1. Protocol details

1.1 PROTOCOL TITLE:

Personalised simulation technologies for optimising treatment in the inte

1.2 Names (titles), roles and contact details of:

Sponsor
Guy's and St Thomas' NHS Foundation Trust

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1.3 Protocol details

Version number 1.0

Draft

Date 05/02/2020

2 Signature Page

The Chief Investigator and the R&D (sponsor office) have discussed this
agree to perform the investigations and to abide by this protocol

The investigator agrees to conduct the trial in compliance with the approv
Data Protection Act (1998), the Trust Information Governance Policy (or
Research Governance Framework (2005' 2nd Edition; as amended), the
regulatory requirements as amended.

Chief investigator

Dr Luigi Camporota

Signature

Sponsor Representative

R&D to Add

GSTFT Signature

Contents Page

3 List of Abbreviations and Definitions

GSTFT	Guy's and St Thomas' NHS Foundation Trust
UON	University of Nottingham
UWAR	University of Warwick

4 Summary/Synopsis

Title	*Personalised simulation technolo intensive care unit*
Protocol Short Title/Acronym	PSTOTICU
Protocol Version number and Date	0.1.4 21/08/2019
IRAS Number	266780
REC Reference	NA
Study Duration	*2 years*
Sponsor name	Guy's and St Thomas' NHS Found
Chief Investigator	Dr Luigi Camporota
Funder	Engineering and Physical Science
Medical condition or disease under investigation	Respiratory Failure
Purpose of research	This study aims to further dev models, by the fitting of those mo data of critical care patients.
Primary objective	To further develop our simulatio of recently proposed therapeuti
Secondary objective (s)	To integrate data-streams and co our existing modelling technolo individual patients and treatme imminent problems. To develop mathematical me explore the "design space" of po individual patient in simulation, can be suggested for evaluation
Number of Episodes	5,000
Study Type	Observational
Endpoints	Not Applicable
Main Inclusion Criteria	This project will include criti

5 Introduction

This project aims to further develop and refine in silico physiological mo
models to the physiological and treatment data of critical care patients.
development is fitting the model to, and its description of, the physiolo
specific interventions. An example would be how a patients physiologica
increase in positive end expiratory pressure (PEEP). Data for this exa
physiological and treatment data pre and post ventilator changes (e.g., PE
the clinical team, for a clinically appropriate time period.

Computer simulation offers a new approach to traditional medical rese
suited to investigating treatment of critical illness. Critically ill patients
great detail, providing extensive, high quality data streams for model
patient-matching. Models based on this data can incorporate very compl
be validated against responses of individual patients, for use as investiga

In contrast to trials on animal models and humans, in silico models o
disease pathology are completely configurable, reproducible and reusab
combinations of treatments, can be applied to the same patient or subse
to understand mode of action, quantitatively compare effectiveness in va
interventions for particular clinical objectives and particular patient grou

It is widely accepted that modification of existing mechanical ventilatio
novel physical treatment strategies could significantly reduce pulmo
impairment, and mortality rates, particularly if combined with novel pha

To achieve this we are undertaking a collaborative project between three
different and complimentary areas of expertise.

The three institutions involved in this project are:

6 Study objectives and purpose

This project is a collaborative endeavour between Guy's and St Thomas
academic collaborators at the University of Nottingham and the Unive
further develop and refine in silico physiological models, by the fitti
physiological and treatment data of critical care patients.

The project's primary objective is to further develop our simulation
simulation of commonly used therapeutic interventions within the in
amenable interventions include prone positioning, optimising the co
breathing effort with mechanical ventilation, application of recruitment
cause and maintain an "open lung", and Extra-corporeal membrane
interventions have been chosen on the basis of amenability to a
optimisation, possessing a strong potential for providing improvement in
current usage in many ICU's worldwide.

Integration of available data within the ICU with our existing modelling t
real time simulation of individual patients and treatments. Sufficient
models would enable systematic and efficient exploration of the possib
for an individual patient in simulation, allowing optimised treatment str
evaluation by the clinician. Possible therapeutic interventions to be expl
designed pulmonary recruitment (alveolar re-opening) manoeuvres, ven
(e.g. airway-pressure release ventilation low tidal volume, high positi
inspiratory flow waveform modification, and closed-loop ventilatory cont

To facilitate the further development of the simulation platform requires
curated data sets representative of the therapeutic interventions of intere
will be created to catalogue and share collated data sets between co
repository will enforce the oversight and governance ensuring the requ
protection against unlawful or unauthorised processing, access, loss, des

At this stage of the project, the simulation platform will not be accessib

7 Study design & Flowchart

7.1 Study Design

This study aims to further develop and refine *in silico* physiological mo
models to the physiological and treatment data of critical care patients.

Of specific interest to model development is fitting the model to,
physiological response of patients to specific interventions. An exampl
physiological parameters respond to an increase in PEEP. Data for this e
physiological and treatment data pre and post ventilator changes (e.g., PE
the clinical team, for a clinically appropriate time period. This would com

Data required for this study will therefore be truncated case report data
short time periods, on the order of 12 hours duration. The exact length
determined by the clinical scenario, but would be for a clinically appropri

No attempt will be made to capture data from entire patient cohorts or t

There is no intention to implement any study specific interventions or tre
be retrospective, pragmatic and limited to that data recorded throu
routinely provided to all patients.

Within this project, there is no intention for physiological models develope
Clinicians will have no access or exposure to the simulations and predicti
by the models that this project aims to develop.

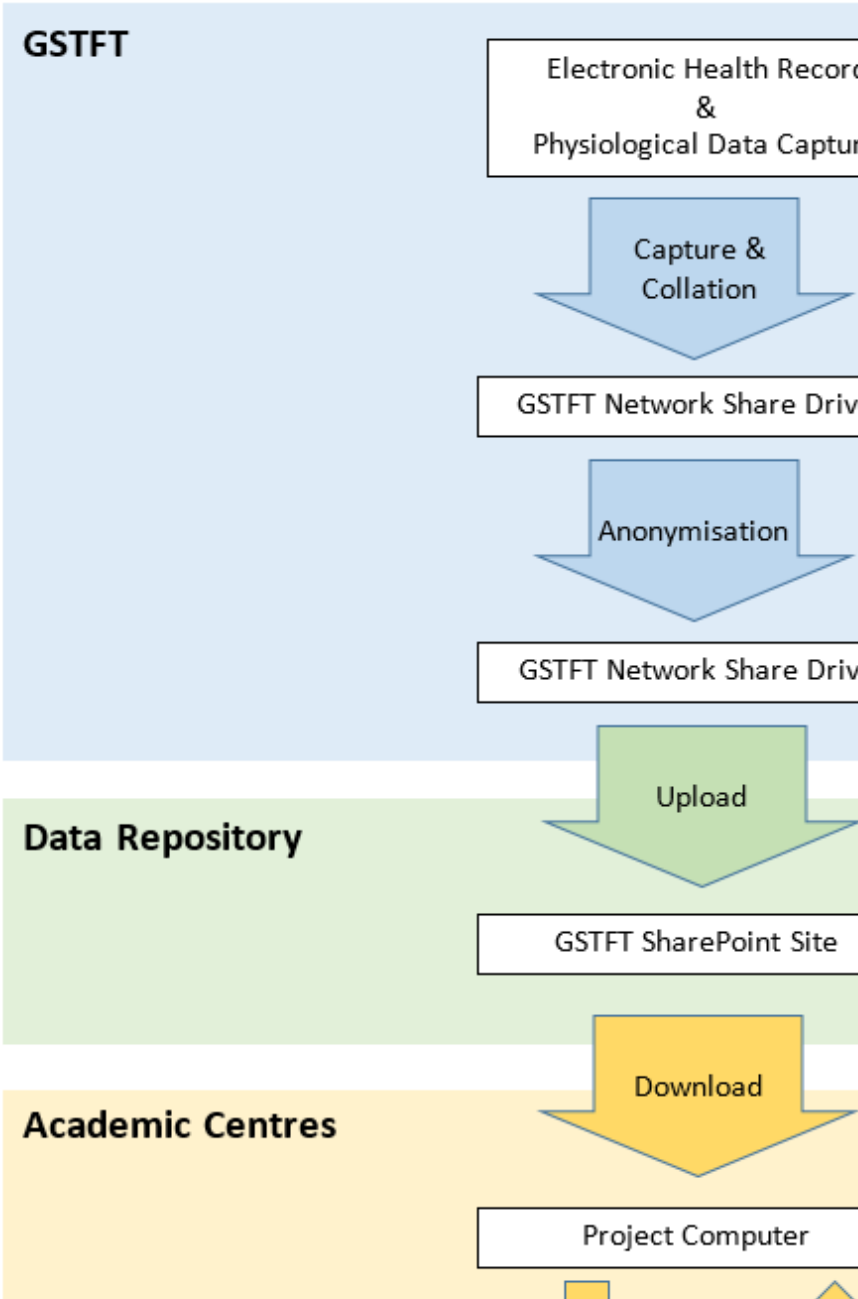
For the purposes of this document, a **data set** is defined as a collated se
subject and one intervention.

7.2 Flowchart

The collaborative nature of this study requires that data be managed a
environments:

Guy's and

NI


GSTFT
Electronic Health Record
&
Physiological Data Captur
Capture &
Collation
GSTFT Network Share Driv
Anonymisation
GSTFT Network Share Driv
Upload
Data Repository
GSTFT SharePoint Site
Download
Academic Centres
Project Computer

8 Subject selection

Subjects will be drawn from the adult critical care population at GSTFT. S
receiving mechanical ventilation.

It is anticipated that this project will require several iterations of
development, with each iteration examining a different treatment interv
will inform the exact nature of data collection in the subsequent iteratio
and analysis iterations that will be required is dependent on the
development.

As noted in section 7.1 collated data sets will episodic in nature with ex
the order of twelve hours. It is entirely possible that the admission and c
several episodes of interest, or the patient may receive a similar interver
episodes may be therefore be contributed under differing study ids to
catalogued in the data repository.

8.1 Inclusion Criteria

- At least 18 years of age
- Patients admitted to GSTFT Intensive Care between th
  31/03/2019
- Receiving mechanical ventilation

8.2 Exclusion Criteria

- Pregnancy or lactation.

9 Study procedures

9.1 Subject recruitment and screening

Episodes of interest will be identified retrospectively by querying existing
attributes. As an example, patient treatment data could be queried for epi
setting is increased from 5 to 10.

Data subjects will not be approached as data is collected retrospectively
existing data sources. We will not be requested any additional data or re

Consent will not be sought from individual patients due to the non-inte
nature of the data collection.

Data collection will be limited to that data recorded as part of routi
01/01/2010 and 31/03/2019

9.2 Schedule of assessments for each visit

Data is available from the electronic health records and the data export
technology employed in the routine care of critically ill patients.

No schedule of assessment is planned due to the retrospective nature of
health care records.

9.3 Follow up Procedures

There are no follow up procedures planned for this study.

9.4 End of Study Definition

Completion of the project is defined as the time point five years after c
activities.

10 Assessment of Safety

Study procedures for this study consist of data collection from the electro
in the routine care provided to patients. It is anticipated that this study p
patient safety than that caused by their routine clinical care.

10.1 Study Steering Committee

There will be no monitoring, steering or safety committees set up for this

10.2 Ethics & Regulatory Approvals

Appropriate HRA and REC will be in place before the study commences.

11 Data

11.1 Data to be collected

Data will be collected within four domains:

- Demographics
- Physiological
- Ventilation
- Blood gas analysis

Demographic data will be collected from the health care record, and is of

Physiological data is continuously captured by monitoring equipment (Phi
within ICU, and recorded on a regular basis into an electronic health rec
Data can also be captured remotely from the continuous stream capture

Ventilator parameters and patient ventilatory parameters are measured
at the bedside in the ICU by the patient ventilators (Drager V500). This d
basis into an electronic health record system by clinical staff. Data can
from the ventilators.

Blood gas analysis results are collected routinely as part of the care of ICU
their electronic health record. Data will be collected retrospectively from

Data points that will be collected from each domain are detailed below.
identify specific data fields, alongside a short description of that data
realistic that only subsets of the entire list of potential data fields will
present in individual data sets, with availability dependent on differing pa

11.1.1 Demographics

STUDY_ID	Unique study data set identifier

CENTRAL_TEMP_MONITOR_C	Central temperature measureme
PERIPHERAL_TEMP_MONITOR_C	Peripheral temperature measure
ECG_HEART_RATE_MIN	ECG Heart Rate
HEART_RATE_MONITOR_MIN	Monitor Heart Rate
ECG_RHYTHM_MONITOR	ECG cardiac rhythm
PVC_RATE_MONITOR_MIN	Premature Ventricular Contracti
ECTOPIC_BEAT_MONITOR_STR	Premature Ventricular Contracti
ECT_RATE_MONITOR_MIN	ECG Ectopic Rate
SPO2_MONITOR	Photoplethysmogram - Non-i
monitoring	
RESP_RATE_MONITOR_MIN	Respiratory Rate
NIBP_SYS_MMHG	Non-invasive systolic blood press
NIBP_DIA_MMHG	Non-invasive diastolic blood pres
NIBP_MEAN_MMHG	Non-invasive mean blood pressu
ABP_SYS_MMHG	Invasive systolic blood pressure
ABP_DIA_MMHG	Invasive diastolic blood pressure
ABP_MEAN_MMHG	Invasive mean blood pressure m
ART_SYS_MMHG	Invasive systolic blood pressure
ART_DIA_MMHG	Invasive diastolic blood pressure
ART_MEAN_MMHG	Invasive mean blood pressure m

CENTRAL_TEMP_ICIP_C	Central temperature measureme
PERIPHERAL_TEMP_ICIP_C	Peripheral temperature measure
HEART_RATE_ICIP	Heart Rate
CARDIAC_RHYTHM_ICIP	Cardiac Rhythm
SPO2_ICIP	Photoplethysmogram
NIBP_SYS_ICIP_MMHG	Non-invasive systolic blood press
NIBP_DIA_ICIP_MMHG	Non-invasive diastolic blood pres
NIBP_MEAN_ICIP_MMHG	Non-invasive mean blood pressu
ABP_SYS_ICIP_MMHG	Invasive systolic blood pressure
ABP_DIA_ICIP_MMHG	Invasive diastolic blood pressure
ABP_MEAN_ICIP_MMHG	Invasive mean blood pressure m
ART_SYS_ICIP_MMHG	Invasive systolic blood pressure
ART_DIA_ICIP_MMHG	Invasive diastolic blood pressure
ART_MEAN_ICIP_MMHG	Invasive mean blood pressure m
PABP_SYS_ICIP_MMHG	Systolic pulmonary artery blood
PABP_DIA_ICIP_MMHG	Diastolic pulmonary artery blood
PABP_MEAN_ICIP_MMHG	Mean pulmonary artery blood pr
CVP_MEAN_ICIP_MMHG	Invasive central venous pressure
CARDIAC_OUTPUT_ICIP_L_MIN	Cardiac Output
CARDIAC_INDEX_ICIP_L_MIN_M2	Cardiac Index

P_LOW_CMH2O	Pressure Low
P_HIGH_CMH2O	Pressure High
P_MEAN_CMH2O	Pressure mean
P_MIN_CMH2O	Pressure minimum
P_PEAK_CMH2O	Pressure peak inspiratory
P_PLATEAU_CMH2O	Pressure plateau
MIN_VOL_EXP_L_MIN	Expired minute volume
MIN_VOL_EXP_SPON_L_MIN	Expired minute volume - sponta
MIN_VOL_EXP_MAND_L_MIN	Expired minute volume - mandat
MIN_VOL_LEAK_L_MIN	Minute volume leak
TIDAL_VOLUME_MLS	Tidal Volume
TIDAL_VOLUME_INSP_MLS	Tidal Volume Inspired
TIDAL_VOLUME_EXP_MLS	Tidal Volume Expired
TIDAL_VOLUME_SPON_MLS	Tidal Volume Spontaneous
TIDAL_VOLUME_INSP_SPON_MLS	Tidal Volume Inspired Spontaneo
TIDAL_VOLUME_EXP_SPON_MLS	Tidal Volume Expired Spontaneo
TIDAL_VOLUME_MAND_MLS	Tidal Volume Mandatory
TIDAL_VOLUME_INSP_MAND_MLS	Tidal Volume Inspired Mandator
TIDAL_VOLUME_EXP_MAND_MLS	Tidal Volume Expired Mandatory

E_IE	Expiratory component IE ratio
I_IE_SPON	Inspiratory component IE ratio -
E_IE_SPON	Expiratory component IE ratio –
ELASTANCE_CMH2O_L	Elastance
RSB_S_L	Rapid shallow breathing index
COMP_DYN_MLS_CMH2O	Dynamic compliance
COMP_20_MLS_CMH2O	Compliance 20
TIME_CONSTANT_S	Time constant
TIME_CONSTANT_EXPIRED_S	Time constant expired
P01_CMH2O	Airway occlusion pressure
NIF_CMH2O	Negative Inspiratory Force
EIP_CMH2O	End inspiratory Pressure
FIO2_PC	Fractional Inspired Oxygen
VTCO2_MLS	Tidal CO2 production
V_CO2_MLS_MIN	CO2 Production
VOLUME_DS_MLS	Deadspace Volume
ET_CO2_KPA	End tidal CO2 kPa
ET_CO2_VOLPC	End tidal CO2 vol%
CO2_SLOPE_KPA_L	CO2 Slope
VENTILATOR_MODE	Ventilator Mode

T_LOW_SETTING_S	Time low - Ventilator Setting
T_INSP_MAX_SETTING_S	Maximum Inspiratory Time - Ven
T_LOW_MAX_SETTING_S	Maximum time low - Ventilator s
SLOPE_SETTING_S	Slope setting - Ventilator Setting
FLOW_SETTING_L_MIN	Flow setting - Ventilator Setting
CONST_FLOW_L_MIN	Constant flow - Ventilator setting
RESPIRATORY_RATE_SETTING_MIN	Respiratory rate - Ventilator Sett
P_SUPPORT_SETTING_CMH2O	Pressure support - Ventilator Set
TIDAL_VOLUME_SETTING_MLS	Tidal volume setting - Ventilator
FLOW_TRIGGER_SETTING_L_MIN	Flow trigger - Ventilator Setting
ATC_COMPENSATION_SETTING_PC	ATC compensation - Ventilator S
FIO2_SETTING_PC	Fractional Inspired Oxygen - Ven
INSP_TERM_SETTING_PIF_PC	Inspiratory term % Peak Inspirat
EXP_TERM_SETTING_PIF_PC	Expiratory term % Peak Expirato

11.1.4 Blood Gas Analysis

STUDY_ID	Unique study data set identifier
DATETIME	ISO 8601 Date & Time
BLOOD_GAS_TYPE	Blood gas type
PCO2_KPA	Partial Pressure CO2

NA_MMOL_L	Sodium concentration
CL_MMOL_L	Chloride concentration
HAEMOGLOBIN_G_L	Haemoglobin concentration
OXY_HAEMOGLOBIN_PC	Oxyhaemoglobin
CARBOXY_HAEMOGLOBIN_PC	Carboxyhaemoglobin
H_HAEMOGLOBIN_PC	Deoxyhaemoglobin
METHE_HAEMOGLOBIN_PC	Methehaemoglobin
GLUCOSE_MMOL_L	Glucose concentration
LACTATE_MMOL_L	Lactate concentration
TEMP_BLOOD_GAS_C	Temperature blood gas
FIO2_BLOOD_GAS_F	FiO2 blood gas
R_BLOOD_GAS	Respiratory quotient
P50_BLOOD_GAS_KPA	P50
BASE_EXCESS_MMOL_L	Base Excess
BASE_EXCESS_ACT_MMOL_L	Actual Base Excess
HCO3_MMOL_L	Bicarbonate concentration
HCO3_STAND_MMOL_L	Standardised bicarbonate concen

11.1.1 ECMO

STUDY_ID	Unique study data set identifier

SWEEP_FO2_ECMO_ICIP_F	Sweep Gas Fractional O2 concen
SWEEP_FLOW_ECMO_ICIP_L_MIN	Sweep gas flow
P_ACCESS_ECMO_CHELP_MMHG	Access pressure - Cardiohelp dat
P_PREOXY_ECMO_CHELP_MMHG	Pre membrane pressure - Cardio
P_POSTOXY_ECMO_CHELP_MMHG	Post membrane pressure - Cardi
P_TMP_ECMO_CHELP_MMHG	Transmembrane pressure - Card
Q_BLOOD_ECMO_CHELP_L_MIN	ECMO Blood Flow - Cardiohelp d
PUMP_ECMO_CHELP_RPM	ECMO Pump RPM - Cardiohelp d
SVO2_ECMO_CHELP_PC	Pre Membrane Haemoglobin sat

11.2 Format and Scale of Data

The requirements and nature of this project mean that all study data will

Data will be collated to comma separated value (CSV) format. CSV is accessible by all major data processing software platforms e.g. spreads software. The vast majority of modern programming languages possess t format files.

The near universal interoperability of the CSV format ensures ease of dat validity of collated data sets.

It is anticipated that this project will require several iterations of development, with each iteration examining a different treatment interv will inform the exact nature of data collection in the subsequent iteratio limited to the scope defined in the preceding section, 11.1

Collated data will then be subject to the defined anonymisation proce
anonymisation process, data will be made available to academic rese
repository.

11.4 Data Quality and Standards

Data retrieved from the EHR has been validated by a qualified clinician at
be considered representative of patient condition and treatment.

Data retrieved from medical equipment, e.g. ventilators, is not validated
data domains exhibit different qualities in this regard. Lab value
measurements are made on equipment that is calibrated on a basis appro
high quality and safe care. Data from sources such as ventilators c
standardised in that the equipment models are standardised across GSTF

11.5 Data handling and record keeping

The collaborative nature of this study requires that data be managed a
environments:

- GSTFT
- Data Repository
- Academic partners

Please note the data pathway defined in section 7.2 of this document.

Each environment differs in available data management facilities a
practices and compliance that must be observed. Each environment v
separately.

11.5.1 GSTFT

Data available at GSTFT can be of a personal and confidential nature, an
project where the highest risk of breaching patient confidentiality exists.

- Confidentiality & Data Protection Policy (Version 2)
- Information Security Policy (Version 4)
- Information security (Principle f)

11.5.2 Data Repository

This project will set up a central data repository for data storage and dist

Clinical investigators at GSTFT will upload data sets to the data repository.
for ensuring the local and data repository indexes are maintained and up

GSTFT operates a SharePoint site, to which read only access can be given
GSTFT.

The duplication between data sets stored within IT systems at GSTFT and
as an extra layer of redundant storage and mutual back up.

Data storage, management and security practices for the data repository
Operating Procedures (SOP):

- PSTOTICU_SOP_003 - Standard Operating Procedure
  Administrator

11.5.3 Academic Partners

The University of Warwick (UWAR) and the University of Nottingham (UOI
of this study and are the end recipients of compiled data sets.

Data storage and management practices for study participants at UWAI
Standard Operating Procedure (SOP):

- PSTOTICU_SOP_002 - Data Storage and Management by Ac

11.6 Metadata standards and data documentation

A log of study subjects linked to unique study data set identifiers investigators at GSTFT. This record will be securely stored within the site f form within GSTFT. This log will not be shared to the central repository o blank log is provided by study document:

- PSTOTICU_SD_004 – Subject Log

A full index of the collated subject data set files will be maintained by si local GSTFT copy will be kept, and duplicated within the central data repo index is included in **Error! Reference source not found.**, and a blan document:

- PSTOTICU_SD_005 – Data Set Index

11.6.2 Metadata Descriptive Files

To provide context for the CSV files of a data set, text files will be g describing the intervention captured. These descriptions will be entirely li intervention and provide no data which might provide an increased r subjects. File format will be of a txt format, and thus universally readab textual descriptions will be apparent on examination of the quantitativ provide a more accessible context for the data.

Example descriptions:

- 'PEEP increased from 5cmH2O to 10cmH2O'
- '250ml Crystalloid Bolus given at 02:00' *
- 'Prone positioning started 02:00. Prone positioning disc

* - Dates and times are subject to anonymisation as per PSTOTICU_SO Procedure (SOP) Data De-Identification

11.7 Data preservation strategy and standards

11.7.2 Data Repository

The data repository will be maintained for a five year period after da
completed. After this period, access will be revoked for those users with
will be retained as part of the study archival process at GSTFT and duplica
no longer required.

11.7.3 Academic Collaborators

Upon completion of data collection activities, it is anticipated that acade
extended period. Data will be available to project collaborators for five
activities are completed.

11.8 Data Security and Confidentiality of Potentially Information

The level of data security is dependent upon the nature of the data – per
higher levels of security.

Data collected for this study will be subjected to an anonymisation proces
a negligible risk of subject re-identification.

Despite the low risk of subject identification, health related data is s
appropriate to ensure study data is handled in a way that ensures se
against unlawful or unauthorised processing, access, loss, destruction or

11.8.1 Data Anonymisation

The aim of anonymisation, is to ensure that the risk of potential re-ident
minimised to negligible levels.

Clinical data will be collected by investigators at GSTFT and subje
anonymisation process, before being made available to academic partn
anonymisation process employed is defined in the SOP:

- PSTOTICU_SOP_004 – Standard Operating Procedure (S

11.8.2.1 GSTFT

Data will be stored on GSTFT network drives within a proje
S:\\IntensiveCare\Research folder. This ensures that access to data is
Intensive Care clinical research team at GSTFT. Access is authoris
authorisation system administered by GSTFT IT services and therefore to t
the security of clinical services and data. This method of project specif
across the research portfolio of this research team.

Usage of GSTFT network drives also ensures the durability and availabi
same standard as that provided for clinical services and data.

GSTFT data management practice and information governance policy will
is resident within the GSTFT environment.

11.8.2.2 Data Repository

Access to the data repository requires a username and password, and ex
an additional one time pass code is required. One time pass codes are
authentication app set up at the time of account registration.

Authorisation and permissions are described in the Standard Operating P

- PSTOTICU_SOP_003 - Standard Operating Procedure
  Administrator

The clinical investigator team at GSTFT will have permissions to upload an
collaborators will be granted read only permissions to the repository, al
download data sets and indexes only.

Auditing of all file operations and specifically downloads will be implem
trail of repository activity is available. This will be collated, reviewed and
monthly basis.

Data sets stored in the repository will be duplicates of data stored withi

Data will only be processed on specific computing devices maintained with
Storage on project computers will be encrypted with BitLocker software a
over an encrypted transport layer. Access to project computers will be lir

Potential loss of data from the computing environments of study collab
duplication of data within the repository and GSTFT environments.

11.9 Data Collection and Processing Responsibilities

The chief investigator for this project has ultimate responsibility for ens
administered in accordance with the processes outlined by this SOP.

The chief investigator may delegate responsibility for management of th
clinical investigators. A record of delegated responsibilities will be mainta
per the study document:

- PSTOTICU_SD_008 – Staff Delegation Log

12 Statistical considerations

12.1 Sample size calculation

The subjects will comprise a convenience sample only. This study is not s
size or incidence, and so a formal sample size calculation to ensure
inappropriate. Power calculation is not meaningful in this context, si
prospective matching technology rather than statistical comparison.

As described in section 8, the admission of one patient may contribute
catalogue of data sets within the repository.

The iterative nature of model development was described previously in se
that there will a large but variable number of episodes, fitting the require
iteration, available from the electronic health record.

Although the precise number of iterations or available episodes cannot
anticipate 20 development iterations for which a maximum of 250 appro
We thus put an upper bound of collected episodes at 5,000 episodes.

12.2 Statistical analysis

The core models have been designed to represent a dynamic in vivo card

The pulmonary model is comprised of conducting airways and a resp
alveolar compartments, with each compartment having a corresponding s
for stiffness, threshold opening pressures and extrinsic pressures as wel
vascular resistances. This allows for a wide spectrum of ventilation
replicated. The model includes inherent physiological reflex mechanis
vasoconstriction.

The cardiovascular model consists of 19 vascular compartments, each
momentary pressure and volume and its non-linear compliance. Ventricu
using a time-dependent elastance, which implements pulsatile blood flo
is variably transmitted to all intrathoracic compartments, including the

13 Ethical considerations

HRA approval will be sought for this study. Local R&D approval will also b

14 Financing and Insurance

Finance for this project is provided through an EPSRC grant, reference nu

Insurance is provided by the sponsor, Guys & St Thomas' NHS Foundation

15 Reporting and dissemination

Progress of the study will be disseminated and discussed at collaborator

The findings will be presented at national and international conferences a
journals.

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