-stand test)		x [if feasible]		x	x	x	x	
Complete the process measure questionnaire (COPD care bundle)		X		x				
Provide tablet and monitoring		x						

devices to patients								
Collect tablet and monitoring devices from patients			x [if participant withdraws]				x	
Conduct patient interviews[7]		x [if baseline occurs after discharge]	x [in the event a participant withdraws and consented to be contacted about interviews]				x	
Conduct health professional interviews			x					
Collection of data from NHS Digital								x

[7] A subset of a further 10 patients will also be interviewed at ~18 and ~32 weeks

24. APPENDIX E: MEASUREMENTS MATRIX

	At baseline (either in hospital or within ~6-weeks of discharge)	At 4 weeks	At 12 weeks	At 24 weeks	At 52 weeks	Data accessed from hospital records	An ongoing measure (up until 5 year follow up)
PRIMARY OUTCOME MEASURES							
Linkage of hospital and tablet data	x						x
SECONDARY OUTCOME MEASURES							
SGRQ-C	x				x		
EQ-5D-5L	x				x		
MGL scale	x				x		
Smoking status	x				x		
Self-efficacy	x				x		
Admissions to hospital	x [in preceding year]				x [any subsequent visits]	x	
Admissions to ICU	x [in preceding year]				x [any subsequent visits]	x	
Number of contacts with healthcare professionals	x [in preceding year]				x [any subsequent visits]		
Medication and oxygen therapy	x				x		
Physical function	x	x	x	x	x		
Costs of the digital intervention	x				x		
Death		x	x	x	x		x
COVID-19 Status	x	x	x	x	x		
Hospital episode statistics							x
SECONDARY PROCESS MEASURES							
COPD care bundle	x	x					

25. APPENDIX F: SOCIALLY DISTANCED STUDY PROCEDURES

As stated in sec 4, pandemic conditions have resulted in the need for adaptive, socially distanced (SD) study procedures. The need for remote monitoring has also been felt amongst the NHS Community Respiratory Team (CRT). The following procedures allow the study to continue to meet its aims whilst also providing the CRT with an extra remote monitoring resource. For the sake of clarity, it will be noted in each participant's research notes whether they have followed the study procedures outlined in sections 7, 8 and 9 or those defined below (in Appendix F). If at any time it becomes safe and appropriate to recommence face-to-face visits with participants procedures may revert to those outlined in the protocol above or may continue follow socially distanced procedures.

25.1. PARTICIPANT IDENTIFICATION (SD PROCESS)

As part of their regular clinical work, the CRT perform regular searches of electronic patient records from the OUH NHS Trust in order to identify recently discharged patients whom could benefit from their care. The CRT will continue to complete this practice and will assess each identified patient against the EDGE2 eligibility criteria. The CRT may also, during the course of their everyday activities, identify a potentially eligible patient from the patients they are already in touch with. Eligible patients will have attended/been discharged from Oxford University Hospital NHS Foundation Trust within the last 90 days (3 months) along with meeting all other eligibility criteria and none of the exclusion criteria as defined in sections 7.2 and 7.3. The CRT will record a pseudo-anonymised (using a study ID) entry for each potential patient identified in a screening log. Upon identifying a potentially eligible patient a member of the CRT who has been approved by the CI will contact the patient to introduce them to the study and ask whether they would like to receive further information. This contact may happen by phone or, if they are seeing the patient as part of their routine care, in person. If the patient would like to hear more about the study the patient will be sent a Study Reply Form and the PIS along with a freepost envelope. The patient will be instructed to thoroughly read the PIS and complete the Study Reply Form with their contact details before returning this to the research team using the freepost envelope. The outcome of the conversation with the patient (consented to be sent more information/declined further information) will be recorded in the screening log. Patients that have been sent the PIS and Study Reply Form but have not returned a completed form within 2-4 weeks of postage may be contacted again by a member of the CRT to ask whether the patient would like any further information or has any questions about the study.

25.2. RECRUITMENT AND INFORMED CONSENT (SD PROCESS)

Following receipt of the patient's completed Study Reply Form a member of the research team will contact the patient to discuss the study. During the phone call the member of the research team will

provide a further brief overview of the study and complete a full eligibility assessment to confirm eligibility. If the patient is found to still be eligible and the patient wants to take part the research team member will ask the patient to provide verbal consent to take part (recorded on the patient verbal consent form). During the call they will also book a date and time for their baseline appointment. If the patient is not available for a baseline appointment within the next two weeks, consent may not be taken during this call. Instead the patient may be contacted again closer to their baseline appointment in order to ensure consent is provided as close to intervention commencement (baseline) as possible. Following provision of consent the research team member will then collect some information required to set up the EDGE2 self-management system (e.g. prescribed inhalers, etc). The research team member may also discuss whether the participant would like to take part in the qualitative portion of the study (n=~30 not necessary for general participation). The patient will then be sent (courier or drop off) the baseline pack containing a welcome letter, a copy of their completed verbal consent form, a baseline questionnaire, a return addressed freepost envelope, an EDGE2 device pack containing all devices and a participant guide on their use. The pack may also contain a patient interviews PIL if the patient had interest in this aspect of the study.

25.3. STUDY VISITS/CONTACTS (SD PROCESS)

Throughout the study period participants may be contacted ad hoc by members of the CRT or research team in order to disseminate study information, troubleshoot issues or check study progress. All time scales are measured from the date of consent. All of the following contacts may occur via video call or telephone call. Physical function assessments will NOT be completed when following SD procedures. This is due to safety concerns that arise when there is no trained nurse present.

25.3.1. BASELINE (SD PROCESS)

A baseline contact will be completed within 2 weeks of a consent being provided. During the contact a baseline CRF will be completed. A baseline questionnaire will also be completed. The research nurse will complete any final set-up required for the EDGE2 self-management system and confirm with the participant that all the information used in the set-up is still accurate, before talking the participant through how to operate the system. This will include asking them to complete their first daily symptom diary and take a pulse oximeter reading. The 4-week follow-up contact will be booked at this time.

25.3.2. 4 WEEK FOLLOW-UP (SD PROCESS)

Participants will be contacted by a research nurse at ~4 weeks post-consent. The research nurses will ask how the participant is finding the study and will help troubleshoot any immediate issues with the

equipment and other aspects of the study. The participant will be asked to complete a short follow-up CRF. The 12-week follow-up contact will be booked at this time.

25.3.3. 12 WEEK FOLLOW-UP (SD PROCESS)

Participants will be contacted by a research nurse at ~12 weeks post-consent. The research nurses will ask how the participant is finding the study and will help troubleshoot any immediate issues with the tech etc. The participant will be asked to complete a short follow-up CRF. The 24-week follow-up contact will be booked at this time.

25.3.4. 24 WEEK FOLLOW-UP (SD PROCESS)

Participants will be contacted by a research nurse at ~24 weeks post-consent. The research nurses will ask how the participant is finding the study and will help troubleshoot any immediate issues with the tech etc. The participant will be asked to complete a short follow-up CRF.

25.3.5. 52 WEEK FOLLOW-UP (SD PROCESS)

Prior to the participants final follow-up contact the participant will be sent (courier or drop-off) return packaging for the device kit (if required) and a copy of the follow-up questionnaire. Participants will then be contacted by a research nurse at ~52 weeks post-consent. The participant will be asked to complete the follow-up questionnaire. The participant will be asked to pack the EDGE2 device kit and the completed follow-up questionnaire into the return packaging provided. The participant will be instructed on when and how their device pack will be collected and thanked for participating in the study. The 52-week follow-up marks the end of active participation in the study.

25.4. QUALITATIVE CONTACTS (INTERVIEWS) (SD PROCESS)

25.4.1. COHORT 1 (PATIENTS)

Up to 30 participants will be invited to take part in interviews which are anticipated to last around 30 minutes to explore their contextualised use of the tablet computer. Participants will be interviewed by telephone or video call by a qualitative researcher up to 3 times over the course of the study. Firstly, at around ~4–weeks post-consent. A separate verbal consent form will be completed by patients wishing to take part. This will be completed prior to the first interview commencing. All interview participants will have a second telephone/video call interview between ~26 and ~34 weeks (around 6 to 8 months after the time of consent) and a final interview at the end of the study period at ~52-weeks. All interviews will be conducted by telephone or video call and are anticipated to last around 30 minutes.

25.4.2. COHORT 2 (HEALTH CARE PROFESSIONALS)

Up to 15 health care professionals (HCPs) working with COPD patients during their day-to-day activities will be invited to take part. HCPs interested in taking part will be emailed the relevant PIL. HCPs will be instructed to read the PIL and, if they would like to take part, to contact the research team. Interviews will be conducted either via telephone or video call and will be held at a time convenient to the HCP. Prior to commencement of the interview the HCP will be asked to provide verbal consent. This will be recorded on the verbal consent form and a copy of the completed form will be made available to them. In order to reduce burden upon HCP time multiple HCPs will be permitted to be interviewed together (in an informal focus group style) if they prefer. HCPs will also be able to submit written feedback to the researcher (e.g. via email) at their leisure over the course of the study. If the researcher feels a topic may be worth revisiting further into the study period or if the HCP feel that they would like to discuss things further, they may be invited to take part in further telephone or video call discussions following the initial interview. Any further discussions/interviews will be entirely voluntary and are not required for the HCP to take part in the initial interview.

26. APPENDIX G: AMENDMENT HISTORY

Amendment No.	Protocol Version No.	Date issued	Author(s) of changes	Details of Changes made
1	1.4	15/02/2019	Maxine Whelan	Adjustment to the physical function assessment to be conducted with patients, inclusion of an additional question in the baseline questionnaire, added the option to contact participants ad-hoc for study related incidents, amended the protocol for the 6-minute walk test and adjusted the inclusion criteria for patients and health professionals.
2	1.5	19/07/2019	Maxine Whelan	Update to the qualitative element involving both patients and health professionals as well as the inclusion of an additional outcome (self-efficacy in COPD)
3	1.6	13/12/2019	Maxine Whelan	Adjusted the planned study date to May 2019-2027. Members of the clinical research team can access patient identifiable data without prior consent for the purposes of screening for eligibility (CAG application).

				Patients who are eligible and interested in taking part in the study, but do not want to give consent to take part whilst still in hospital, will be able to give consent to be contacted about taking part after discharge. In the event the patient interview cannot be conducted during a planned visit with the research nurse, a separate visit will be made by the qualitative researcher to complete the interview. Clarification that incoming data through the tablet computer will be monitored by the clinical research team (safety procedure). Removal of 6-minute walk test physical function assessment. Clarification that patients wear the physical activity monitor as much as possible during the whole study period (not only the first 2 weeks). In parallel to collecting weather data, we will also collect pollution data. Correction to the time period as to when data will be extracted from NHS Digital – up until 5 years after date of discharge (rather than up until 5 years after date of hospital attendance/admission).
4	n/a	n/a	Beth Lawson	Non-substantial amendment made in response to COVID-19 to allow certain study procedures to be conducted by phone. No protocol changes made at this time.
5	2	22/07/2020	Beth Lawson	Addition of appendix F outlining study procedure adjustments to mitigate infection risks due to COVID-19. Various comments have been added to relevant sections of the protocol. Patients may be first screened and approached by the NHS community respiratory team (Oxford Health). Updated inclusion criteria to allow inclusion of patients that have attended/been admitted to OUH NHS Trust within the last ~90 days. Approved members of Oxford Health community respiratory team will be given access to data collected from participant

				tablets. These persons will be permitted to contact participants to discuss these data if appropriate (e.g. data suggests clinical concern) Extended the study period from 6 months to 12 months, resulting in one additional study contact at ~52 weeks. Increase in participants taking part in interviews from 20 to 30 to a include a new subset of 10 participants who will be interviewed an additional two times. Clarified that HCP interview participants may be invited to discuss their comments in further interviews/discussions however this is not required for participation.
6	3	08Sep2021	Beth Lawson	Change to qualitative work by interviewing all 30 participants 3 times during the study period and removing the subset of 10 participants who would have been interviewed 4 times.