Using linked administrative data: Hospital Episode Statistics linked with the CLS cohorts

6 December 2022

CENTRE FOR LONGITUDINAL STUDIES

Economic and Social Research Council

Housekeeping

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- Please keep your cameras off and mics muted at all times.
- If you have a question, please use the chat function, and please note your question will be visible to all attendees.
- Technical issues – please email us: ioe.clsevents@ucl.ac.uk.
- We would be grateful for your feedback. Please follow the link in the chat at the end of the event for the short survey.
- Slides and recording will be made available after the session.

- Thank you for joining us today.

Today's schedule

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Time	Topics covered	Speaker
1.00 – 1.15pm	Brief introduction to the cohorts	Richard Silverwood Associate Professor of Statistics
1.15 – 1.30pm	HES data and linkage overview	Sarah Kerry-Barnard Research Data Manager
1.30 – 1.45pm	Accessing linked HES datasets	Danielle Gomes and Karen Dennison Record Linkage Managers
1.45 – 2.15pm	Analysing linked HES data	Richard Silverwood Associate Professor of Statistics
2.15 – 2.30 pm	Q&A	All

CLS studies follow people across life

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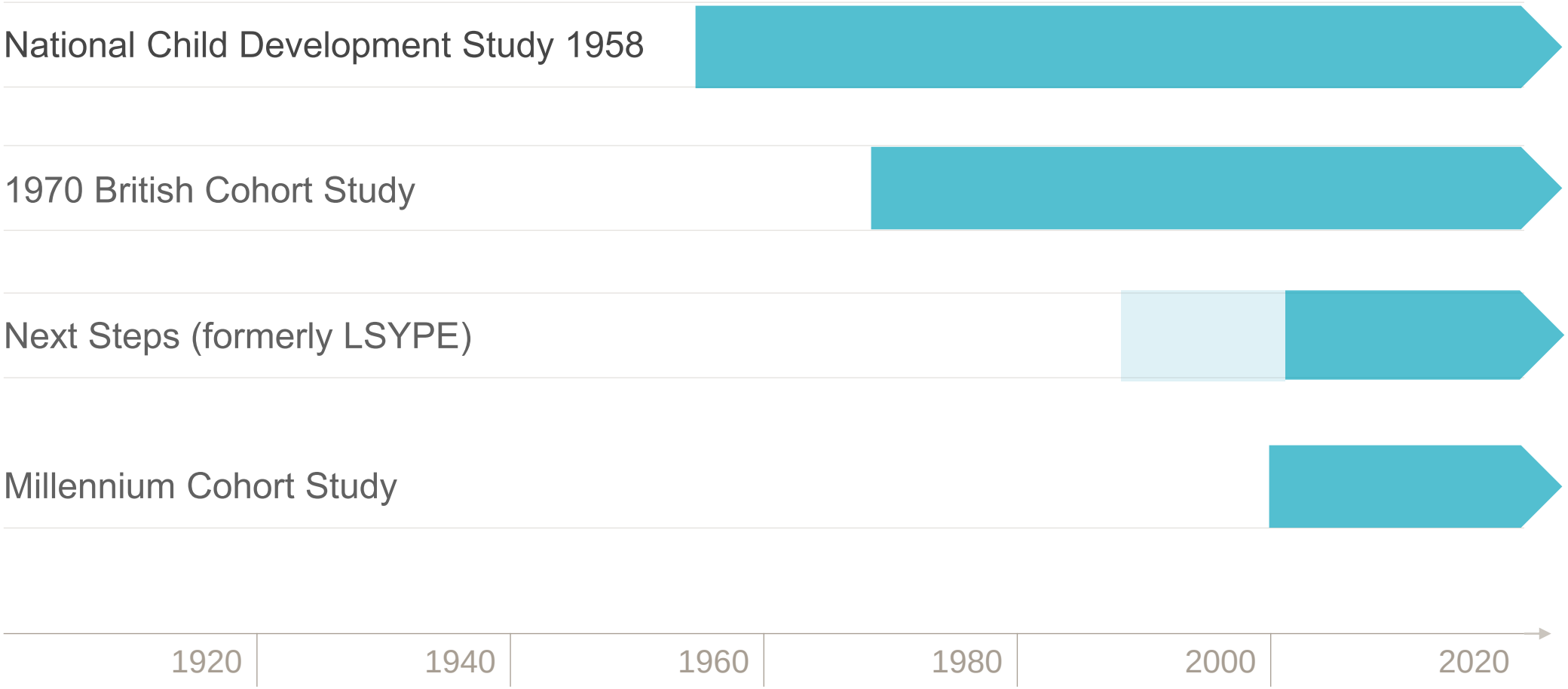

Study timelines

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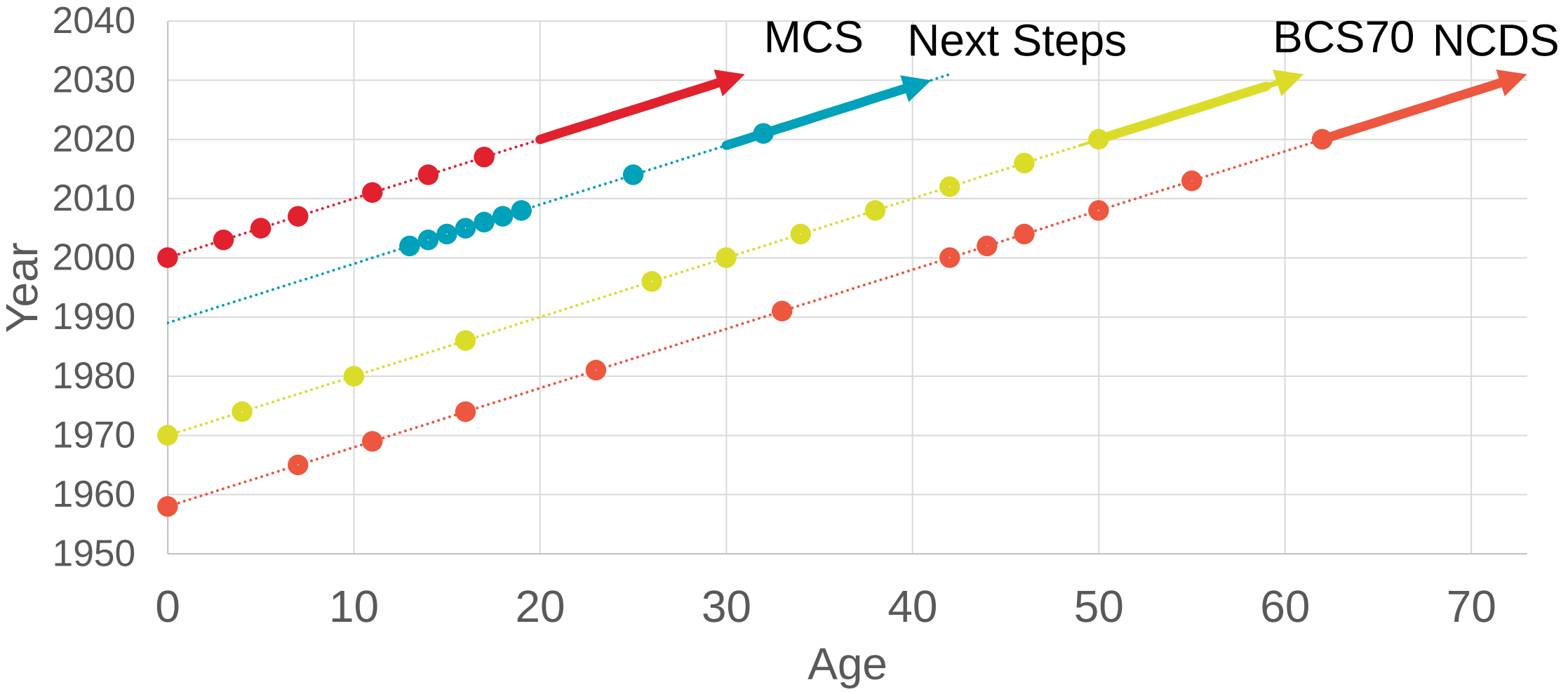

Typical information covered

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Birth (excluding Next Steps)	School years	Adult
Household composition	Household composition	Household composition
Parental social class	Parental social class	Employment
Obstetric history	Parental employment	Social class
Smoking in pregnancy	Financial circumstances	Income
Pregnancy (problems, antenatal care)	Housing	Housing
Labour (length, pain relief, problems)	Health	Health (including biomarkers)
Birthweight, length	Cognitive tests	Well-being and mental health
	Emotions and behaviour	Health-related behaviour
	School	Training and qualifications
	Views and expectations	Basic skills
	Attainment	Cognitive tests
		Views and expectations

Forthcoming training events

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Introduction to NCDS
25 January 2023, 1.00–2.30pm

Introduction CLS cohorts to biomedical researchers (CLOSER)
9 February 2023, 1.00pm–2.00pm

Handling missing data in the CLS cohorts
28 February 2023, 1.00–4.30pm

Introduction to BCS70, Next Steps and MCS
Later in 2023

https://cls.ucl.ac.uk/events/

Call for papers - Children of the noughties: a conference to celebrate 21 years of the Millennium Cohort Study

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- A scientific conference in London, 13-14 June 2023
- Papers may include substantive research topics and research methods. Studies involving cross-study or intergenerational comparisons, or analyses of linked data, are all welcome. It must include MCS data or another millennial longitudinal study. Deadline: Wednesday 18 January 2022

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NHS England – Hospital Episode Statistics (**HES**)

Linked Health Administrative Data

- NHS England – Hospital Episode Statistics (**HES**)
  - NCDS
  - BCS70
  - Next Steps
  - MCS*

- NHS Scotland – Scottish Medical Records (**SMR**)
  - NCDS
  - BCS70
  - MCS

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*available Wed 7th December 2022

Hospital Episodes Statistics User Guide(s)

- Covers everything in this webinar and more
- Available publicly from UK Data Service (UKDS) and CLS websites for NCDS, BCS70 and Next Steps

1. Introduction

2. Consent to health data linkage

3. Health data linkage

3.1 HES datasets

3.2 Matching strategy

3.3 Matching rates

4. The research datasets

4.1 Licensing

4.2 Data documentation provided

4.3 Identifiers

4.4 Data processing

4.5 Data de-identification

4.6 The Accident and Emergency (A&E) data

4.7 The Admitted Patient Care (APC) data

4.8 The Critical Care (CC) data

4.9 The Outpatient Care (OP) data

5. Disclosure control: requirements for data users

5.1. UKDS requirements

5.2. NHS Digital requirements

6. Data access and variable selection

6.1 UKDS Secure Access application

6.2 Selection of variables

6.3 CLS Licence Agreement

Appendices

Modifications to the Accident and Emergency Data

Modifications to the Admitted Patient Care Data

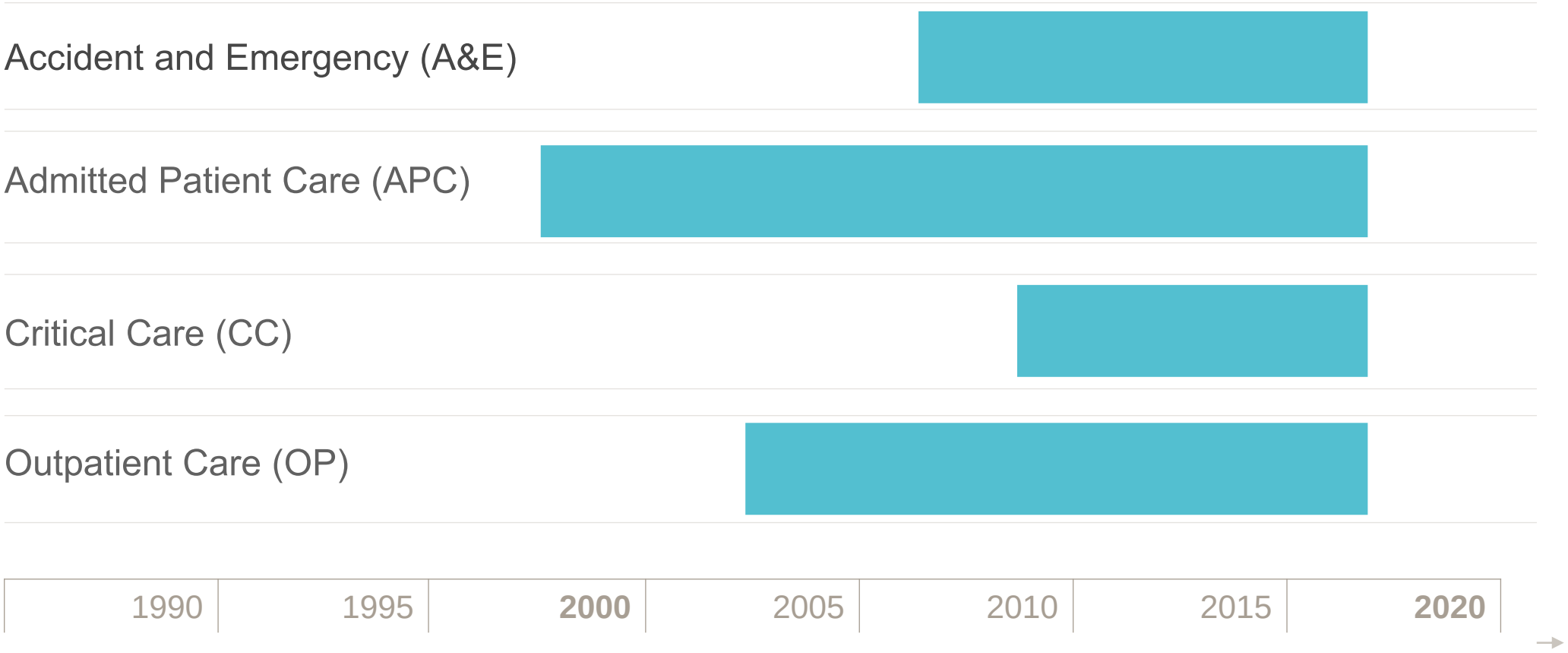
Modifications to the Outpatient Care Data

NHS England – Hospital Episode Statistics (HES)

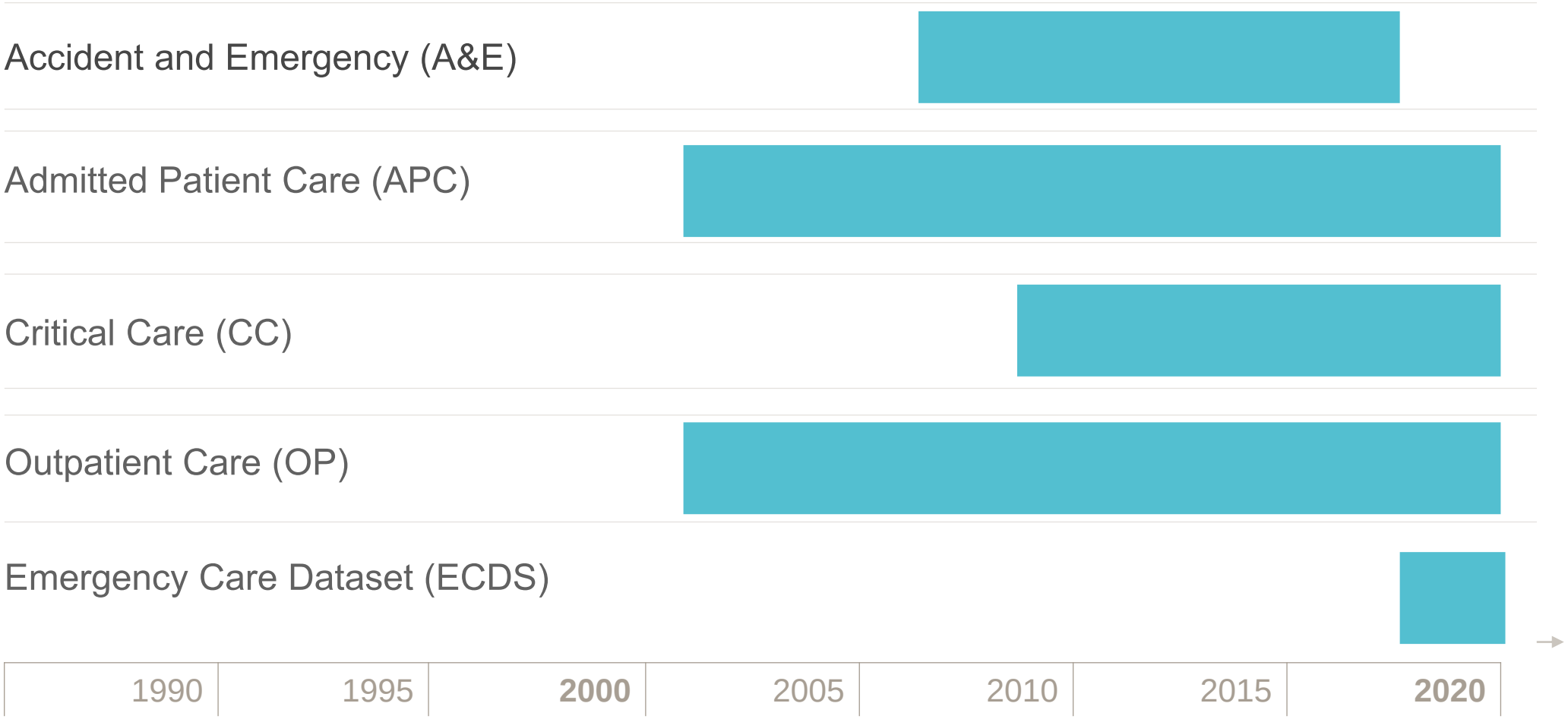
Datasets available:

- Admitted Patient Care (APC)
- Critical Care (CC) – linked to APC records
- Accident and Emergency (A&E)
- Outpatient Care (OP)
- Emergency Care Dataset (ECDS – MCS only)

Hospital Episode Statistics over time – Next Steps, NCDS, BCS70



Hospital Episode Statistics over time – MCS



HES - Linkage

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	Number in sweep*	Gave consent (% of in sweep)	Has matched data (% of consented)
Next Steps	7,707	4,895 (63.5)	4,579 (93.5)
BCS70	9,841	7,048 (71.6)	5,488 (77.9)
NCDS	9,790	7,065 (72.2)	6,188 (87.6)
MCS	10.757	9.214 (86.7)	7,396 (81.5)

* Sweep in which consent was sought for linkage:

- Next Steps: Age 25 Survey
- BCS70: Age 42 Survey
- NCDS: Age 50 Survey
- MCS: Age 17 Survey

HES – Linkage

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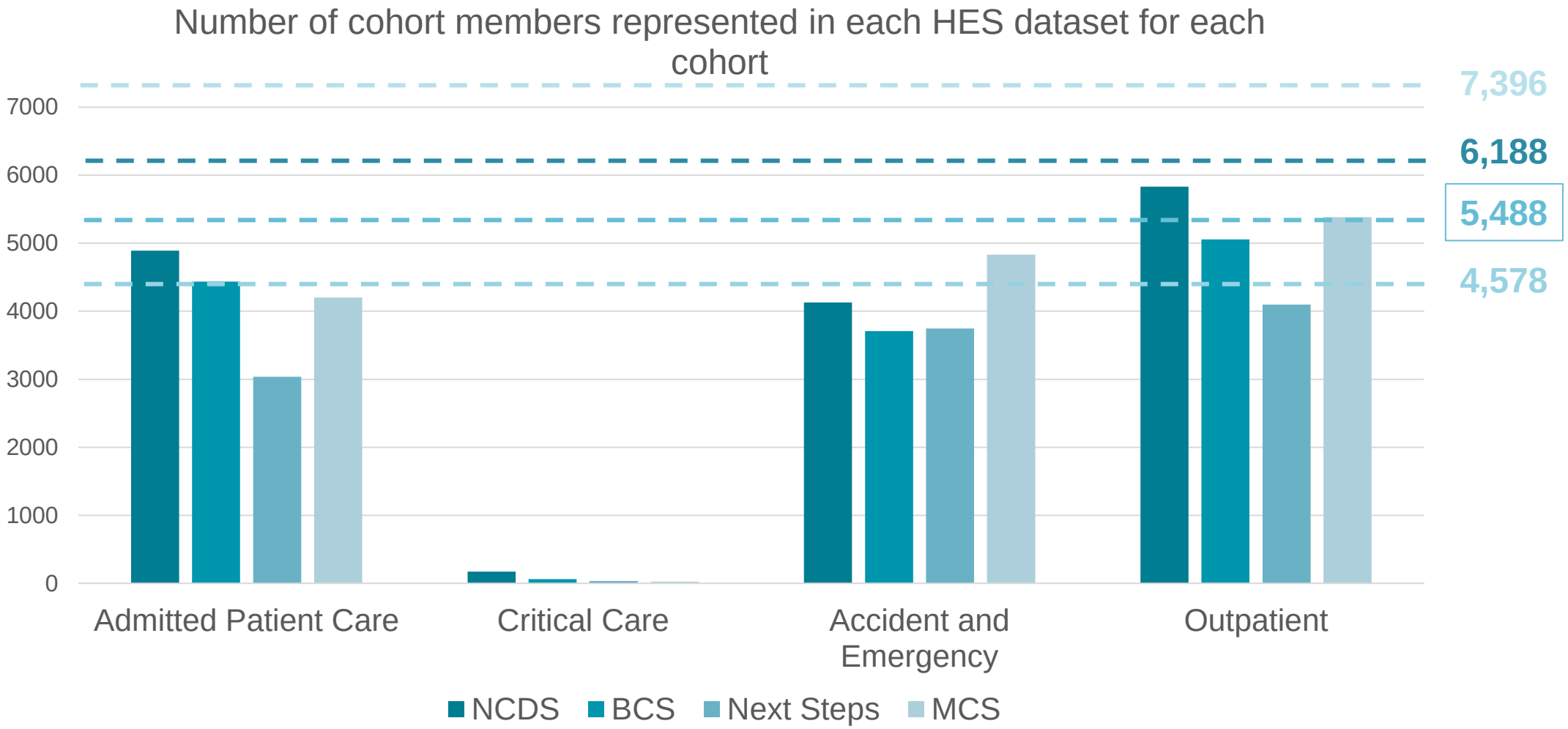

HES – Structure of the data

The NHS organizes the data into episodes

- **Episode**
  - A continuous period of patient care administered under one consultant within health care providers.
  - Each episode is a row in each dataset.
- **Hospital Spell**
  - Total time spent by a patient in the same care provided by a hospital, from date of admission to date of discharge.
  - Spells cover one or more episodes.
  - To avoid double counting, use the last episode in a spell (spelend = Y).

HES - What data are available?

Admitted Patient Care 1997-2017

- Diagnostic codes (ICD-10)
- Operation Chapter (OPCS-4)
- Maternity data
- Indices of Multiple Deprivation
- Administrative data e.g. Health Authority
- Dates of admission, discharge etc

Critical Care 2009-2017

- Types of specialist support i.e. Renal
- Number of days spent with assistance for specialist care.
- Every critical care episode links with an APC code (D_SUSID)

HES - What data are available?

Outpatient Care 2003-2017

- Diagnostic codes (ICD-10) (poorly completed)
- Operation Chapter (OPCS-4)
- Indices of Multiple Deprivation
- Administrative data
- Dates (DD/MM/YYYY) seen

Accident and Emergency 2007-2017

- Diagnostic codes (A&E)
- Treatment codes
- Administrative data
- Dates (DD/MM/YYYY) time admission and discharge

HES – what data are available?

Emergency Care Dataset

- SNOMED-CT
- Diagnostic codes
- Causes of injury & drug information
- Treatment
- Dates of arrival/being seen

HES - Dictionaries & Supplementary Documentation

- CLS User Guide
- NHS Data Dictionaries
- HES Analysis Guide
- International Classification of Diseases ICD-10 (Diagnoses, Symptoms, Causes)
- Operational codes OPCS-4
- A&E Diagnosis and Treatment codes

➢Available on the Secure Access server at the UK Data archive

➢Can be viewed alongside the data

➢Links can also be found in the CLS user guide

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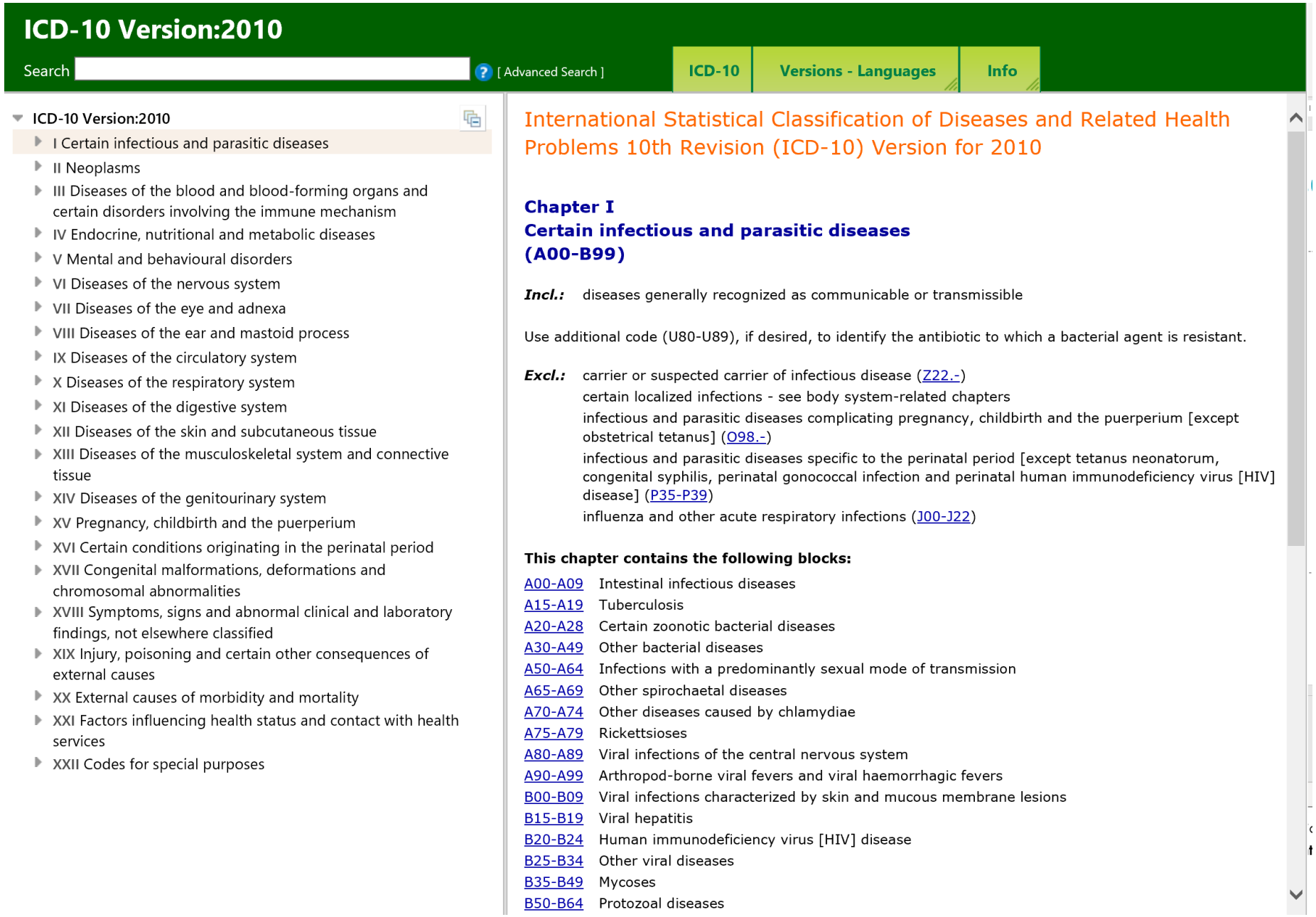
ICD-10



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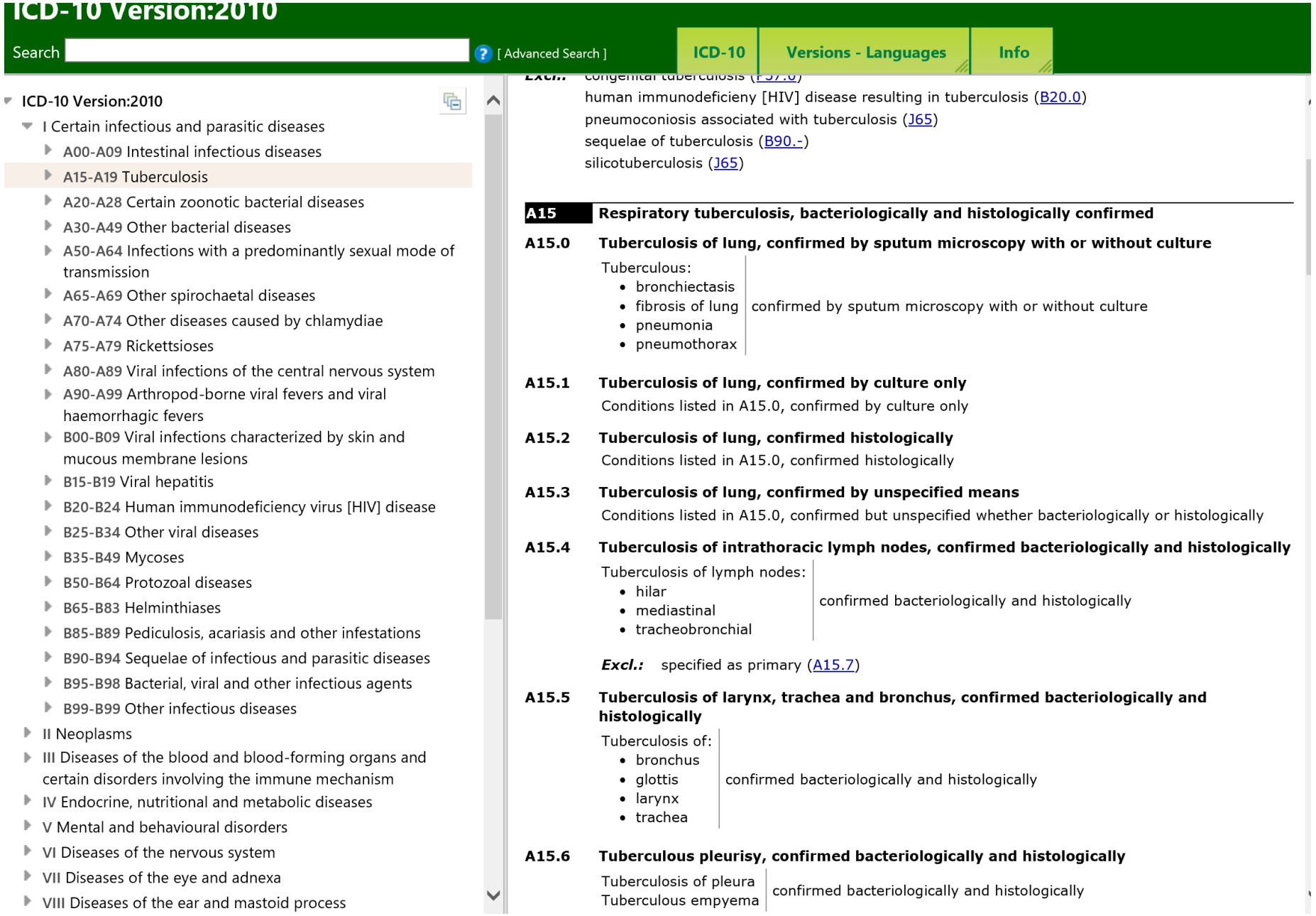
ICD-10



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NHS Scotland – Scottish Medical Records (**SMR**)

NHS Scotland – Scottish Medical Data (SMR)

Dataset	NCDS	BCS70	MCS
Prescribing Information System (PIS)	☑	☑	☑
Outpatient Records (SMR00)	☑	☑	☑
Inpatient Records (SMR01)	☑	☑	☑
Maternity Records (SMR02)	☑	☑	
Birth and Neonatal Records (SMR11)			☑
Scottish Immunisation & Recall System (SIRS)			☑
Child Health Reviews (CHR) 1st visit / 6-8 week visit / 8-9 month visit / 22-24 month visit / 37-42 month visit / Preschool visit /School reviews			☑

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Accessing Health Data

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UK Data Service (UKDS)
UK Longitudinal Linkage Collaboration (UKLLC)

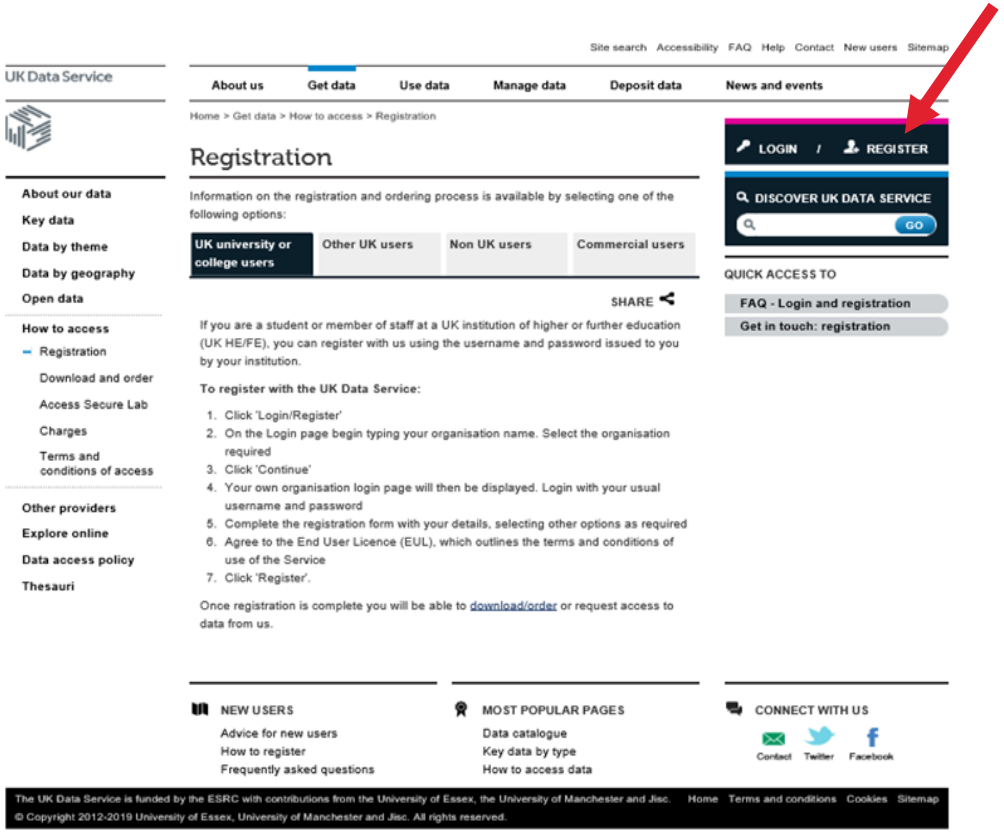
Accessing the data

- Due to the potential disclosivity and sensitivity of HES and SMR data, these datasets are **only** accessible under Secure Access conditions through the UK Data Service Secure Lab.

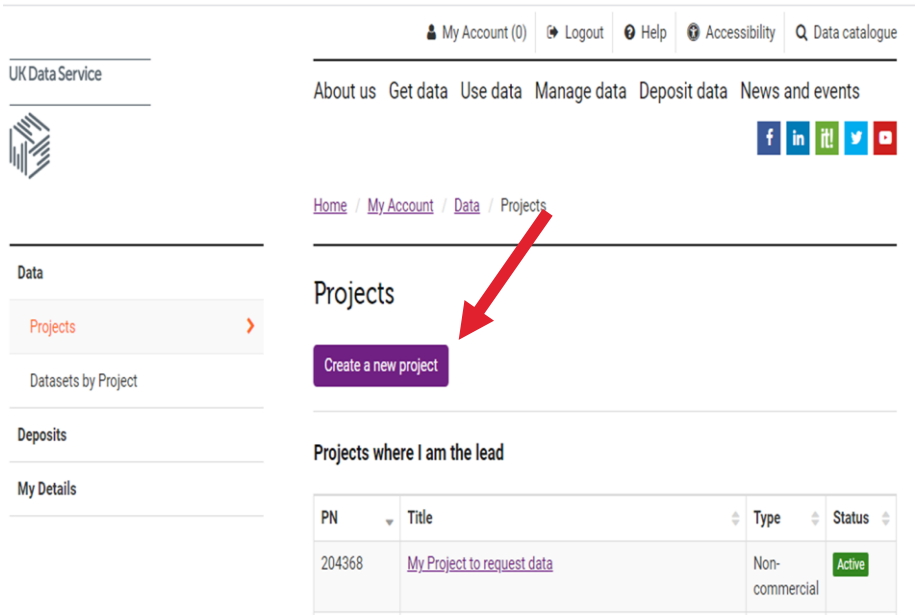
- In order to have access to the data and as part of the application process:
  - you must be based in a UK organisation, and be affiliated with a UK HE or FE institution.
  - you must be an accredited researcher to use **ONS data** or apply to be one as part of the project application **or** you must fill in the accredited researcher form each time you apply to access **ESRC data**
  - your User Agreement must be authorised and signed by someone who can take legal responsibility on behalf of your institution
  - you must have attended and passed a Safe Researcher training course (a place on this course can be offered as part of the application process)
  - you must be able to access the data from a suitable safe environment that meets the UK Data Service's security requirements

To apply to use the data:

Step 1: Register

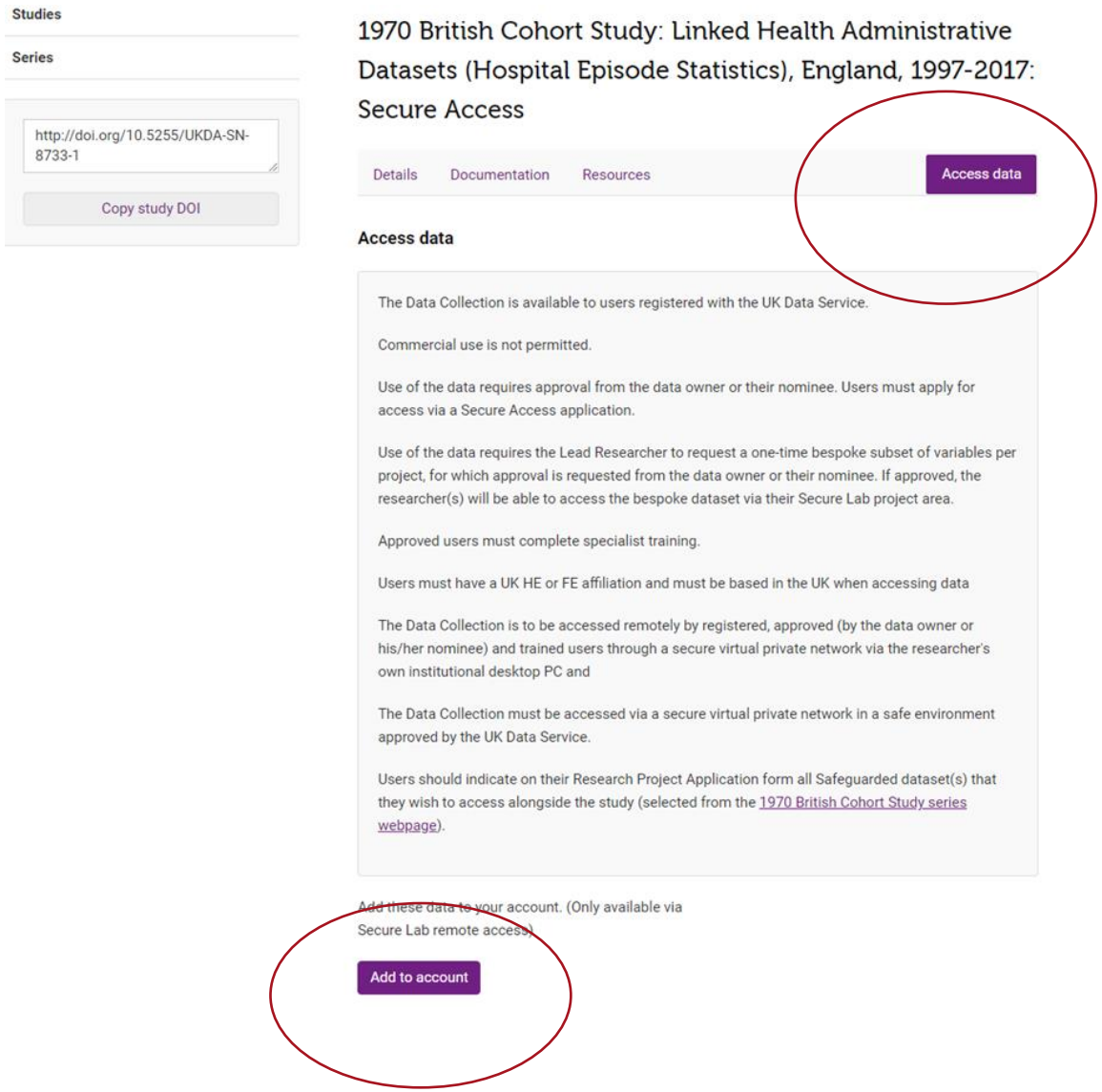


Step 2: Create a project

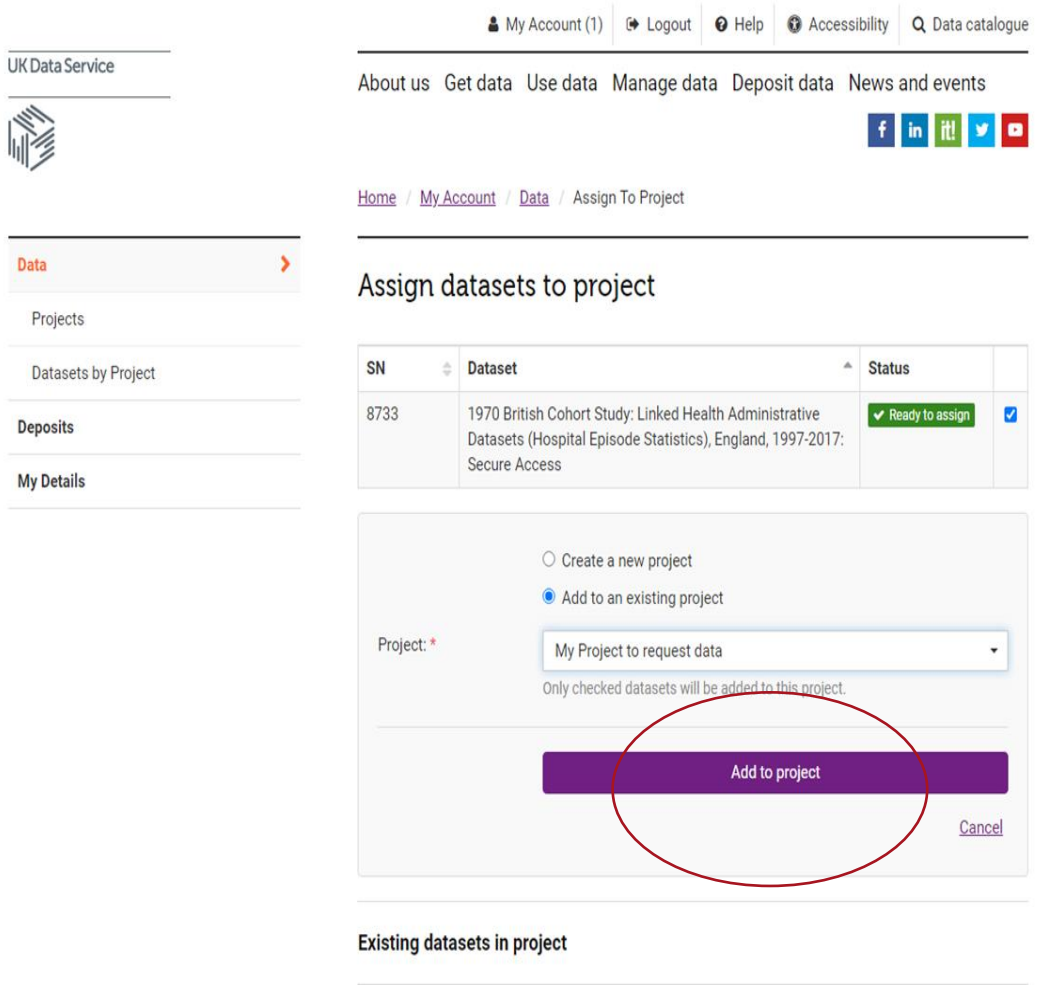


To apply to use the data:

Step 3: Select your data



Step 4: Assign dataset to a project



To apply to use the data

Step 5: Access the appropriate forms

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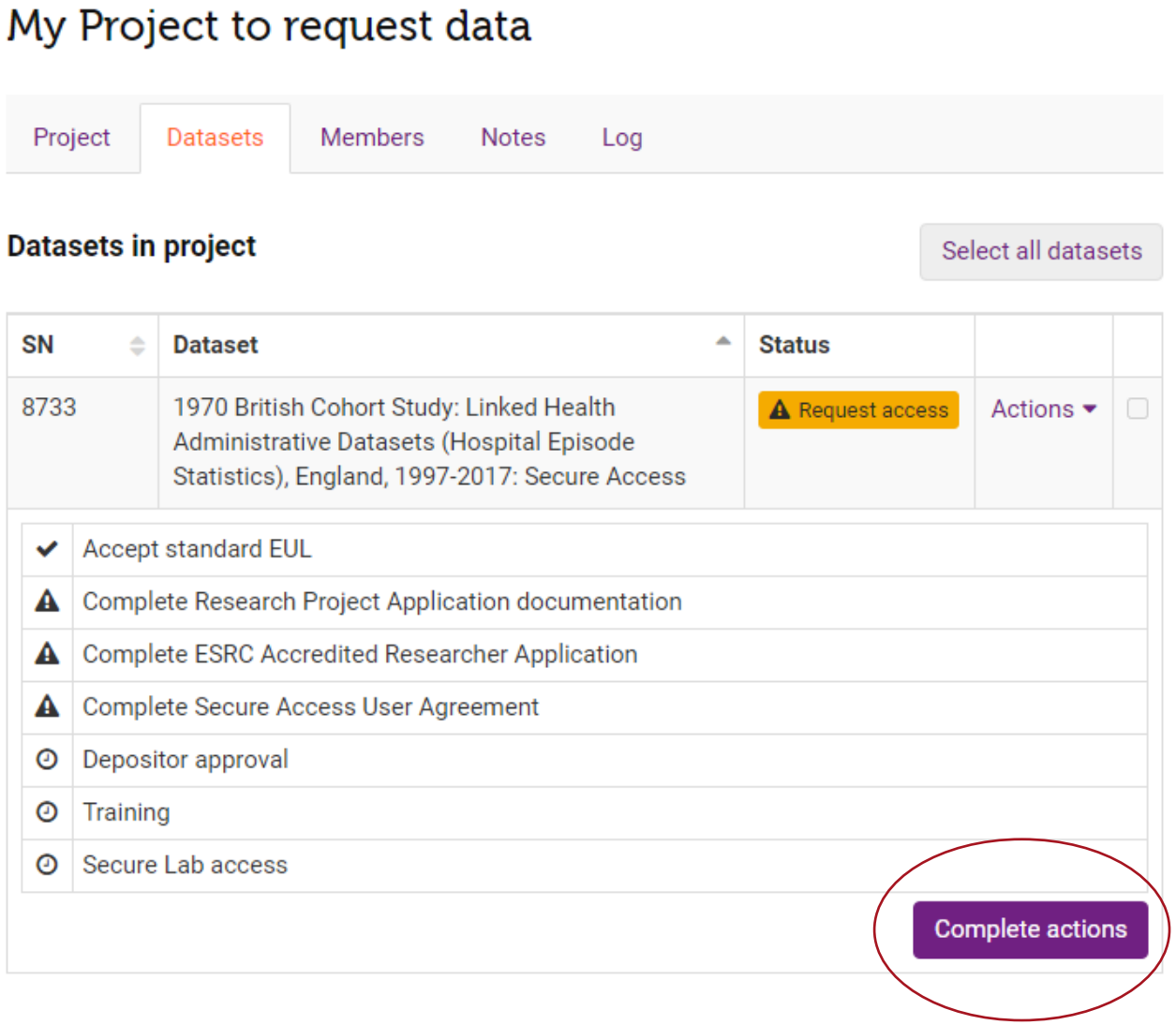
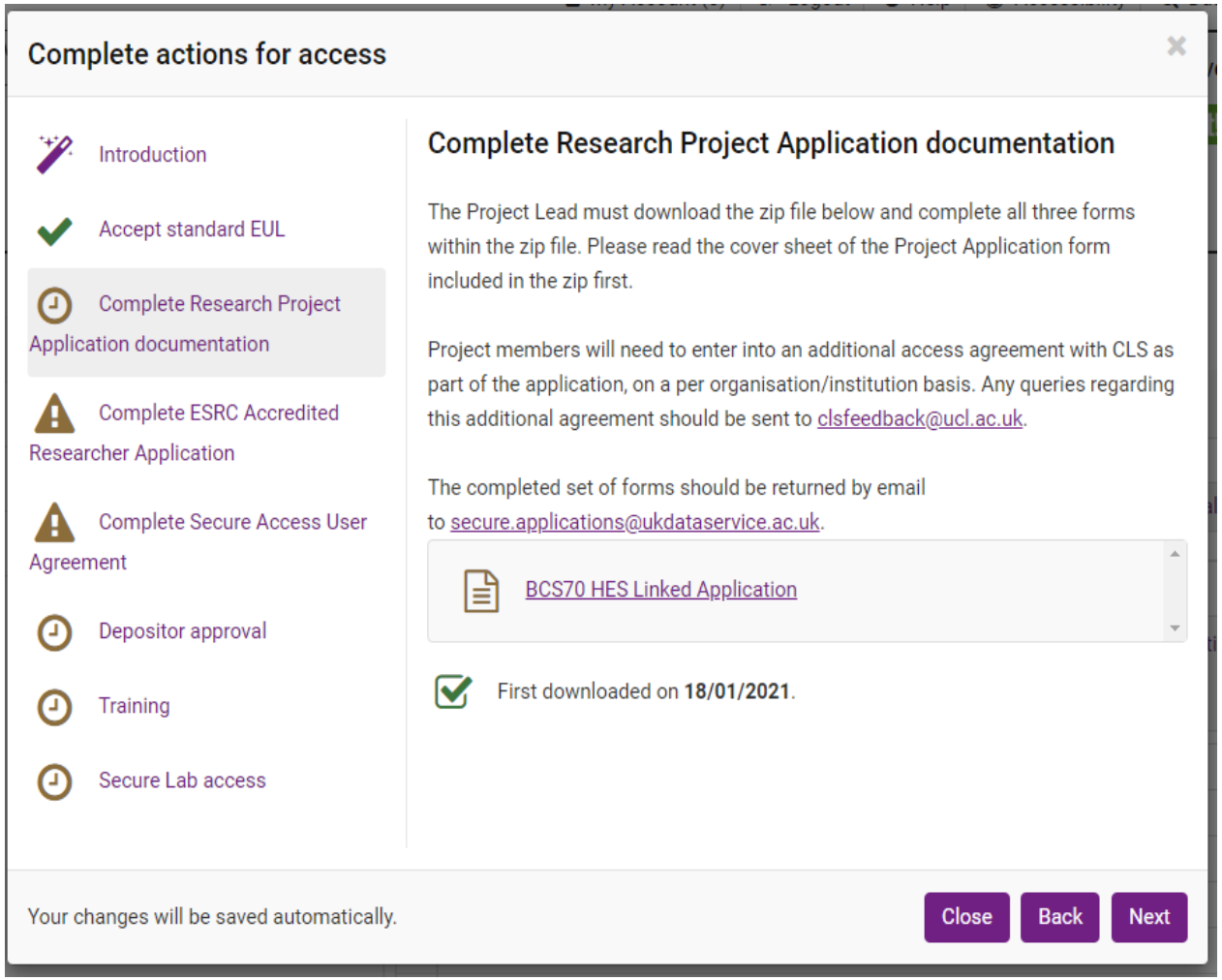


To apply to use the data

Step 5: Download Application forms



Research Project Application documentation

1. UKDS Project Application form
2. ESRC Accredited Researcher Application.
3. Secure Access User Agreement
4. CLS Licence Agreement (HES only)
5. HES Variables list (HES only)
6. Complete the Secure access section

To apply to use the data

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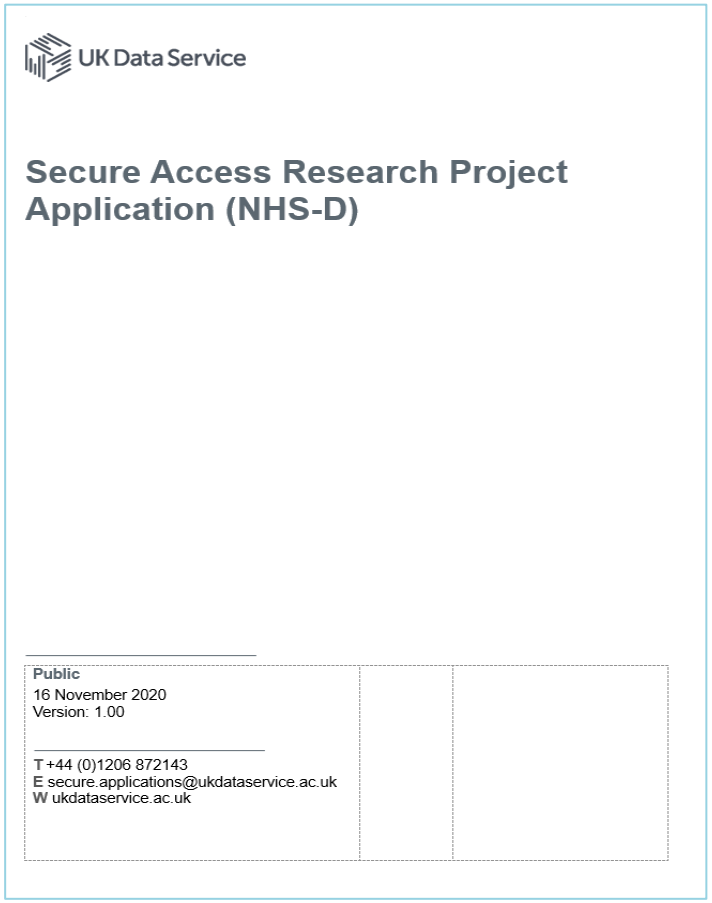
Step 5: Application forms (HES and SMR data)

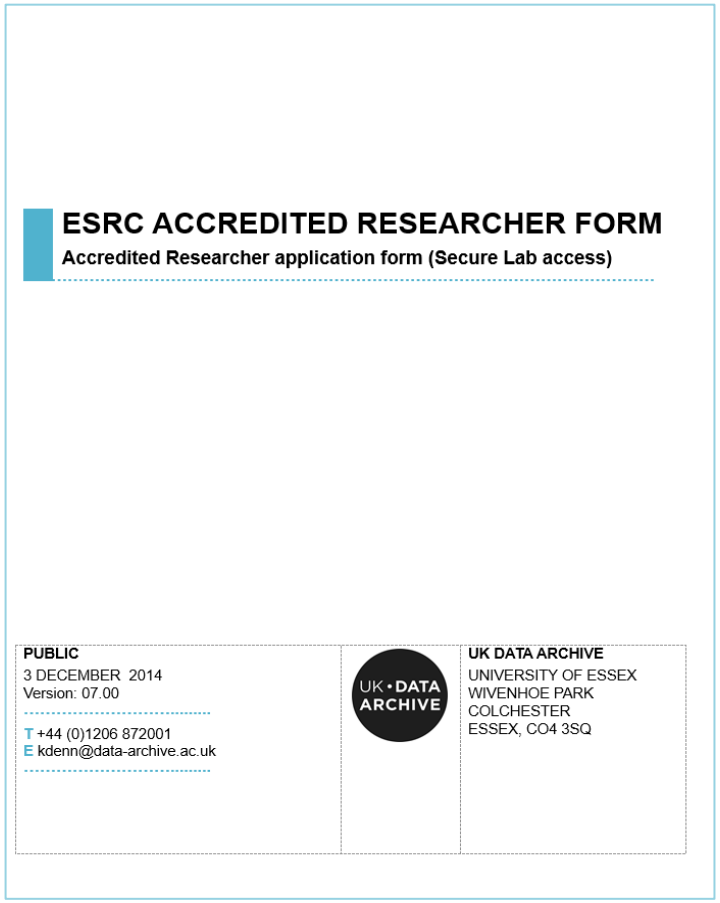

UK Data Service

Secure Access Research Project Application (NHS-D)

Public
16 November 2020
Version: 1.00

T +44 (0)1206 872143
E secure.applications@ukdataservice.ac.uk
W ukdataservice.ac.uk

- **Completed by :** Project Lead


ESRC ACCREDITED RESEARCHER FORM

Accredited Researcher application form (Secure Lab access)

PUBLIC
3 DECEMBER 2014
Version: 07.00

T +44 (0)1206 872001
E kdenn@data-archive.ac.uk

UK • DATA ARCHIVE

UK DATA ARCHIVE
UNIVERSITY OF ESSEX
WIVENHOE PARK
COLCHESTER
ESSEX, CO4 3SQ

Completed by: the Principal Investigator/Project Lead

- Any project member who requires access to statistical analysis before release from the UK Data Service
- PhD supervisors and co-authors (even if they will not be analysing the data)

To apply to use the data

Step 5: Application forms- Agreements (HES and SMR data)

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Project lead and their organisation signatory need to read and agree to terms.

Signed by :

- Project Lead &
- Institution Contracts Office or person authorised to sign on behalf of the organisation.

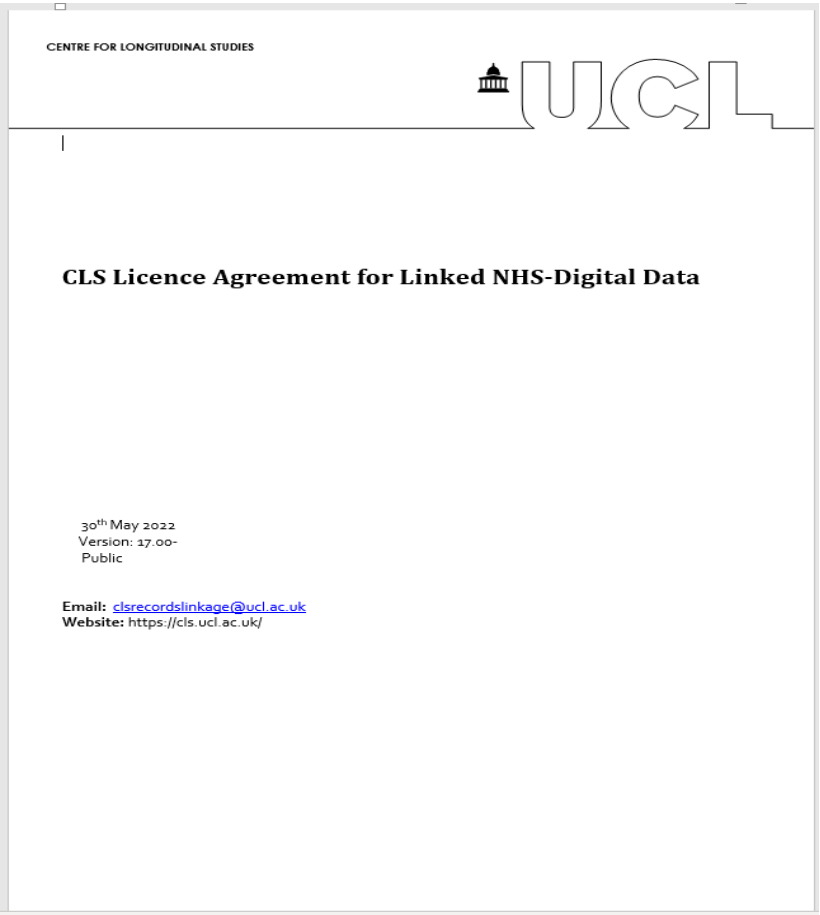
To apply to use the data

Step 5: Application – HES Variable selection (e.g. NCDS_HES_variables_List_1.xlsx)

	A	B	C	D	E	F
1	**Next Steps - Accident & Emergency - Data Dictionary**			Please select the variables you need in the 'Requested' drop down cells		
2						
3	**var_order**	**variable_name**	**variable_label**	**value_labels**	**Requested ? (YES/blank)**	
4	1	NSID	NSID - cohort member identifier		Yes	
5	2	AEARRIVALMODE	Arrival mode	(-1) "Missing: not applicable/not available/not given" (1) " Brought in by ambulance (including helicopter)" (2) "Other"		
6	3	AEATTEND_EXC_PLANNED	Attendances excluding planned	(0.0) "Planned AE Attendance " (1.0) "Unplanned AE Attendance"		
7	4	AEATTENDCAT	Attendance category	(-1) "Missing: not applicable/not available/not given" (1) "First Accident and Emergency attendance" (2) "Follow-up Accident and Emergency attendance - planned" (3) "Follow-up Accident and Emergency attendance - unplanned" (9) "Not known".		
8	5	AEATTENDDISP	Attendance disposal	(1)"Admitted to hospital bed at same HCP" (2)"Discharged follow-up treatment to be provided by GP" (3)"Discharged did not require any follow-up treatment" (4)"Referred to A&E clinic" (5)"Referred to fracture clinic" (6)"Referred to other outpatient clinic" (7)"Transferred to other healthcare provider" (10)"Died in department" (11)"Referred to other healthcare professional" (12)"Left department before being treated" (13)"Left department having refused treatment" (14)"Other" (99)"Not known"		
9	6	AEDEPTTYPE	Department type	(-1) "Missing: not applicable/not available/not given" (1) "Emergency departments" (2) "Consultant-led mono specialty accident and emergency service" (3) "Other type of A&E/ minor injury activity with designated accommodation for reception of patients" (4) "NHS walk-in centres" (99) "Not known"		
10	7	AEINCLOCTYPE	Incident location type	(-1) "Missing: not applicable/not available/not given" (10) "Home" (40) "Work" (50) "Educational establishment" (60) "Public Place" (91) "Other" (99) "Not known"		
11	8	AEPATGROUP	Patient group	(-1) "Missing: not applicable/not available/not given" (10) "Road traffic accident" (20) "Assault" (30) "Deliberate self-harm" (40) "Sports injury" (50) "Firework injury" (60) "Other accident" (70) "Brought in dead" (80) "Other than above" (99) "Not known"		
12	9	AEREFSOURCE	Source of referral for A&E	(-1) "Missing: not applicable/not available/not given" (0) "General medical practitioner" (1) "Self referral" (2) "Local authority social services" (3) "Emergency services" (4) "Work" (5.0) "Educational establishment" (6) "Police " (7.0) "Health care provider: same or other" (8.0) "Other " (92.0) "General dental practitioner" (93.0) "Community dental service"		
13	10	ARRIVALDATE	Arrival start date			
14	11	ARRIVALTIME	Arrival Time HH:MM (00:00 to 25:59)			
15	12	CARERSI	Carer support indicator	(-1) "Missing: not applicable/not available/not given" (1) "Yes" (2) "No"		
16	13	CONCLDUR	Duration to conclusion (in minutes)	(-1) "Missing: not applicable/not available/not given"		
17	14	CONCLTIME	Conclusion time HH:MM (00:00 to 25:59)			
18	15	DEPDUR	Duration to departure (in minutes)	(-1) "Missing: not applicable/not available/not given"		
19	16	DEPTIME	Departure time HH:MM (00:00 to 25:59)			
20	17	DIAG_01	A&E diagnosis (1)	he A&E diagnosis is a six character code made up of, diagnosis condition (n2), sub-analysis (n1), anatomical area (n2) and anatomical side (an1). (-1) "Missing: not applicable/not available/not given"		
21	18	DIAG_02	A&E diagnosis (2)	he A&E diagnosis is a six character code made up of, diagnosis condition (n2), sub-analysis (n1), anatomical area (n2) and anatomical side (an1). (-1) "Missing: not applicable/not available/not given"		
22	19	DIAG_03	A&E diagnosis (3)	he A&E diagnosis is a six character code made up of, diagnosis condition (n2), sub-analysis (n1), anatomical area (n2) and anatomical side (an1). (-1) "Missing: not applicable/not available/not given"		

To apply to use the data

Step 5: Application forms- Additional agreement required (HES data only)



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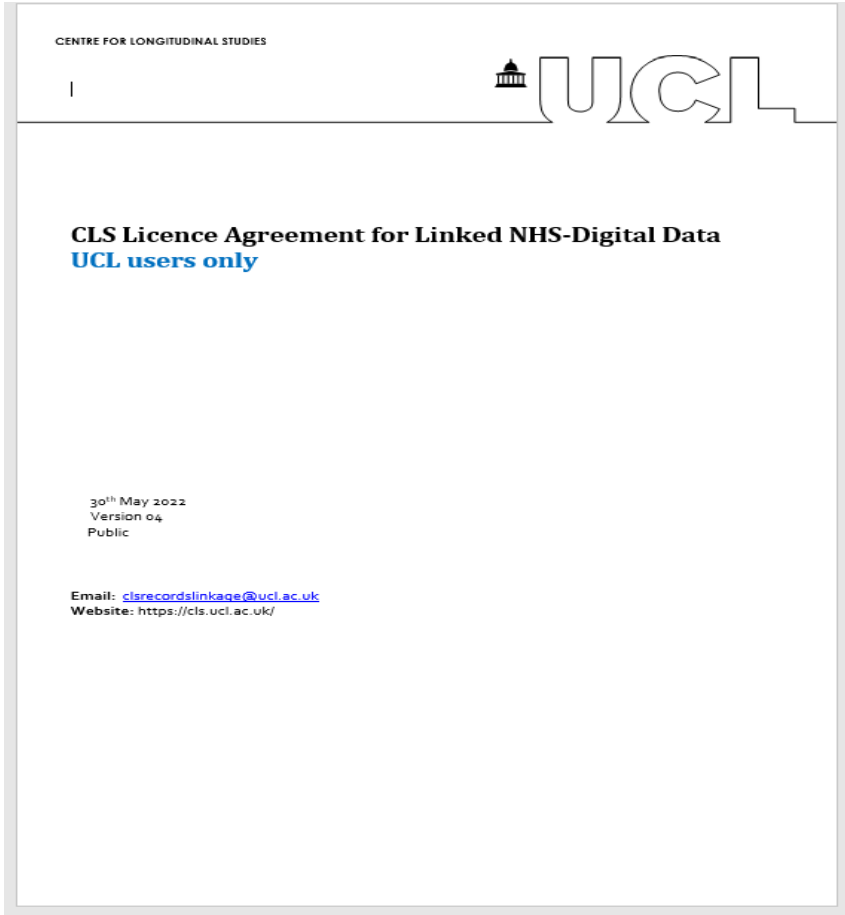
CLS Licence Agreement for Linked NHS-Digital Data

30th May 2022
Version: 17.00-
Public

Email: clsrecordslinkage@ucl.ac.uk
Website: https://cls.ucl.ac.uk/



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UCL

CLS Licence Agreement for Linked NHS-Digital Data
UCL users only

30th May 2022
Version 04
Public

Email: clsrecordslinkage@ucl.ac.uk
Website: https://cls.ucl.ac.uk/

To apply to use the data

Step 5: Application forms- Additional agreement required (HES data only)

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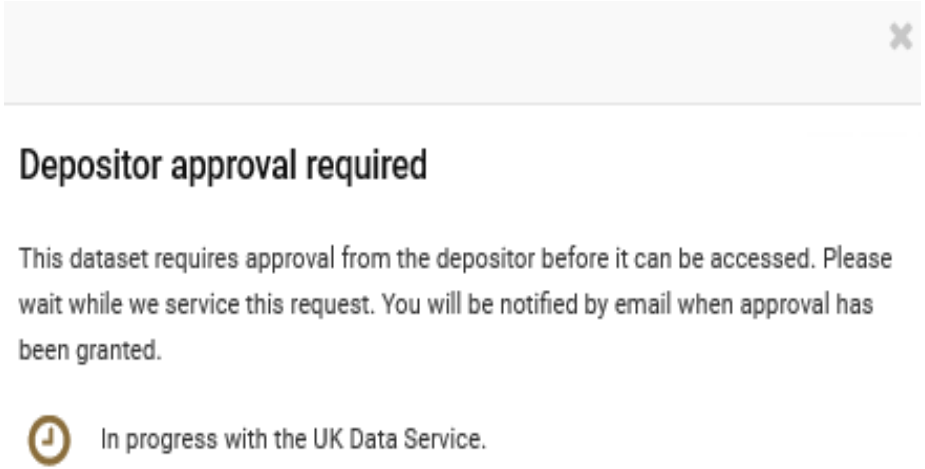
Important sections in the document: These are NHS Digital requirements.

- ✓ Legal basis
- ✓ Organisational Security
- ✓ Project proposal
- ✓ Provide project's expected measurable benefits to Health and/or Social Care
- ✓ Select variables (this is different to Scottish health data where only datasets are specified)
- ✓ Completed by Project Lead and each member applying to use the data.
- ✓ Signed by Institution Contracts Offices or authorised signatory.

Access to secure data

Step 6: **Depositor approval**

- The application will be presented to the CLS Data Access Committee (DAC) for approval.
- For applications requesting access to HES data, DAC will assess whether the researcher has provided satisfactory information to the NHS Digital requirements sections highlighted previously.



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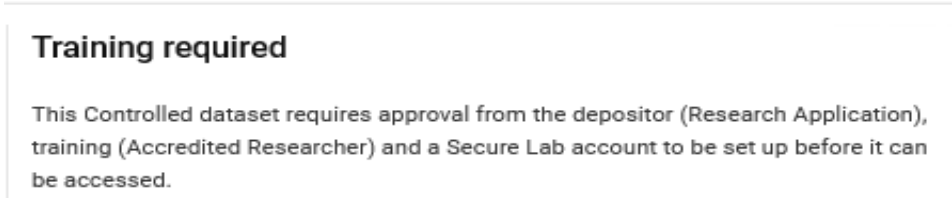
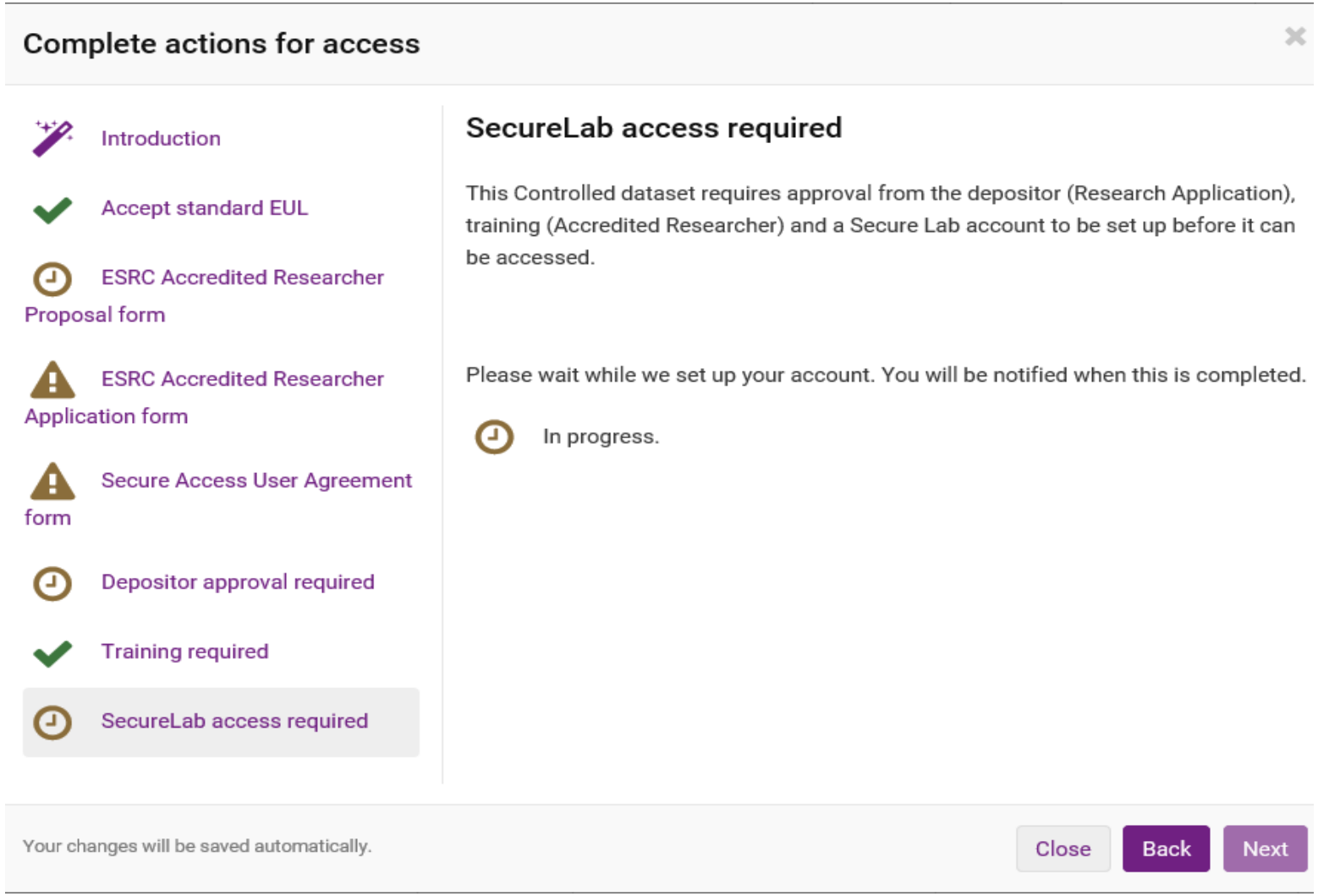
Access to secure data



Step 7: **Training**

- New Secure Lab researchers who haven't previously completed the Safe User of Research Environment (SURE) or Safe Researcher Training will be invited by the UKDS to attend training.
- Researchers who completed training since January 2016 will be required to complete a short online training that covers the specifics of the Secure Lab,
- Current Secure Lab researchers who have not accessed the Secure lab for 30 months will be asked to complete a short online refresher course.

Access to secure data: Secure Lab Access



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Accessing the data

- For more information **on how to apply** for access, please visit https://www.ukdataservice.ac.uk/get-data/how-to-access/accesssecurelab
- If you have any **enquiries regarding the application process**, please contact the UK Data Service via their 'Accessing data' web form: https://beta.ukdataservice.ac.uk/help?id=accessingData
- Alternatively, the UK Data Service can be contacted via email at help@ukdataservice.ac.uk, or by telephone on 01206 872143.

Timescales
All applications must be validated and processed by the UK Data Service and then approved by the data owners. The UK Data Service works through a high volume of applications throughout the year. The UK Data Service endeavour to process applications as soon as possible but each application may take a number of months from start to finish.

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Welsh health data in the MCS via the SAIL Data Bank

Datasets available:

- Emergency Department Dataset
- Primary Care GP dataset
- Outpatient Dataset
- Patient Episode Database (episodes of inpatient and day case care)
  - MCS1-6 currently available
  - Data for CM's (up to age 14) and parents

Access

Secure Anonymised Information Linkage **(SAIL) Databank** – a Wales-wide research resource offering a range of health related datasets.

- Can apply for any health data in the SAIL Databank via https://data.ukserp.ac.uk/Organisation/Category?nodeId=1&orgId=0
- Application process can be found at https://saildatabank.com/application-process/two-stage-process/
- There is a charge determined on a case by case basis

Linked health administrative data available at the UKDS in the near future

- HES refresh for Next Steps, BCS70 and NCDS.
- CLS will refresh the Welsh health dataset linked to MCS (2001-2012) currently available at the UKDS.

CENTRE FOR LONGITUDINAL STUDIES

Thank you

Any questions?

CENTRE FOR LONGITUDINAL STUDIES

Economic and Social Research Council

The UK Longitudinal Linkage Collaboration:
a research resource for the longitudinal research commun

UK LLC led by the Universities of Bristol & Edinburgh

Funded by

UK Research and Innovation

In collaboration with

A work package in the COVID-19 Longitudinal Health & Wellbeing National Core Study

Slides provided by UK LLC and adapted/presented by CLS

A globally unique cross-cutting resource

20+ Longitudinal Population Studies

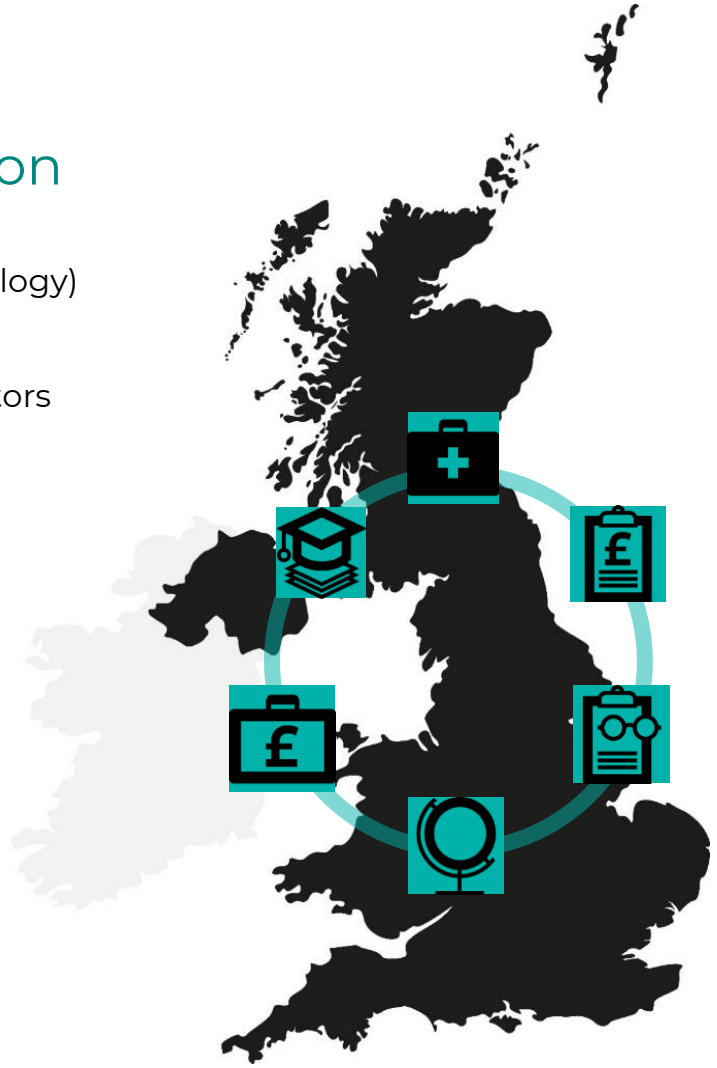
- COVID-19 collections (Questionnaires, Serology)
- SES & demographic
- Baseline physical & mental health
- Baseline family, SES and life-course indicators

NHS COVID-19 datasets

- GP Data
- Vaccinations
- COVID-19 test data (Pillar 1-3)
- Accident & Emergency
- CHESS

Wider NHS datasets

- Hospital Inpatient data
- Cancer & mortality registers
- Community Mental Health (MHSDS, IAPT)
- Prescribing data



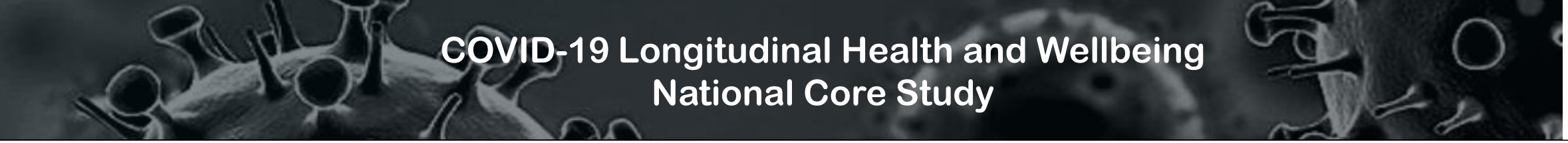
Administrative records

- HMRC
- DWP
- DfE

Approvals in place

Environmental & neighbourhood

- Air pollution
- Noise
- Greenspace
- SES & demographic indicators
- Service provision
- Property data



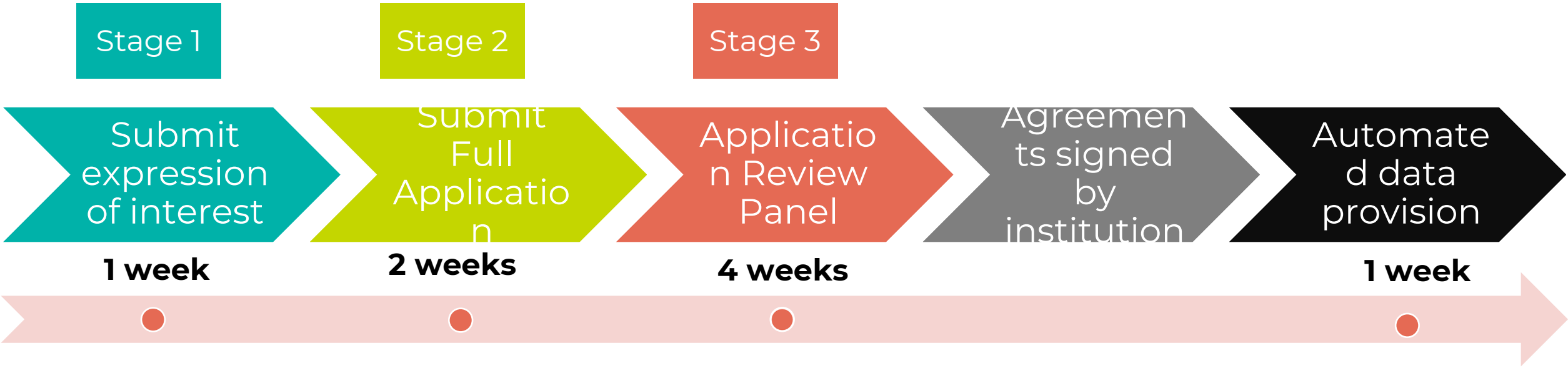
COVID-19 Longitudinal Health and Wellbeing
National Core Study

UK Longitudinal Linkage Collaboration

20+ longitudinal studies with **>280,000 participants**
A new Trusted Research Environment
Novel NHS Digital data pipeline
Approvals for hitherto inaccessible data
Public contributors & application panel
23 approved research projects

AIRWAVE Health Monitoring Study Tissue Bank
ALSPAC: Avon Longitudinal Study of Parents and Children
BCS70 British Cohort Study
Born in Bradford
ELSA: English Longitudinal Study of Ageing
EPIC-Norfolk: The European Prospective Investigation into Cancer (EPIC) Norfolk Study
EXCEED: Extended Cohort for E-health, Environment & DNA
The Fenland Study
Generation Scotland
GLAD: Genetic Links to Anxiety and Depression Study
MCS: Millennium Cohort Study
NCDS 58: 1958 National Child Development Study
Next Steps
NICOLA: Northern Ireland Cohort for the Longitudinal Study of Ageing
NIHR BioResource_COPING: National Institute of Health Research BioResource, COVID-19 Psychiatry and Neurological Genetics Study
NSHD46: MRC National Survey of Health and Development Cohort/1946 Birth Cohort
SABRE: Southall & Brent Revisited
TRACK-COVID Study
TwinsUK
Understanding Society - the UK Household Longitudinal Study

UK LLC: Data Access Overview



Submit expression of interest via Health Data Research UK gateway https://www.healthdatagateway.org/ - search for UK LLC
- in the UK LLC record, click on 'How to access'

- Free to ONS accredited UK Researchers
- Public benefit with public review
- Requirements for reproducible research
- UK LLC distributes applications to contributing studies
- UK LLC has delegated review authority from NHS Digital

- **8 - week Service Level Agreement**

Access to the data

All processing *within* the ISO 27001 accredited Trusted Research Environment

- Access via Windows 10 remote desktop environment using two-factor authentication
- Project-specific database views
- Access to code lists and code mappings
- Standard packages for analyses include - Python, R(+RStudio), Stata and SPSS
- Outputs checked for statistical disclosure control before released from the Trusted Research Environment

Looking ahead

- Currently funded until May 2023 - application for new 5-year funding submitted
- Q3 and Q4 2023
  - Opening up to research beyond Covid-19
  - Addition of Welsh NHS data
  - Addition of HMRC data
- Q1 and Q2 2024
  - Addition of Scottish NHS data
  - DWP then DfE to follow

Help/questions

- **access@ukllc.ac.uk**

Analysing linked HES data

Richard Silverwood
Associate Professor of Statistics &
CLS Chief Statistician

6 December 2022

CENTRE FOR LONGITUDINAL STUDIES

UKRI Economic and Social Research Council

Outline

CENTRE FOR LONGITUDINAL STUDIES

1. HES data structure and variables
2. Defining your analysis sample
3. Recent analyses
4. Resources

HES data structure and variables

HES data structure: Episodes and spells

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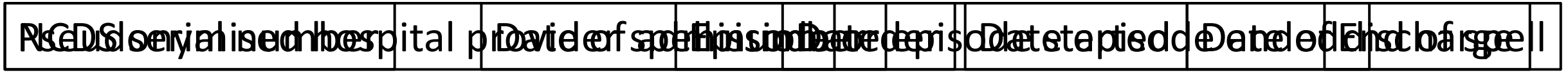
- Each record in HES is a hospital **episode**.
- Episodes relate to a period of care for a patient under a single consultant within one hospital provider.
- A stay in hospital from admission to discharge is called a **spell** and can be made up of one or more episodes of care.

HES data structure: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES



ncdsid	provspnops	admidate	epiorder	epistart	epiend	disdate	spelend
N3674M	HS6Q9B4HU27D96MF61P5	16jan2010	1	16jan2010	18jan2010	18jan2010	Y
N8429G	JS8G36DJV8538JSBDNH8	07aug2003	1	07aug2003	07aug2003	.	N
N8429G	JS8G36DJV8538JSBDNH8	07aug2003	2	07aug2003	13aug2003	13aug2003	Y
N4275R	H836FTK2SN9JTEB533N2	21feb1999	1	21feb1999	22feb1999	.	N
N4275R	H836FTK2SN9JTEB533N2	21feb1999	2	22feb1999	22feb1999	.	N
N4275R	H836FTK2SN9JTEB533N2	21feb1999	3	22feb1999	25feb1999	25feb1999	Y
N4275R	64NQF48J6D2UH76WN382	09nov2015	1	09nov2015	09nov2015	.	N
N4275R	64NQF48J6D2UH76WN382	09nov2015	2	09nov2015	14nov2015	14nov2015	Y

HES data structure: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

ncdsid	provspnops	Admidate	epiorder	epistart	epiend	disdate	spelend
N3674M	HS6Q9B4HU27D96MF61P5	16jan2010	1	16jan2010	18jan2010	18jan2010	Y
N8429G	JS8G36DJV8538JSBDNH8	07aug2003	1	07aug2003	07aug2003	.	N
N8429G	JS8G36DJV8538JSBDNH8	07aug2003	2	07aug2003	13aug2003	13aug2003	Y
N4275R	H836FTK2SN9JTEB533N2	21feb1999	1	21feb1999	22feb1999	.	N
N4275R	H836FTK2SN9JTEB533N2	21feb1999	2	22feb1999	22feb1999	.	N
N4275R	H836FTK2SN9JTEB533N2	21feb1999	3	22feb1999	25feb1999	25feb1999	Y
N4275R	64NQF48J6D2UH76WN382	09nov2015	1	09nov2015	09nov2015	.	N
N4275R	64NQF48J6D2UH76WN382	09nov2015	2	09nov2015	14nov2015	14nov2015	Y

Basic data checks

CENTRE FOR LONGITUDINAL STUDIES

- Variable completeness and quality differs by variable and dataset.
- Important to conduct some basic data checks, e.g.:
  - Dates correctly recorded/formatted (e.g. within plausible range).
  - Ordering of dates is plausible (e.g. within spells).
  - Observed episodes within spell consistent with epiorder.

ICD-10 coding

CENTRE FOR LONGITUDINAL STUDIES

- International Classification of Diseases version 10 (ICD-10).
- Codifies diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases.

ICD-10 Version:2010

https://icd.who.int/browse10/2010/en#/

Search hypertension [Advanced Search]

ICD-10 | Versions - Languages | Info

- ICD-10 Version:2010
  - I Certain infectious and parasitic diseases
  - II Neoplasms
  - III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
  - IV Endocrine, nutritional and metabolic diseases
  - V Mental and behavioural disorders
  - VI Diseases of the nervous system
  - VII Diseases of the eye and adnexa
  - VIII Diseases of the ear and mastoid process
  - IX Diseases of the circulatory system
    - I00-I02 Acute rheumatic fever
    - I05-I09 Chronic rheumatic heart diseases
    - I10-I15 Hypertensive diseases
    - I20-I25 Ischaemic heart diseases
    - I26-I28 Pulmonary heart disease and diseases of pulmonary circulation
    - I30-I52 Other forms of heart disease
    - I60-I69 Cerebrovascular diseases
    - I70-I79 Diseases of arteries, arterioles and capillaries
    - I80-I89 Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified
    - I95-I99 Other and unspecified disorders of the circulatory system
  - X Diseases of the respiratory system
  - XI Diseases of the digestive system
  - XII Diseases of the skin and subcutaneous tissue
  - XIII Diseases of the musculoskeletal system and connective tissue

(I00-I99)

Hypertensive diseases (I10-I15)

Excl.: complicating pregnancy, childbirth and the puerperium (O10-O11, O13-O16)
involving coronary vessels (I20-I25)
neonatal hypertension (P29.2)
pulmonary hypertension (I27.0)

I10 Essential (primary) hypertension

Incl.: High blood pressure
Hypertension (arterial)(benign)(essential)(malignant)(primary)(systemic)

Excl.: involving vessels of:
- brain (I60-I69)
- eye (H35.0)

I11 Hypertensive heart disease

Incl.: any condition in I50.-, I51.4-I51.9 due to hypertension

I11.0 Hypertensive heart disease with (congestive) heart failure

Hypertensive heart failure

I11.9 Hypertensive heart disease without (congestive) heart failure

Hypertensive heart disease NOS

I12 Hypertensive renal disease

Incl.: any condition in N00-N07, N18.-, N19 or N26 due to hypertension
arteriosclerosis of kidney
arteriosclerotic nephritis (chronic)(interstitial)
hypertensive nephropathy
nephrosclerosis

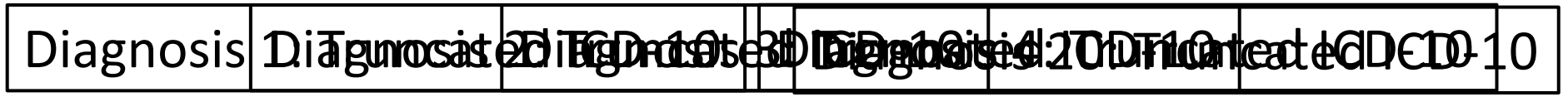
ICD-10 coding: Chapters

CENTRE FOR LONGITUDINAL STUDIES

Chapter	Block	Title
I	A00–B99	Certain infectious and parasitic diseases
II	C00–D48	Neoplasms
III	D50–D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	E00–E90	Endocrine, nutritional and metabolic diseases
V	F00–F99	Mental and behavioural disorders
VI	G00–G99	Diseases of the nervous system
…	…	…
XXII	U00–U99	Codes for special purposes

ICD-10 coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES



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N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.

ICD-10 coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

ncdsid	provspnops	D_DIAG_01	D_DIAG_02	D_DIAG_03	D_DIAG_04	…	D_DIAG_20
N3674M	HS6Q9B4HU27D96MF61P5	I77	.	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.

ICD-10 coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

ncdsid	provspnops	D_DIAG_01	D_DIAG_02	D_DIAG_03	D_DIAG_04	…	D_DIAG_20
N3674M	HS6Q9B4HU27D96MF61P5	I77	.	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	Z85	G35	Z51	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	I42	K29	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.
N4275R	64NQF48J6D2UH76WN382	R06	Z87	K12	N23	…	.

ICD-10 coding: Example code

CENTRE FOR LONGITUDINAL STUDIES

May want to group codes, e.g. into chapters:

```
. gen D_DIAG_01_ch = .

. replace D_DIAG_01_ch = 1 if substr(D_DIAG_01, 1, 1)=="A" |
  substr(D_DIAG_01, 1, 1)=="B"

. replace D_DIAG_01_ch = 2 if substr(D_DIAG_01, 1, 1)=="C" |
  substr(D_DIAG_01, 1, 2)=="D0" | substr(D_DIAG_01, 1, 2)
  =="D1" | substr(D_DIAG_01, 1, 2)=="D2" |
  substr(D_DIAG_01, 1, 2)=="D3" | substr(D_DIAG_01, 1,
  2)=="D4"

  ...
```

Expand to all diagnosis positions by looping over D_DIAG_01, …, D_DIAG_20.

ICD-10 coding: Example code

CENTRE FOR LONGITUDINAL STUDIES

Often interested in whether an individual has *ever* had a certain diagnosis. E.g. for Chapter I:

```
. gen D_DIAG_01_ch1 = (D_DIAG_01_ch==1)

. gen D_DIAG_01_ch1_ever = D_DIAG_01_ch1

. bysort ncdsid (D_DIAG_01_ch1_ever): replace
  D_DIAG_01_ch_1_ever = D_DIAG_01_ch1_ever[_N]
```

Extend to all chapters by looping over Chapters 1-22

OPCS coding

CENTRE FOR LONGITUDINAL STUDIES

- Office of Population Censuses and Surveys (OPCS) Classification of Interventions and Procedures.
- Codifies operations, procedures and interventions performed during in-patient stays, day case surgery and some out-patient treatments in NHS hospitals.

NHS Digital **Classifications Browser OPCS-4.8**

https://classbrowser.nhs.uk/#/book/OPCS-4.8

appendix

OPCS-4.8 ➤ Volume I - Tabular List

- OPCS-4.8
  - Volume I - Tabular List
  - Volume II - Alphabetical Index

Found: 16 matches

- Volume I - Tabular List
  - Part 2 - Tabular List of Four Digit Subcategories
    - H01 Emergency excision of appendix
    - H01.1 Emergency excision of abnormal appendix and drainage HFQ
    - H01.2 Emergency excision of abnormal appendix NEC
    - H01.3 Emergency excision of normal appendix
    - H02 Other excision of appendix
    - H03 Other operations on appendix
    - H03.1 Drainage of abscess of appendix
    - H03.2 Drainage of appendix NEC
    - H03.3 Exteriorisation of appendix
    - Z28.1 Appendix
- Volume II - Alphabetical Index
  - I. Alphabetical Index of Interventions and Surgical Procedures
    - H03.- Appendix Operations NEC
    - Z28.1 Appendix site
    - H03.- Drainage Appendix
    - H01.- Excision Appendix Emergency
    - H02.- Excision Appendix NEC
    - H03.3 Exteriorisation Appendix

OPCS coding: Chapters

CENTRE FOR LONGITUDINAL STUDIES

Chapter/first character*	Title
A	Nervous System
B	Endocrine System and Breast
C	Eye
D	Ear
E	Respiratory Tract
F	Mouth
…	…
Z	Subsidiary Classification of Sites of Operation

*Codes beginning with an “O” are overflow codes and should be handled differently.

OPCS coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

Intervention/procedure	Intervention/procedure	Intervention/procedure	Intervention/procedure	Intervention/procedure	Intervention/procedure	Intervention/procedure	Intervention/procedure
OPCS 4.3	**OPCS 4.3**	**OPCS 4.3**	**OPCS 4.3**	**OPCS 4.3**	**OPCS 4.3**	**OPCS 4.3**	**OPCS 4.3**

ncdsid	provspnops	opertn_01	opertn_02	opertn_03	opertn_04	…	opertn_23
N3674M	HS6Q9B4HU27D96MF61P5	Z815	.	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	U212	W581	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	Y534	Z664	G451	.	…	.
N4275R	H836FTK2SN9JTEB533N2	T202	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.

OPCS coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

ncdsid	provspnops	opertn_01	opertn_02	opertn_03	opertn_04	…	opertn_23
N3674M	HS6Q9B4HU27D96MF61P5	Z815	.	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	U212	W581	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	Y534	Z664	G451	.	…	.
N4275R	H836FTK2SN9JTEB533N2	T202	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.

OPCS coding: Example (made up) data

CENTRE FOR LONGITUDINAL STUDIES

ncdsid	provspnops	opertn_01	opertn_02	opertn_03	opertn_04	…	opertn_23
N3674M	HS6Q9B4HU27D96MF61P5	Z815	.	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	U212	W581	.	.	…	.
N8429G	JS8G36DJV8538JSBDNH8	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	.	.	.	.	…	.
N4275R	H836FTK2SN9JTEB533N2	Y534	Z664	G451	.	…	.
N4275R	H836FTK2SN9JTEB533N2	T202	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.
N4275R	64NQF48J6D2UH76WN382	.	.	.	.	…	.

Defining your analysis sample

Defining your analysis sample

CENTRE FOR LONGITUDINAL STUDIES

- Cohort members may legitimately not have a HES record over the period of HES data availability, so don't usually want to analyses only those with linked HES records.
- If we believe that any cohort member with a HES record would have been successfully matched to it, we can conclude that any eligible cohort members without a matched HES record truly had no HES record.
- In order to do this, we need to consider who is eligible for linkage.
- Linkage consent certainly a condition for eligibility.

Defining your analysis sample

CENTRE FOR LONGITUDINAL STUDIES

- HES data only relate to English (NHS) hospitals, so restrict eligibility to cohort members living in England over the relevant period?
- E.g. In analyses of linked NCDS-HES data we have considered cohort members to be eligible for linkage if they reported living in England at any one or more waves between waves 6 (2000, age 42) and 9 (2013, age 55).
- But eligibility definition may differ depending on context.

Silverwood RJ, et al. Examining the linkage quality and sample representativeness of linked National Child Development Study and Hospital Episode Statistics data. CLS Working Paper 2022/5. London: UCL Centre for Longitudinal Studies; 2022.

Recent analyses

Recent analyses: Mental health and hospital interactions in young people

CENTRE FOR LONGITUDINAL STUDIES

- Nasir Rajah, Emla Fitzsimons.
- Aimed to investigate association between poor mental health in young people and subsequent hospital service use.
- Used linked Next Steps-HES data.
- Next Steps: self-reported mental health and self-harm.
- HES: any/number of A&E visits (A&E), diagnosis of mental or behavioural disorder (APC).

Recent analyses: Mental health and hospital interactions in young people

CENTRE FOR LONGITUDINAL STUDIES

- Poor self-reported mental health at age 17 associated with:
  i. 6 percentage point (95% CI 2, 10) greater probability of an A&E appointment in the following decade
  ii. 6 percentage point (95% CI 2, 9) greater probability of a diagnosis of mental or behavioural disorder in hospital.
- Conclude that there may be associations between young people's poorer self-reported mental health and increased hospital interactions.
- Important implications for future research on demand and allocation of healthcare resources in England.

Recent analyses: Using linked HES data to aid the handling of cohort study non-response

CENTRE FOR LONGITUDINAL STUDIES

- Nasir Rajah, Lisa Calderwood, Bianca L De Stavola, Katie Harron, George Ploubidis, Richard Silverwood.
- Growing interest in whether linked administrative data can aid analyses of cohort data subject to missingness.
- Used linked NCDS-HES data.
- Derived 58 variables from HES data (numbers of admissions and appointments, missed appointments, investigations undertaken, diagnoses and treatments received).
- Applied LASSO variable selection approach to identify HES variables predictive of non-response at age 55 sweep of NCDS.

Recent analyses: Using linked HES data to aid the handling of cohort study non-response

CENTRE FOR LONGITUDINAL STUDIES

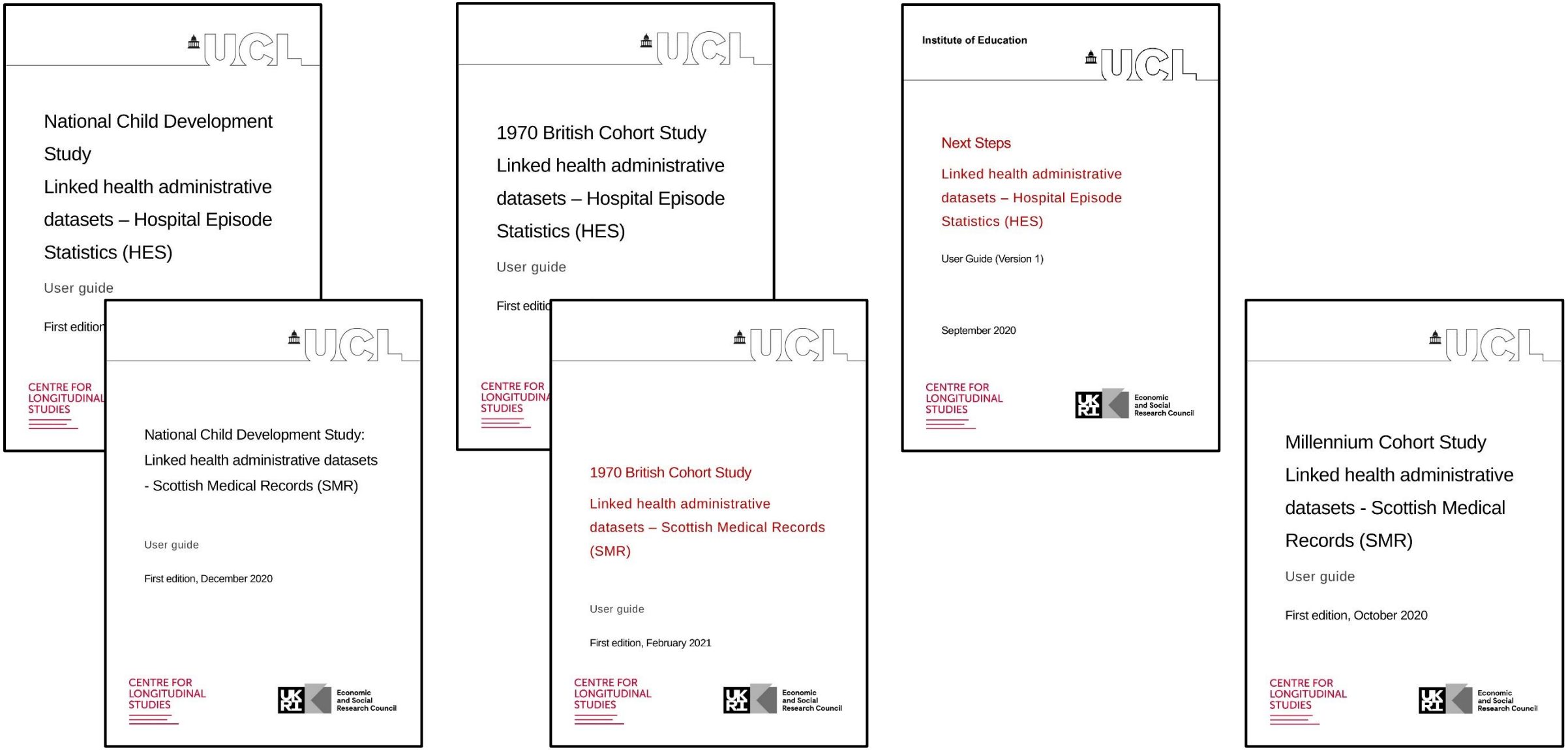
- Identified 10 such variables, e.g. cohort members treated for adult mental illness >70% more likely to be non-respondents (risk ratio 1.73; 95% CI 1.17, 2.51).
- Included these variables as auxiliary variables in multiple imputation analyses to explore the extent to which they helped restore sample representativeness.
- However, only helped to a limited extent. Essentially no additional gain relative to using only previously identified survey predictors of non-response (i.e. NCDS rather than HES variables).

Resources

Resources: User Guides

https://cls.ucl.ac.uk/data_documentation

CENTRE FOR LONGITUDINAL STUDIES



Resources: Quality and representativeness of linked NCDS-HES data

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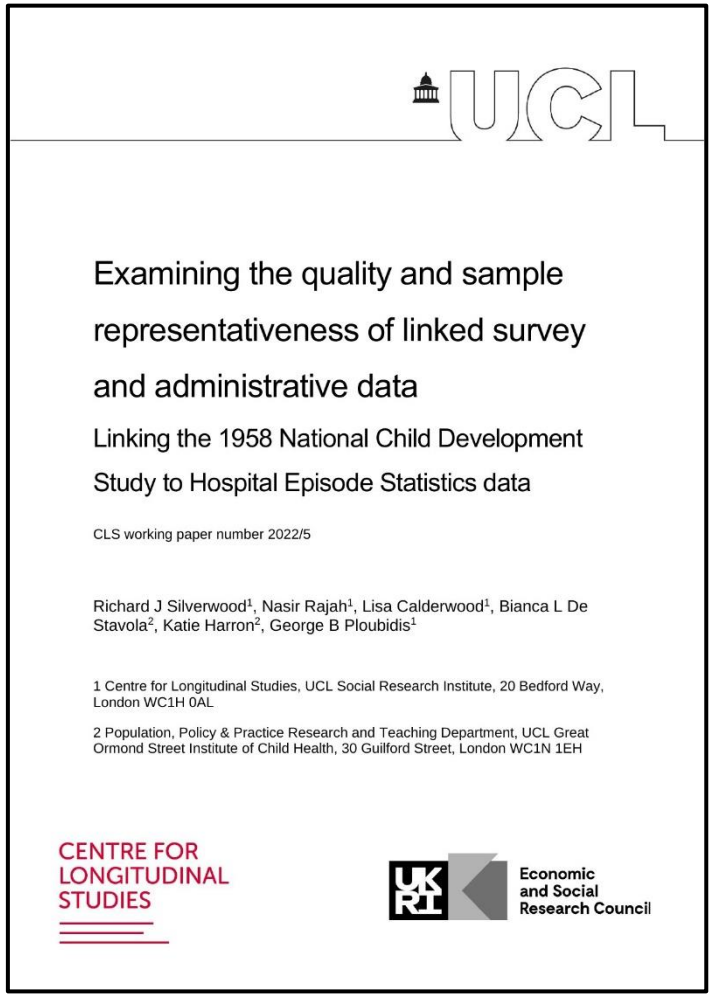
- Examined associations between key cohort member sociodemographic characteristics and successful linkage.
- Compared the levels of successful linkage within strata of NCDS variables which may be expected to be associated with hospital attendance, and hence with successful HES linkage.



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Examining the quality and sample representativeness of linked survey and administrative data

Linking the 1958 National Child Development Study to Hospital Episode Statistics data

CLS working paper number 2022/5

Richard J Silverwood[1], Nasir Rajah[1], Lisa Calderwood[1], Bianca L De Stavola[2], Katie Harron[2], George B Ploubidis[1]

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Resources: Quality and representativeness of linked NCDS-HES data

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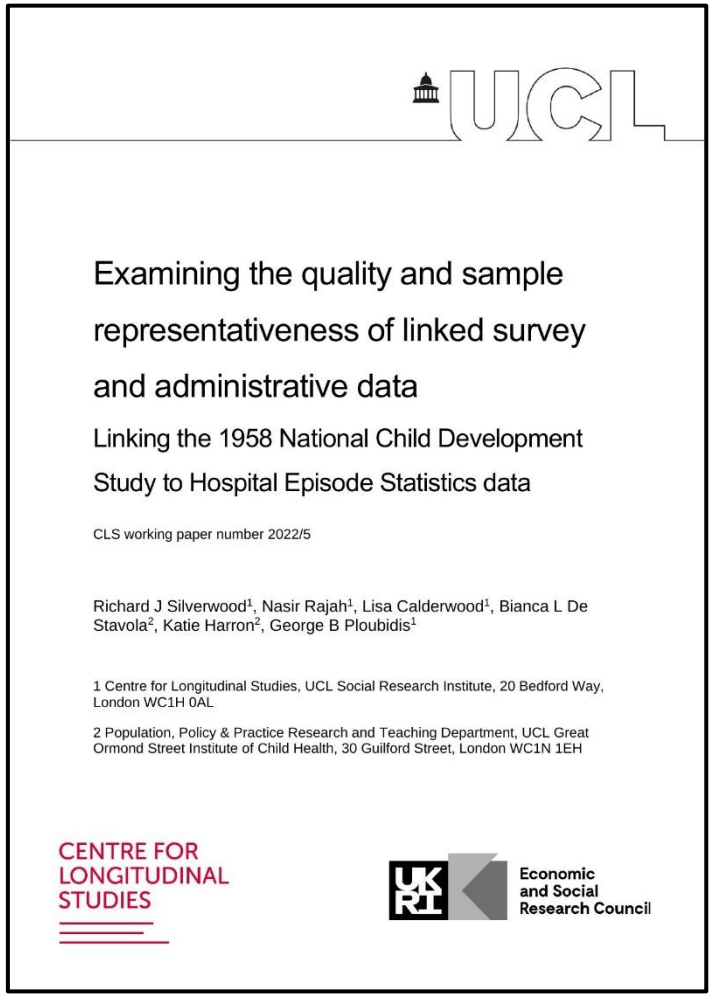
- Evaluated the population representativeness of the linked sample using external data (hospital admission rates in the general population).
- Findings suggest that the linkage quality of the NCDS-HES data is high and that the linked sample maintains an excellent level of population representativeness.



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Other resources

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- Boyd A, Cornish R, Johnson L, Simmonds S, Syddall H, Westbury L, et al. Understanding Hospital Episode Statistics (HES). London, UK: CLOSER; 2017.
- Herbert A, Wijlaars L, Zylbersztejn A, Cromwell D, Hardelid P. Data Resource Profile: Hospital Episode Statistics Admitted Patient Care (HES APC). International Journal of Epidemiology. 2017;46(4):1093-i.
- NHS Digital. Hospital Episode Statistics (HES). https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/hospital-episode-statistics.

Thank you.

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