



OpenSAFELY





NHS England OpenSAFELY GP Data Service

- 58 million** patients' records
- 181** projects
- 31** organisations
- >100** completed outputs
- 42 days** from first shovel to first output
- £10 million** spend to date, new funding to scale



GP data presents huge opportunities for the UK

Breadth: one record for every citizen

Depth: detailed info on all GP contacts, diagnoses, tests, more

Research: causes of disease, prevention, treatment benefits / risks / uptake / costs

Improving NHS care: who gets what treatments, where, understand variation.



GP data presents huge challenges

Privacy: records that generate insights also contain everyone's confidential medical history

Transparency: people (professions, campaigners, patients) want to know what's done with their medical records.

Usability: patient records data is hard to work with, and huge, with a historic culture of duplicated effort & closed working.



the data
the outputs
the privacy & transparency tools
the ehr data management tools



Data via OpenSAFELY

Full coded GP records

- Every prescription
- Every blood test and its result
- Every diagnostic code
- Every referral
- More

Additional datasets

- UK Renal Registry
- COVID surveys
- Randomised trial
- Household pseudonym
- More

HES/SUS hospital data

- Every hospital admission
- Every outpatient appointment
- Every A&E attendance

ONS death certificate and cause of death



Attribute	Category	TPP		EMIS		Combined	
		Total	%	Total	%	Total	%
Total		24,011,964	100.0	34,032,530	100.0	58,044,494	100.0
Age group	0-17	4,821,223	20.1	6,901,845	20.3	11,723,068	20.2
	18-24	1,901,509	7.9	2,884,964	8.5	4,786,473	8.2
	25-34	3,340,123	13.9	4,962,526	14.6	8,302,649	14.3
	35-44	3,220,499	13.4	4,745,812	13.9	7,966,311	13.7
	45-54	3,230,861	13.5	4,546,614	13.4	7,777,475	13.4
	55-69	4,202,414	17.5	5,697,231	16.7	9,899,645	17.1
	70-79	2,080,859	8.7	2,699,998	7.9	4,780,857	8.2
	80+	1,214,476	5.1	1,593,540	4.7	2,808,016	4.8
Sex	F	12,004,974	50.0	17,014,169	50.0	29,019,143	50.0
	M	12,006,990	50.0	17,018,361	50.0	29,025,351	50.0
Region	East of England	5,638,753	23.5	1,341,520	3.9	6,980,273	12.0
	East Midlands	4,191,051	17.5	763,830	2.2	4,954,881	8.5
	London	1,702,673	7.1	7,804,070	22.9	9,506,743	16.4
	North East	1,100,356	4.6	1,189,619	3.5	2,289,975	3.9
	North West	2,067,131	8.6	6,875,180	20.2	8,942,311	15.4
	South East	1,582,440	6.6	7,191,261	21.1	8,773,701	15.1
	South West	3,304,393	13.8	2,488,558	7.3	5,792,951	10.0
	West Midlands	988,286	4.1	5,057,090	14.9	6,045,376	10.4
	Yorkshire and The Humber	3,427,713	14.3	1,278,147	3.8	4,705,860	8.1
IMD	1 Most deprived	4,818,642	20.1	7,015,392	20.6	11,834,034	20.4
	2	4,707,307	19.6	7,244,664	21.3	11,951,971	20.6
	3	4,941,725	20.6	6,633,133	19.5	11,574,858	19.9
	4	4,655,595	19.4	6,401,478	18.8	11,057,073	19.0
	5 Least deprived	4,302,292	17.9	6,635,613	19.5	10,937,905	18.8
Ethnicity	White	14,573,038	60.7	17,677,690	51.9	32,250,728	55.6
	Mixed	319,793	1.3	581,965	1.7	901,758	1.6
	South Asian	1,500,012	6.2	2,489,843	7.3	3,989,855	6.9
	Black	515,866	2.1	1,173,341	3.4	1,689,207	2.9
	Other	476,065	2.0	754,993	2.2	1,231,058	2.1



OpenSAFELY >100 outputs

Who gets COVID-19?

Do different ethnic groups have different risks?

Does household transmission play a role?

Do COVID treatments work?

Who gets them?

Do vaccines work?

Who gets them?

Do they have any adverse effects?

What are the consequences of COVID infection?

Who gets “long COVID”?

How did NHS activity change during the pandemic?

How did NHS activity recover after the pandemic?





204 projects across
31 different organisations



Article

Factors associated with COVID-19-related death using OpenSAFELY

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Check for updates

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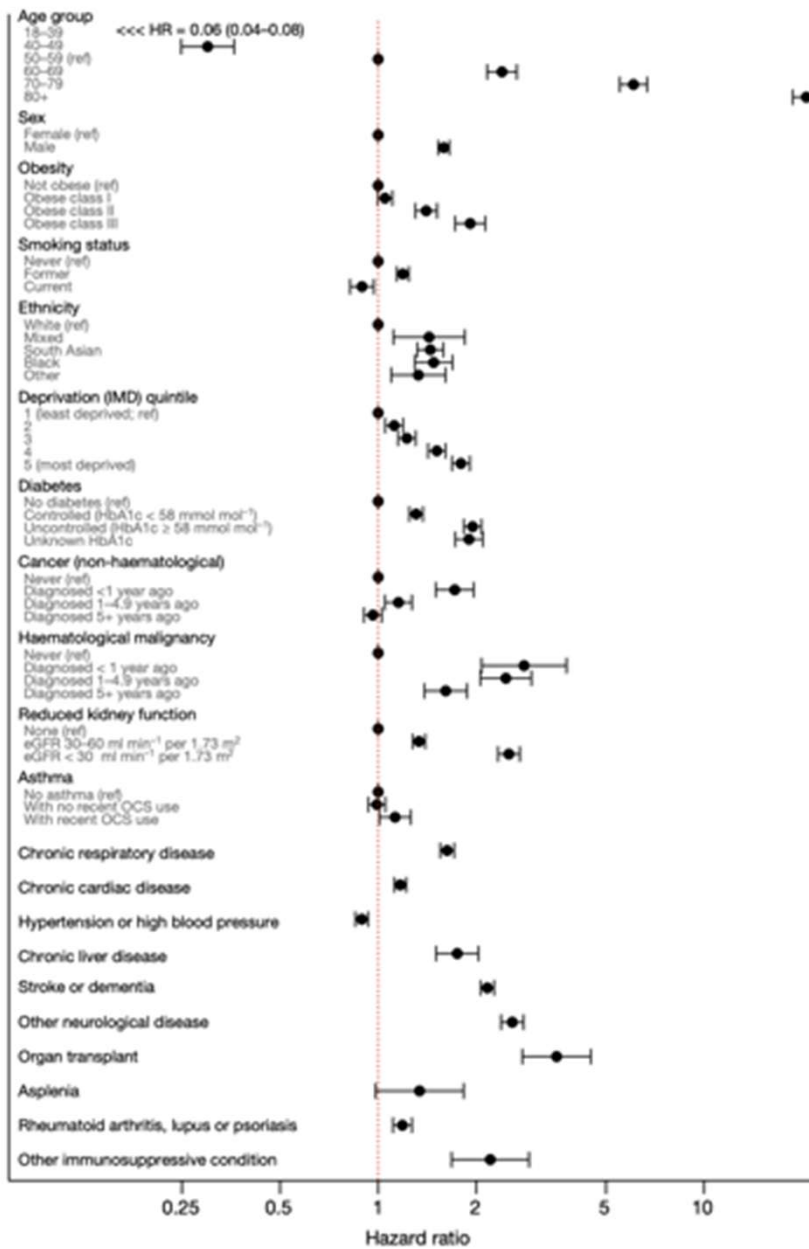
Coronavirus disease 2019 (COVID-19) has rapidly affected mortality worldwide¹. There is unprecedented urgency to understand who is most at risk of severe outcomes, and this requires new approaches for the timely analysis of large datasets. Working on behalf of NHS England, we created OpenSAFELY—a secure health analytics platform that covers 40% of all patients in England and holds patient data within the existing data centre of a major vendor of primary care electronic health records. Here we used OpenSAFELY to examine factors associated with COVID-19-related death. Primary care records of 17,278,392 adults were pseudonymously linked to 10,926 COVID-19-related deaths. COVID-19-related death was associated with: being male (hazard ratio (HR) 1.59 (95% confidence interval 1.53–1.65)); greater age and deprivation (both with a strong gradient); diabetes; severe asthma; and various other medical conditions. Compared with people of white ethnicity, Black and South Asian people were at higher risk, even after adjustment for other factors (HR 1.48 (1.29–1.69) and 1.45 (1.32–1.58), respectively). We have quantified a range of clinical factors associated with COVID-19-related death in one of the largest cohort studies on this topic so far. More patient records are rapidly being added to OpenSAFELY, we will update and extend our results regularly.

On 11 March 2020, the World Health Organization (WHO) characterized COVID-19—which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)—as a pandemic, after 118,000 cases and 4,291 deaths were reported in 114 countries². As of 6 May 2020 (the date of latest data availability for this study), cases had reached to the 3.5 million globally, with more than 240,000 deaths attributed to the virus³. On the same day in the UK, there had been 206,715 confirmed cases of COVID-19, and 30,615 COVID-19-related deaths⁴.

Age and gender are well-established risk factors for severe COVID-19 outcomes: over 90% of the COVID-19-related deaths in the UK have

in a French intensive care cohort⁵ (n = 124) and a New York hospital presentation cohort⁶ (n = 3,615). The risks associated with smoking are unclear^{7–9}. People from Black and minority ethnic groups are at increased risk of poor outcomes from COVID-19, for reasons that are unclear^{10,11}.

Patient care is typically managed through electronic health records, which are commonly used in research. However traditional approaches to the analysis of electronic health records rely on intermitted extracts of small samples of historic data. Evaluating a rapidly arising novel cause of death requires a new approach. We therefore set out to deliver a secure analytics platform inside the data centre of major electronic health records, spanning across the full, linked and pseudonymized



Research

Bee / Hodder, Brian MacKenna, Peter Ingelidis, Laurie Tomlinson, Christopher T Rentch, Helen J Curtis, Caroline E Martin, Jessica Morley, Amir Mehrikar, Seb Bacon, George Hickman, Chris Bates, Richard Croker, David Evans, Tom Reed, Jonathan Cockburn, Simon Day, Krishnar Prasharan, Anna Schultze, Elizabeth J Williamson, William J Hulme, Helen J McDonald, Rohan Mathur, Rosalind M Eggo, Kevin Wong, Angel Y S Wong, Harriet Forbes, John Tatters, John Parry, Frank Hester, Sam Harper, Shaun O'Hanlon, Alex East, Richard Jarvis, Olena Aramova, Phil Griffin, Kara Fowler, Naureen Parkes, Ian J Douglas, Stephen M Everts, Liam Smeeth and Ben Oldaker (The OpenSAFELY Collaborative)

Clinical coding of long COVID in English primary care:

a federated analysis of 58 million patient records, in situ using OpenSAFELY

Abstract

Background Long COVID describes new or persistent symptoms at least 4 weeks after onset of acute COVID-19. Clinical codes to describe this phenomenon were recently created.

Aim To describe the use of long COVID codes, and variation of use by general practice, demographic variables, and over time.

Design and setting Population-based nested study in English primary care.

Method Working in health systems England, OpenSAFELY links with confidentialising NHS in the English response between 1 January 2020 and 31 May 2021. The proportion of people with a linked code for long COVID was measured relative to demographic factors, electronic health record software system (EMR) or NHS, and week.

Results Long COVID was recorded for 23,272 people. Coding was evenly distributed among practices, with 26.7% of practices having never used the codes. Regional variation ranged from 0.1 per 100,000 people for East of England (95% confidence interval (CI) 0.1 to 0.2) to 1.4 per 100,000 people in London (95% CI 1.3 to 1.5). Coding was higher among females (2.1, 95% CI 2.0 to 2.2) than males (1.6, 95% CI 1.5 to 1.7), and higher among practices using EMR (2.1, 95% CI 2.0 to 2.2) than those using NHS (1.6, 95% CI 1.5 to 1.7).

Conclusion Current recording of long COVID in primary care is by day and variable between practices. This may inform future practice. The long COVID codes are being used by clinicians and patients, leading to better diagnostic thinking, or challenges with the design and communication of diagnostic codes. National assessment of diagnostic codes is recommended to facilitate research and planning of services, and also support with qualitative work to better evaluate clinicians' understanding of the diagnosis.

Keywords COVID-19, general practice, electronic health records, federated analysis, health equity.

INTRODUCTION

Long COVID has been broadly defined as new or persistent symptoms of COVID-19 beyond the acute phase of SARS-CoV-2 infection.¹ The National Institute for Health and Care Excellence (NICE) have produced guidance on managing the long-term effects of COVID-19 as these symptoms can have a significant effect on a person's quality of life.² NICE recognise that as long COVID is such a new condition the exact clinical definition and treatments are evolving.

A recent systematic review found a very high prevalence of persisting COVID symptoms after COVID diagnosis.³ For symptoms lasting 4–12 weeks 82% of people reported at least one persisting symptom, whereas for symptoms lasting beyond 12 weeks, the proportion was 54%. The reported associated symptoms are numerous, but include fatigue, shortness

of breath, cough, smell or taste dysfunction, cognitive impairment, and muscle pain.³ NICE developed their definitions and clinical guidelines using a living approach based on early data. This means that the guidelines will be continuously reviewed and updated and it is therefore critical to continue studying the long-term effects of COVID-19 as data accrue, and refine the guidelines appropriately. To support this need, long COVID (SNOMED-CT codes (diagnostic codes) listed in Box 1) were developed and released in the UK in November 2020. To support clinical care and implementation of NICE guidance, distinct SNOMED-CT codes were made available by NHS Digital, which distinguish between the length of ongoing symptoms, SNOMED-CT is an international structured clinical coding system for use in electronic health records. Symptoms between 4 and 12 weeks are defined as ongoing symptomatic disease

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1st study ever in whole population GP records

RESEARCH

Association between living with children and outcomes from covid-19: OpenSAFELY cohort study of 12 million adults in England

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Abstract **OBJECTIVE** To investigate whether risk of infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) differed between adults living with and without children during the first two waves of the UK pandemic.

DESIGN Population based cohort study, on behalf of NHS England.

SETTING Primary care data and pseudonymously linked hospital and intensive care admissions and death records from England, during wave 1 (2 February to 31 August 2020) and wave 2 (3 September to 18 December 2020).

RESULTS Among 7 334 933 adults aged 65 years and under, during wave 1, living with children was not associated with materially increased risks of recorded SARS-CoV-2 infection, covid-19 related hospital or intensive care admission, or death from covid-19. In wave 2, among adults aged 65 years and under, living with children of any age was associated with an increased risk of recorded SARS-CoV-2 infection (hazard ratio 1.06 (95% confidence interval 1.05 to 1.06) for living with children aged 0–11 years, 1.22 (1.20 to 1.24) for living with children aged 12–18 years and covid-19 related hospital admission (1.18 (1.16 to 1.21) for living with children aged 0–11, 1.26 (1.22 to 1.40) for living with children aged 12–18). Living with children aged 0–11 was associated with reduced risk of death from both covid-19 and non-covid-19 causes in both waves, living with children of any age was also associated with lower risk of dying from non-covid-19 causes. For adults 65 years and under during wave 2, living with children aged 0–11 years was associated with an increased absolute risk of having SARS-CoV-2 infection recorded of 40–60 per 10 000 people, from 810 to between 810 and 870, and an increase in the number of hospital admissions of 1.5 per 10 000 people, from 140 to between 140 and 145. Living with children aged 12–18 years was associated with an increase of 140–190 per 10 000 in the number of SARS-CoV-2 infections and an increase of 2–6 per 10 000 in the number of hospital admissions.

CONCLUSIONS In contrast to wave 2, evidence existed of increased risk of reported SARS-CoV-2 infection and covid-19 outcomes among adults living with children during wave 2. However, this did not translate into a materially increased risk of covid-19 mortality, and absolute increases in risk were small.

WHAT IS ALREADY KNOWN ON THIS TOPIC Adults living with children have more "common codes" than do those not living with children. This could result in a lower risk of serious outcomes from SARS-CoV-2 infection due to under-precise imputation from other associated comorbidities. Alternatively, living with children may lead to greater opportunities for infection with SARS-CoV-2 and increased risks to adults they live with.

WHAT THIS STUDY ADDS During the first wave of the pandemic in the UK, living with children of any age was not associated with an increased risk of serious outcomes from covid-19, compared with not living with children. Risk of SARS-CoV-2 infection and covid-19 related hospital admission was increased for adults aged 65 years and under living with children of any age during the second wave, compared with those not living with children. Absolute increases in risks of SARS-CoV-2 infection and covid-19 related hospital admission among adults living with children in wave 2 were small.

INTRODUCTION The role of children and adolescents in the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is uncertain.^{1–4} Good evidence indicates that they have lower susceptibility to infection and are less likely to have severe disease once infected.^{1–4} Modelling of other respiratory tract infections such as influenza suggests that children are a major driver of

Household pseudo-identifier for household risks

RESEARCH Open Access

Implementing Germ Defence digital behaviour change intervention via all primary care practices in England to reduce respiratory infections during the COVID-19 pandemic: an efficient cluster randomised controlled trial using the OpenSAFELY platform

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Abstract **Background** Germ Defence (www.germdefence.org) is an evidence-based interactive website that promotes behaviour change for infection control within households. To maximise the potential of Germ Defence to effectively reduce the spread of COVID-19, the intervention needed to be implemented at scale rapidly. **Methods** With NHS England approval, we conducted an efficient two-arm (1:1 ratio) cluster randomised controlled trial (RCT) to examine the effectiveness of randomised implementation of Germ Defence via general practitioner (GP) practices across England, UK, compared with usual care to disseminate Germ Defence to patients. GP practices randomised to the intervention arm (n=3292) were emailed and asked to disseminate Germ Defence to all adult patients via mobile phone text, email or social media. Usual care arm GP practices (n=3287) maintained standard management for the 4-month trial period and then asked to share Germ Defence with their adult patients. The primary outcome was the rate of GP presentations for respiratory tract infections (RTI) per patient. Secondary outcomes comprised rates of acute RTIs, confirmed COVID-19 diagnoses and suspected COVID-19 diagnoses, COVID-19 symptoms, gastrointestinal infection diagnoses, antibiotic usage and hospital admissions. The impact of the intervention on outcome rates was assessed using negative binomial regression modelling within the OpenSAFELY platform. The uptake of the intervention by GP practice and by patients was measured via website analytics.

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24 million patient randomised trial, follow up in TRE



Do vaccines wane over time? How helpful are boosters?



Comparative effectiveness of BNT162b2 booster doses in England: an observational study in OpenSAFELY-TPP

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This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should not be used to guide clinical practice.

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Abstract Full Text Info/History Metrics

Comparative effectiveness of BNT162b2 versus mRNA-1273 covid-19 vaccine boosting in England: matched cohort study in OpenSAFELY-TPP

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ABSTRACT
OBJECTIVE
To compare the effectiveness of the BNT162b2 mRNA (Pfizer BioNTech) and mRNA-1273 (Moderna) covid-19 vaccines during the booster programme in England.

DESIGN
Matched cohort study, emulating a comparative effectiveness trial.

SETTING
England, United Kingdom.

RESULTS
The 20 week risks per 1000 for hospital admission with covid-19 were 0.75 (0.73 to 0.79) for BNT162b2 and 0.65 (0.61 to 0.69) for mRNA-1273; the hazard ratio was 0.89 (0.82 to 0.95). Covid-19 related deaths were 0.09 (0.08 to 0.10) for BNT162b2 and 0.08 (0.07 to 0.09) for mRNA-1273; the hazard ratio was 0.93 (0.87 to 0.99). Comparative effectiveness was generally similar within subgroups defined by the primary course vaccine (mRNA-1273 or BNT162b2), age, sex, and ethnicity.

CONCLUSIONS
Comparative effectiveness was generally similar within subgroups defined by the primary course vaccine (mRNA-1273 or BNT162b2), age, sex, and ethnicity.

Waning effectiveness of BNT162b2 and ChAdOx1 covid-19 vaccines over six months since second dose: OpenSAFELY linked electronic health records cohort study

Elsie M F Horne,^{1,2} William J Hulme,³ Ruth H Keogh,⁴ Tom M Palmer,^{5,5} Elizabeth J Williamson,⁶ Edward P K Parker,⁷ Venexia Walker,^{8,9} Helen Curtis,¹⁰ Louis Fisher,¹¹ Brian MacKenna,¹² Venexia Walker,¹³ Alex J Walker,¹⁴ Christopher T Rentsch,¹⁵ Anna Schultze,¹⁶ Krishnan Bhaskaran,¹⁷ John Tazare,¹⁸ Laurie Tomlinson,¹⁹ Helen I McDonald,²⁰ Caroline E Morton,²¹ Amir Mehrkar,²² Seb Bacon, Dave Evans,²³ Peter Inglesby,²⁴ George Hickman,²⁵ Simon Day,²⁶ Tom Ward,²⁷ Iain Dillingham,²⁸ Ben Goldacre,²⁹ Miguel A Hernán,^{30,31} Jonathan A C Sterne,^{32,33}

ABSTRACT
OBJECTIVE
To estimate waning of covid-19 vaccine effectiveness over six months after second dose.

DESIGN
Cohort study, approved by NHS England.

SETTING
Linked primary care, hospital, and covid-19 records within the OpenSAFELY-TPP database.

PARTICIPANTS
Adults without previous SARS-CoV-2 infection were eligible, excluding care home residents and healthcare professionals.

MEASUREMENTS AND MAIN RESULTS
Vaccine effectiveness was quantified as ratios of adjusted hazard rates per 1000 in subgroups aged ≥65 years vulnerable, 40-64 years vulnerable, and 18-39 years vulnerable. Vaccine effectiveness was 19.5% (95% CI 17.1% to 21.9%) for BNT162b2 and 24.2% (95% CI 21.8% to 26.6%) for ChAdOx1. Waning was observed in both groups, with a greater decline in effectiveness for BNT162b2. The difference in effectiveness between the two vaccines was 4.7% (95% CI 2.9% to 6.5%) in the 40-64 years vulnerable group, 3.1% (95% CI 1.5% to 4.7%) in the 18-39 years vulnerable group, and 1.6% (95% CI 0.1% to 3.1%) in the ≥65 years vulnerable group. The difference in effectiveness between the two vaccines was 1.6% (95% CI 0.1% to 3.1%) in the ≥65 years vulnerable group.

CONCLUSIONS
Waning of effectiveness was observed in both groups, with a greater decline in effectiveness for BNT162b2. The difference in effectiveness between the two vaccines was 4.7% (95% CI 2.9% to 6.5%) in the 40-64 years vulnerable group, 3.1% (95% CI 1.5% to 4.7%) in the 18-39 years vulnerable group, and 1.6% (95% CI 0.1% to 3.1%) in the ≥65 years vulnerable group.

Comparative effectiveness of ChAdOx1 versus BNT162b2 covid-19 vaccines in health and social care workers in England: cohort study using OpenSAFELY

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ABSTRACT
OBJECTIVE
To compare the effectiveness of the BNT162b2 mRNA (Pfizer BioNTech) and the ChAdOx1 (Oxford-AstraZeneca) covid-19 vaccines against infection and covid-19 disease in health and social care workers.

DESIGN
Cohort study, emulating a comparative effectiveness trial, on behalf of NHS England.

SETTING
Linked primary care, hospital, and covid-19 surveillance records available within the OpenSAFELY-TPP research platform, covering a period when the SARS-CoV-2 Alpha variant was dominant.

PARTICIPANTS
317 361 health and social care workers vaccinated between 4 January and 28 February 2021, registered with a general practice using the TPP SystemOne clinical information system in England, and not initially extremely vulnerable.

INTERVENTIONS
Vaccination with either BNT162b2 or ChAdOx1 administered as part of the national covid-19 vaccine rollout.

MEASUREMENTS AND MAIN RESULTS
Over the duration of 116 771 person-years of follow-up there were 6962 positive SARS-CoV-2 tests, 282 covid-19 related A&E attendances, and 166 covid-19 related hospital admissions. The cumulative incidence of each outcome was similar for both vaccines during the first 20 weeks after vaccination. The cumulative incidence of recorded SARS-CoV-2 infection 20 weeks after first dose vaccination with BNT162b2 was 21.7 (95% CI 20.9 to 22.4) and with ChAdOx1 was 23.7 (21.8 to 25.6), representing a difference of 2.04 per 1000 people (0.04 to 4.04). The difference in the cumulative incidence per 1000 people of covid-19 related A&E attendance at 20 weeks was 0.06 per 1000 people (95% CI -0.31 to 0.43). For covid-19 related hospital admission, this difference was 0.11 per 1000 people (-0.22 to 0.44).

CONCLUSIONS
In this cohort of healthcare workers where we would not anticipate vaccine type to be related to health status, we found no substantial differences in the incidence of covid-19 infection or covid-19 disease between the two vaccines.

Abstract

Background The UK COVID-19 vaccination programme delivered its first "booster" dose in 2021 initially in groups at high risk of severe disease then across the population. We compared the effectiveness of two- and three-dose schedules involving AZD1222 and BNT162b2 in people with kidney disease: a linked OpenSAFELY and UK Renal Registry cohort study

Methods We used linked electronic health records from the OpenSAFELY-TPP database and the UK Renal Registry to identify people with kidney disease who had received two doses of BNT162b2 or AZD1222. We compared the effectiveness of two- and three-dose schedules in people with kidney disease using linked electronic health records from the OpenSAFELY-TPP database and the UK Renal Registry.

Results The effectiveness of two-dose schedules was 19.5% (95% CI 17.1% to 21.9%) for BNT162b2 and 24.2% (95% CI 21.8% to 26.6%) for AZD1222. The effectiveness of three-dose schedules was 24.2% (95% CI 21.8% to 26.6%) for BNT162b2 and 24.2% (95% CI 21.8% to 26.6%) for AZD1222. The difference in effectiveness between the two vaccines was 4.7% (95% CI 2.9% to 6.5%) in the 40-64 years vulnerable group, 3.1% (95% CI 1.5% to 4.7%) in the 18-39 years vulnerable group, and 1.6% (95% CI 0.1% to 3.1%) in the ≥65 years vulnerable group.

Conclusions The effectiveness of two-dose schedules was lower than that of three-dose schedules in people with kidney disease. The difference in effectiveness between the two vaccines was 4.7% (95% CI 2.9% to 6.5%) in the 40-64 years vulnerable group, 3.1% (95% CI 1.5% to 4.7%) in the 18-39 years vulnerable group, and 1.6% (95% CI 0.1% to 3.1%) in the ≥65 years vulnerable group.

Annals of Internal Medicine

Challenges in Estimating the Effectiveness of Vaccines Using Observational Data

RESEARCH AND REPORTING METHODS

William J. Hulme, PhD; Elizabeth J. Williamson, PhD; Alex J. Walker, PhD; Amir Mehrkar, PhD; Ben Goldacre, PhD

Do the new covid treatments work?

Who is getting them?

thebmi

RESEARCH

Comparative effectiveness of sotrovimab and molnupiravir for prevention of severe covid-19 outcomes in patients in the community: observational cohort study with the OpenSAFELY platform

Bang Zheng,¹ Amelia CA Green,² John Tazare,¹ Helen J Curtis,¹ Louis Fisher,¹ Linda Nab,² Anna Schultze,¹ Viyaasan Mahalingasivam,¹ Edward P K Parker,¹ William J Hulme,² Sebastian C Bacon,¹ Nicholas J DeVito,² Christopher Bates,² David Evans,² Peter Inglesby,² Henry Drysdale,² Simon Davy,¹ Jonathan Cockburn,¹ Caroline E Morton,² George Hickman,² Tom Ward,² Rebecca M Smith,¹ John Parry,¹ Frank Hester,¹ Sam Harper,² Amir Mehrkar,² Rosalind M Eggo,¹ Alex J Walker,¹ Stephen J W Evans,¹ Ian J Douglas,¹ Brian MacKenzie,¹ Ben Goldacre,¹ Laurie A Tomlinson¹

OBJECTIVE To compare the effectiveness of sotrovimab (a neutralising monoclonal antibody) with molnupiravir (an antiviral) in preventing severe outcomes of covid-19 in adult patients infected with SARS-CoV-2 in the community and at high risk of severe outcomes from covid-19.

DESIGN Observational cohort study with the OpenSAFELY platform.

SETTING With the approval of NHS England, a real world cohort study was conducted with the OpenSAFELY-TTP platform (a secure, transparent, open source software platform for analysis of NHS electronic health records), and patient level electronic health record data were obtained from 24 million people registered with a general practice in England that uses TTP software. The primary care data were securely linked with data on SARS-CoV-2 infection and treatments, hospital admission, and death, over a period when both admissions and molnupiravir from 16 December 2021 were frequently prescribed in community settings.

PARTICIPANTS Adult patients with covid-19 in the community or molnupiravir from 16 December 2021.

INTERVENTIONS Sotrovimab or molnupiravir given in a covid-19 medicine delivery units.

MAIN OUTCOME MEASURES Admission to hospital with covid-19 as the primary diagnosis or death as the underlying cause with covid-19 as the underlying cause within 28 days of treatment.

RESULTS Between 16 December 2021 and 28 February 2022, 3331 and 2689 patients were treated with sotrovimab and molnupiravir, respectively. There were no differences in baseline characteristics between the two groups. Within 28 days of treatment, 10.1% of patients were admitted to hospital with covid-19 as the primary diagnosis or died with covid-19 as the underlying cause. The risk of hospital admission with covid-19 as the primary diagnosis or death was 10.1% lower in patients treated with sotrovimab compared with molnupiravir (95% CI 1.1% to 19.1%).

WHAT IS ALREADY KNOWN ON THIS TOPIC Two phase 3 randomised controlled trials in patients with covid-19 in the community who were not vaccinated and at high risk of severe outcomes from covid-19, showed strong efficacy for sotrovimab in preventing admission to hospital or death (relative risk reduction by 79% and modest efficacy for molnupiravir (20%). No randomised controlled trial comparing these drug treatments has been published, and evaluations of their effectiveness when used in routine care are limited.

WHAT THIS STUDY ADDS This real world cohort study showed that in the routine care of adult patients in England with covid-19 in the community, at high risk of severe outcomes from infection, those receiving sotrovimab had a substantially lower risk of severe covid-19 outcomes than those treated with molnupiravir. The findings support the current clinical guideline which prioritises sotrovimab for patients who were vaccinated and infected with omicron variants. The findings support the current clinical guideline which prioritises sotrovimab over molnupiravir in patients with covid-19 who do not require admission to hospital.

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NICE National Institute for Health and Care Excellence

Nirmatrelvir plus ritonavir, sotrovimab and tocilizumab for treating COVID-19

Technology appraisal guidance
Published: 29 March 2023
Last updated: 1 May 2025

www.nice.org.uk/guidance/ta878

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OPEN ACCESS

bmjmedicine

Trends, variation, and clinical characteristics of recipients of antiviral drugs and neutralising monoclonal antibodies for study of 23.4 million people in OpenSAFELY

Amelia C A Green,¹ Helen J Curtis,¹ Rose Higgins,¹ Linda Nab,¹ Viyaasan Mahalingasivam,¹ Rebecca M Smith,¹ Amir Mehrkar,¹ Peter Inglesby,¹ Henry Drysdale,¹ Tazare,¹ Nicholas J DeVito,² Richard Coker,¹ Christopher T Bentsch,¹ Krishnan Bhaskaran,² John Parry,¹ Bang Zheng,¹ Louis Fisher,¹ George Hickman,¹ Simon Davy,¹ Simon Day,¹ Tom Ward,¹ Orla MacDonal,¹ Jessica Morley,¹ Lisa E M Hopcroft,¹ William J Hulme,¹ David Evans,¹ Tom Hester,¹ Milan Wiedemann,¹ Caroline E Morton,¹ Robin Parry,¹ Alex J Walker,¹ Frank Hester,¹ Sam Harper,¹ Ian J Douglas,¹ Jonathan Cockburn,¹ John Parry,¹ Laurie A Tomlinson,¹ Brian MacKenzie¹

OBJECTIVE To ascertain patient eligibility status and describe coverage of antiviral drugs and neutralising monoclonal antibodies (mAbs) as treatment for covid-19 in community settings in England.

DESIGN Retrospective, descriptive cohort study, approved by NHS England.

SETTING Routine clinical data from 23.4 million people linked to data on covid-19 infection and treatment, within the OpenSAFELY-TTP database.

PARTICIPANTS Outpatients with covid-19 at high risk of severe outcomes.

INTERVENTIONS Nirmatrelvir/ritonavir (paxlovid), sotrovimab, molnupiravir, casirivimab/imsdevimab, or remdesivir, used in the community by covid-19 medicine delivery units.

RESULTS 93 870 outpatients with covid-19 were identified between 12 December 2021 and 28 April 2022 to be at high risk of severe outcomes and potentially eligible for antiviral or mAb treatment for both. Of these patients, 19 040 (20%) received treatment (sotrovimab, 9660 (51%); molnupiravir, 6500 (34%); paxlovid, 4680 (24%); casirivimab/imsdevimab, 50 (0.3%); remdesivir, 30 (0.2%)). The proportion of patients treated with treatment available to 29% (460/1600) in the latest week. The proportion treated varied by disease (16%; 95% confidence interval 15% to 17%; molnupiravir and paxlovid in all but three high risk immune deficiencies (45%; 30% to 59%), age ranging from 28 to 84 years (1%; 0.4% to 4.7%), and years (0.1%; 2.2% to 2.3%) by ethnic group, ranging from black (0.1%; 0.1% to 0.1%) to white (0.1%; 0.1% to 0.1%) in the East of England, and by deprivation level, areas to 23% (0.1% to 0.1%) in the most deprived areas. Coverage was also lower in the least deprived areas (6%; 5% to 7%), and care home residents (6%; 6% to 7%).

CONCLUSIONS Using the OpenSAFELY platform, we were able to identify patients with covid-19 at high risk of severe outcomes who were potentially eligible to receive treatment and assess the coverage of these new treatments among these patients. In the context of a rapid deployment of a new service, the NHS analytical code used to determine eligibility could have been over-inclusive.

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SCHOOLS 'NO RISK' Schools do not fuel

Coronavirus: Living with

The New York Times

The Telegraph

Hydroxychloroquine does not pre
... exposure to Co

Study of 17 M:11.

INDEPENDENT

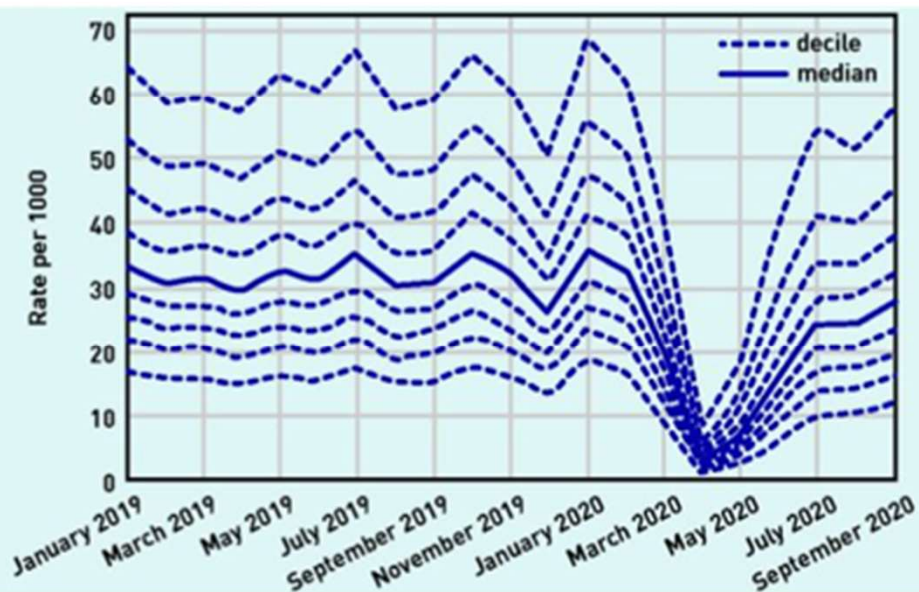
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**Coronavirus: Underlying health
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**Parents of schoolchildren
... a greater risk of being**

Monitoring NHS activity and outcomes in near real time

Serum cholesterol tests performed per 1000 members of the population



Blood coagulation tests performed per 1000 members of the population

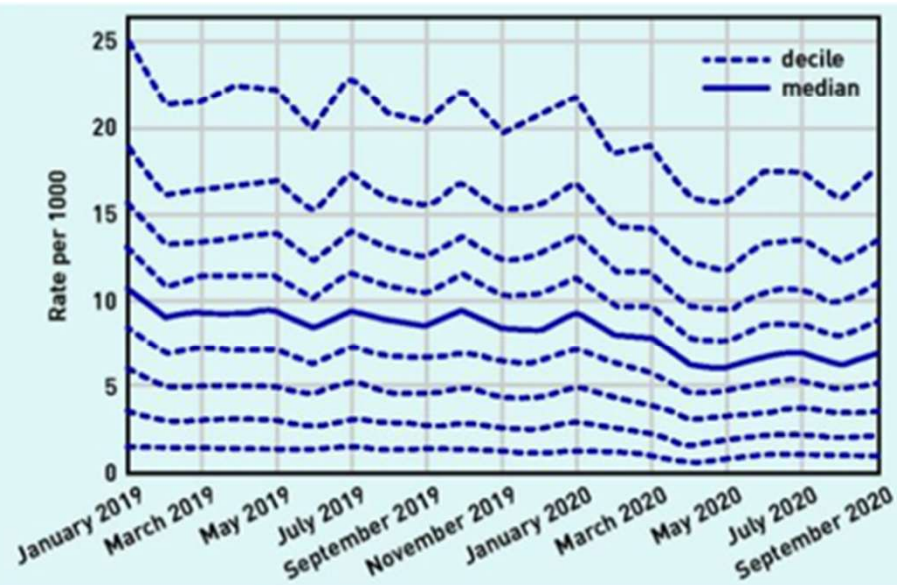
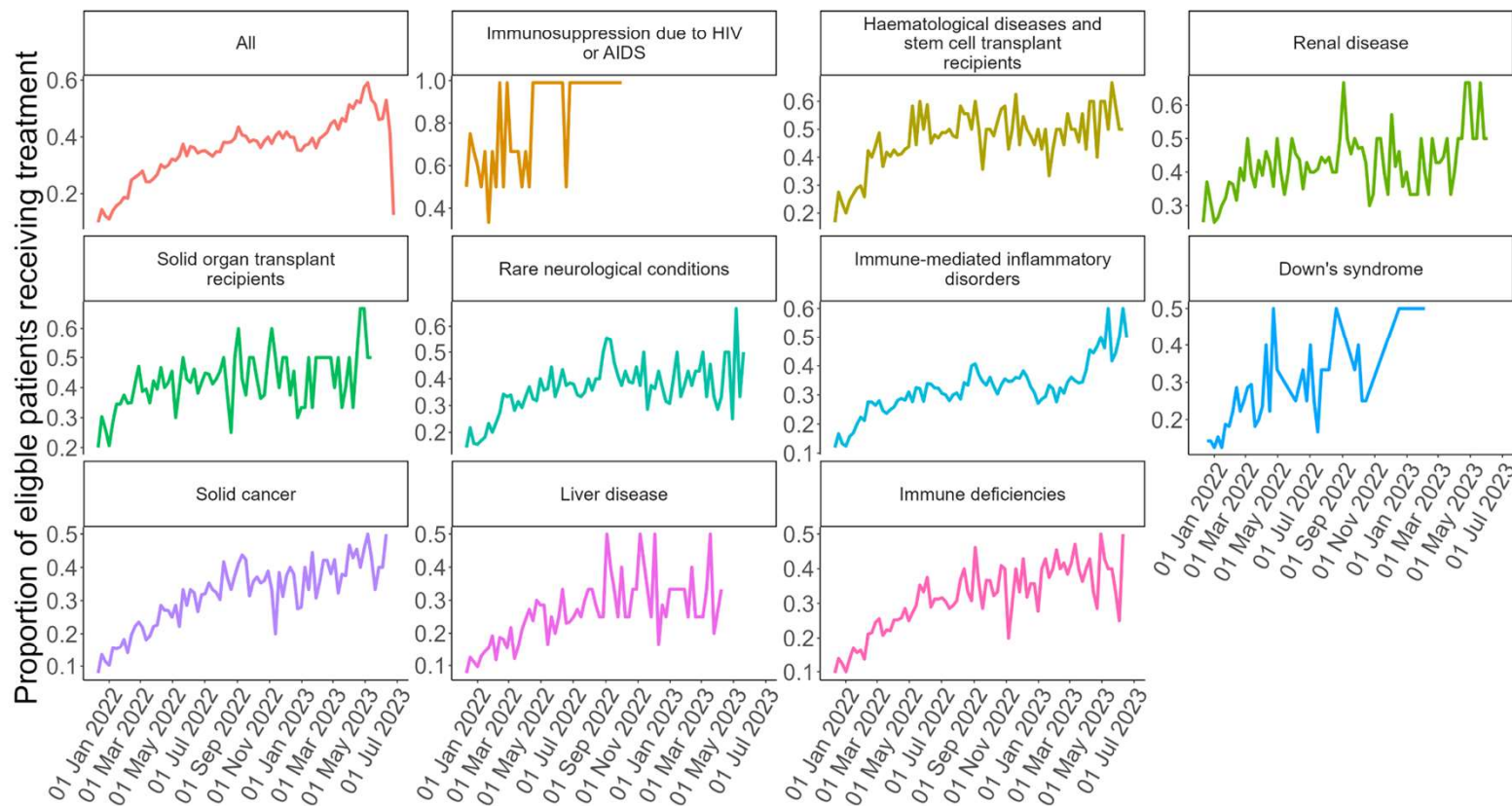


Figure 3 Weekly proportion of eligible patients receiving an antiviral or nMAB for treating COVID-19 since 11th December 2021, stratified by high risk cohort. Proportions are rounded to 2 decimal places.



Key demographic and clinical characteristics of treated patients

the data
the outputs
the privacy & transparency tools
the ehr data management tools



Trust

NHSE and GP as data controller

Records don't move

Users work on dummy data

Total, “code-level” transparency



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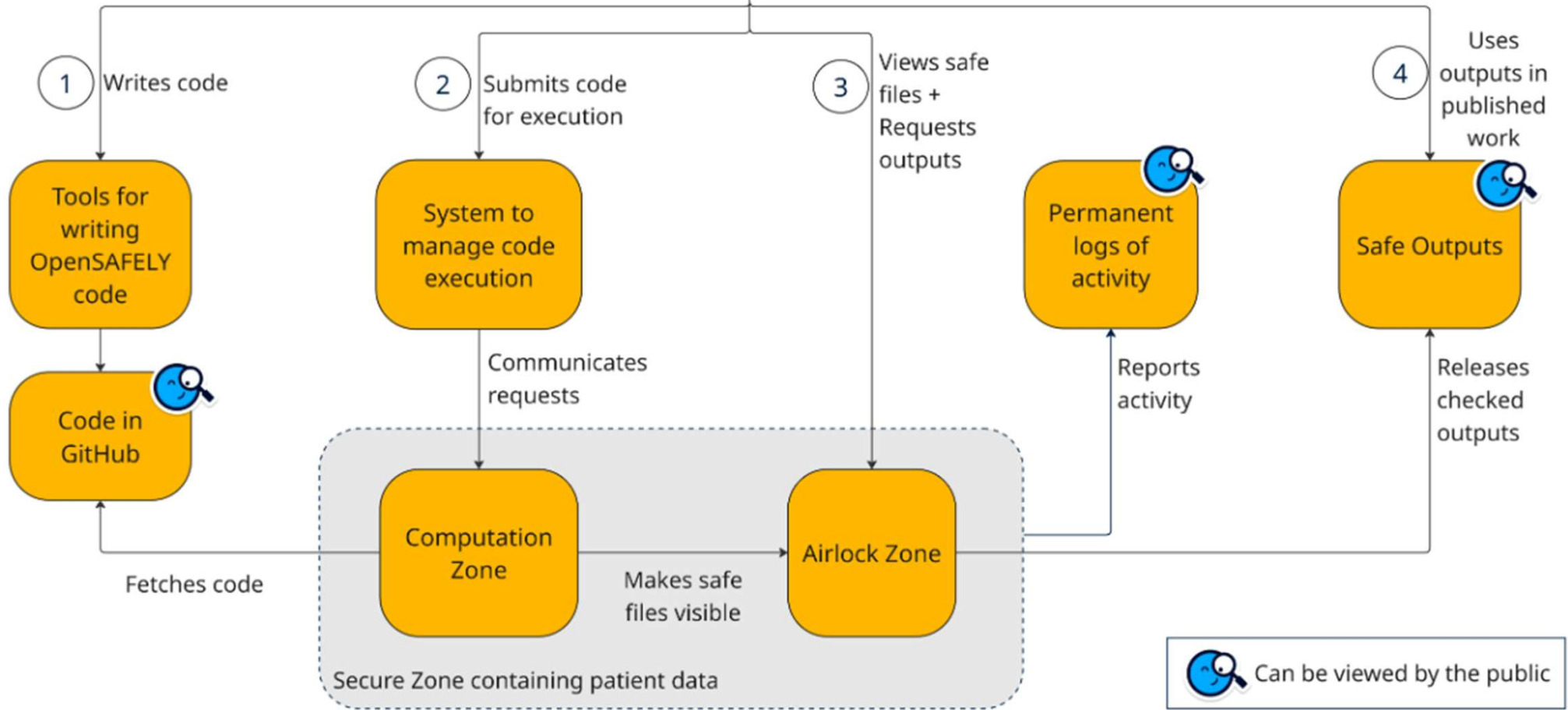
Users work on dummy data

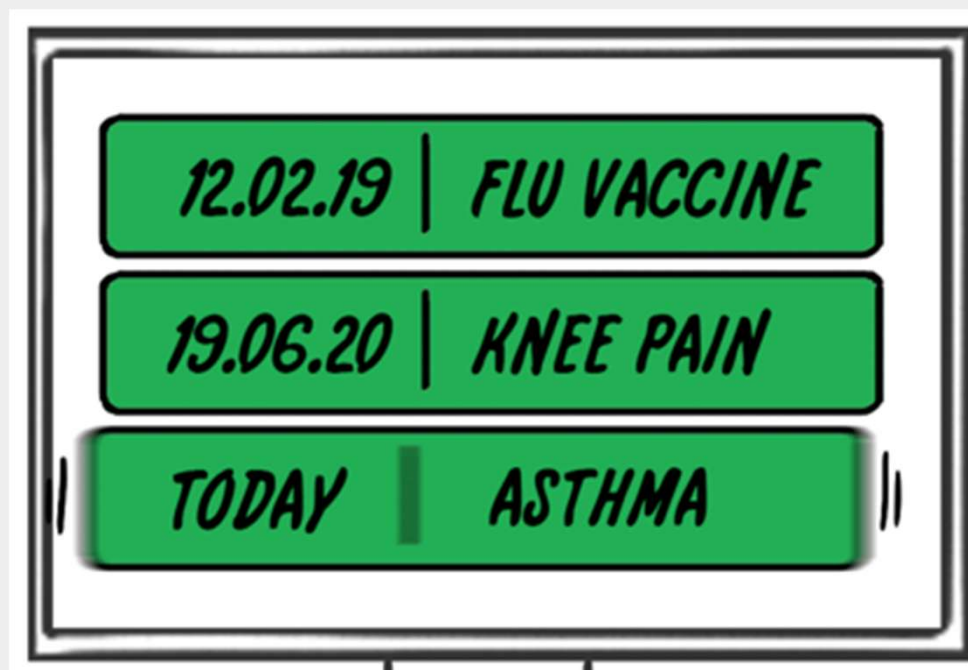
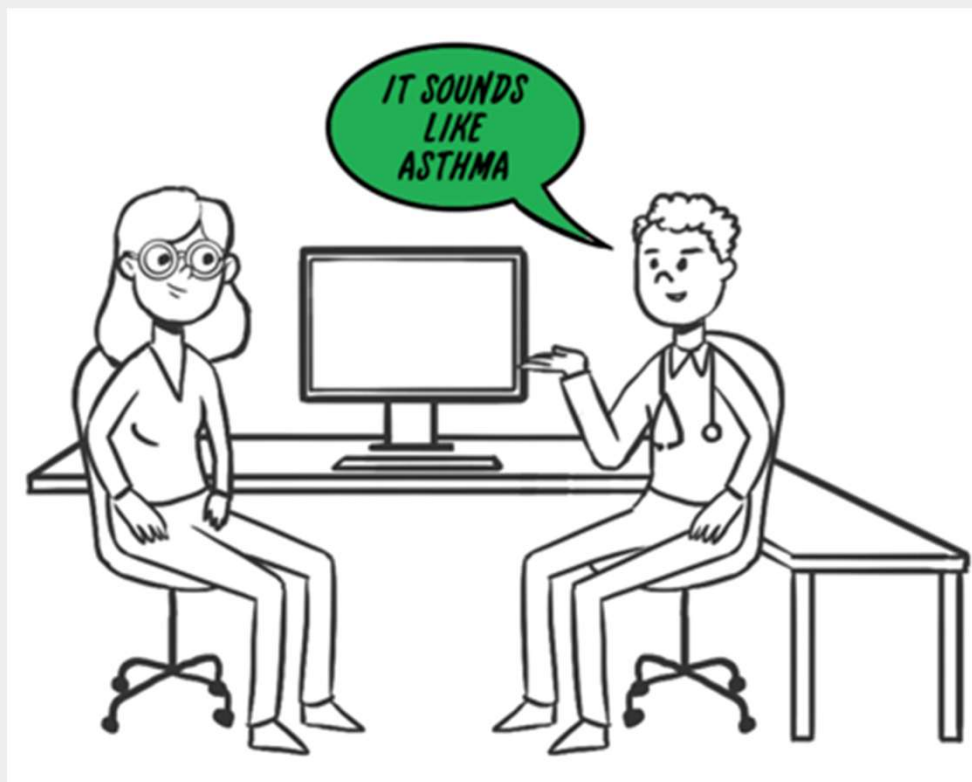
Total, code-level transparency

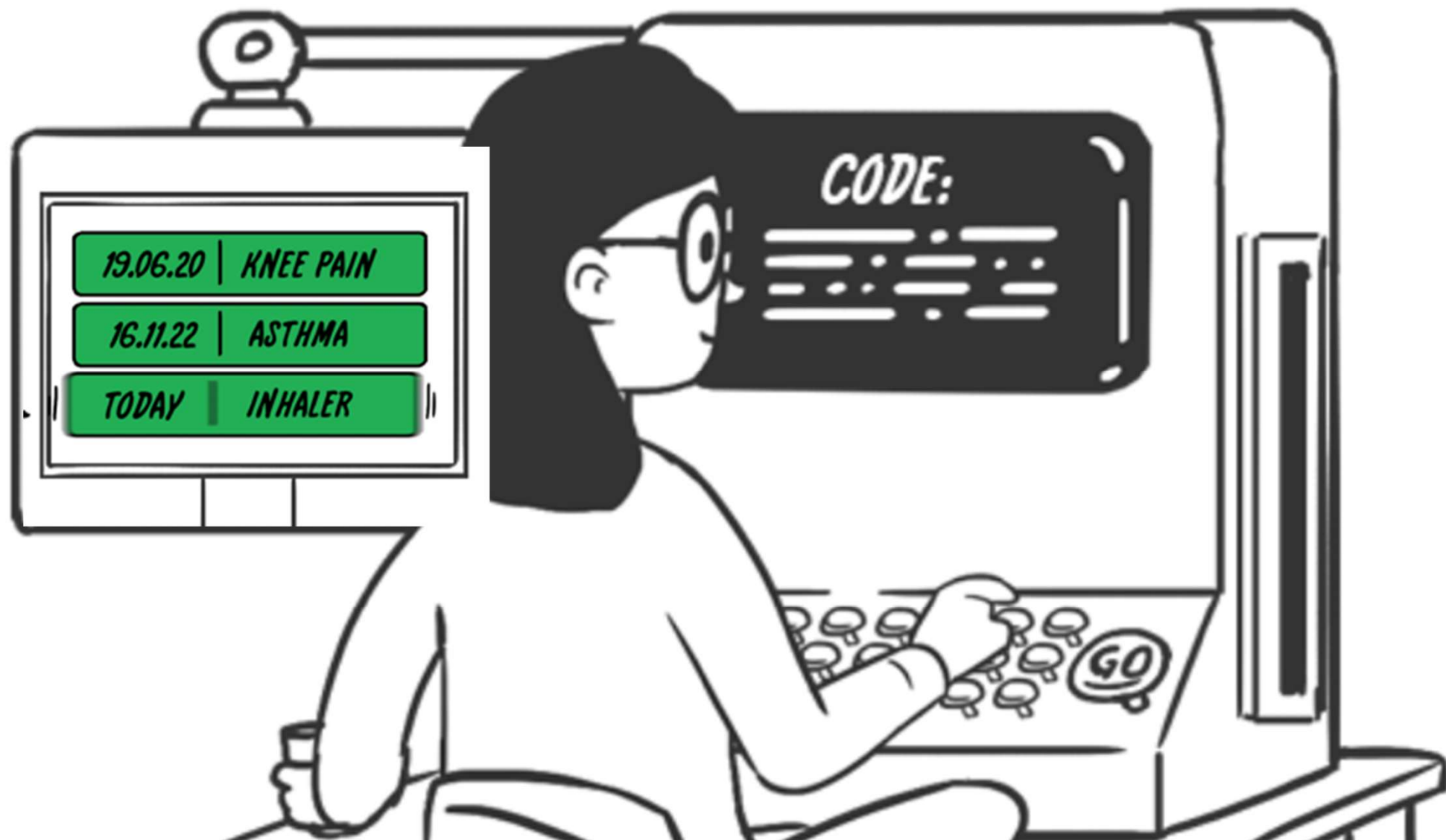




Approved Researcher







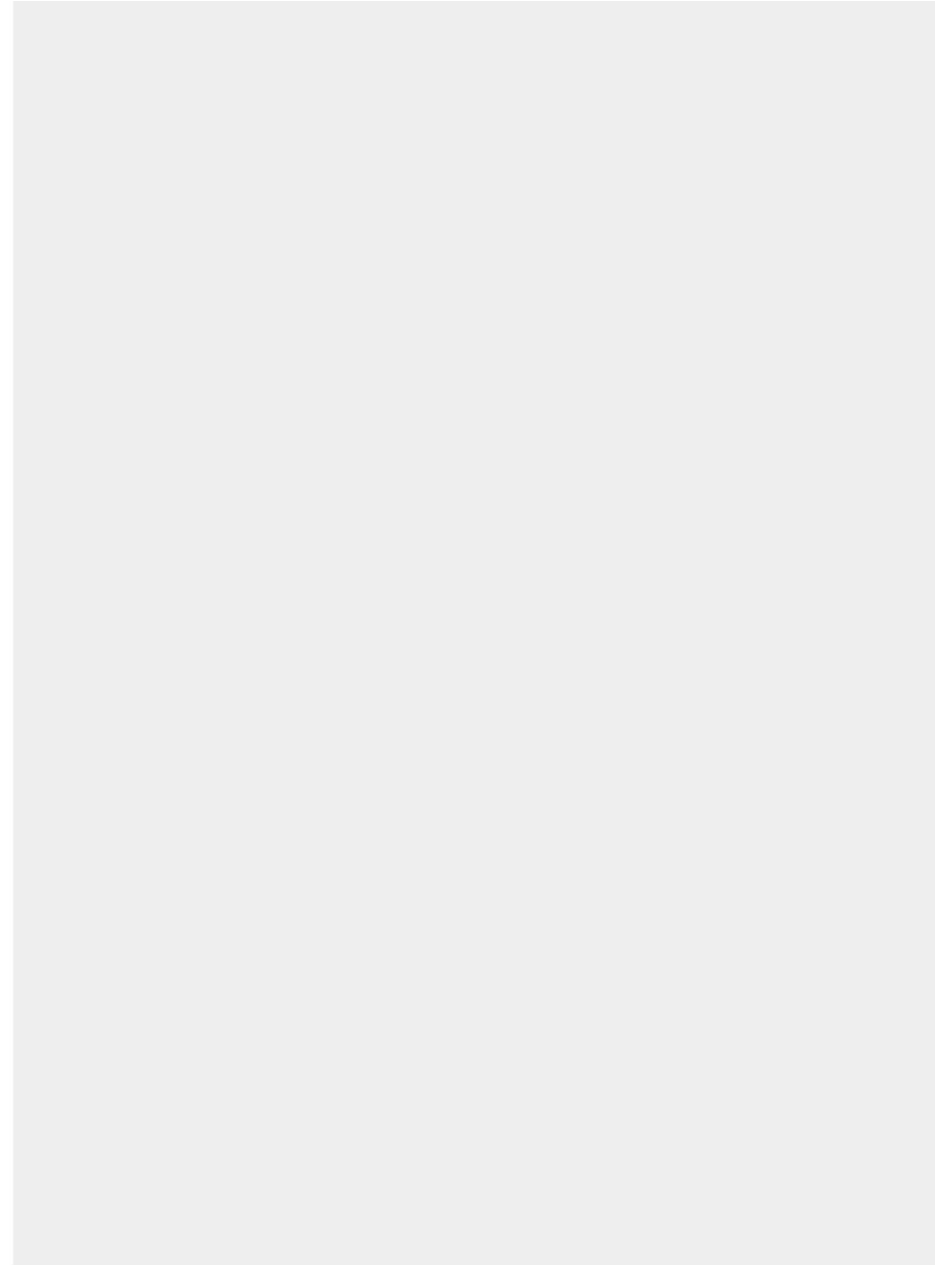
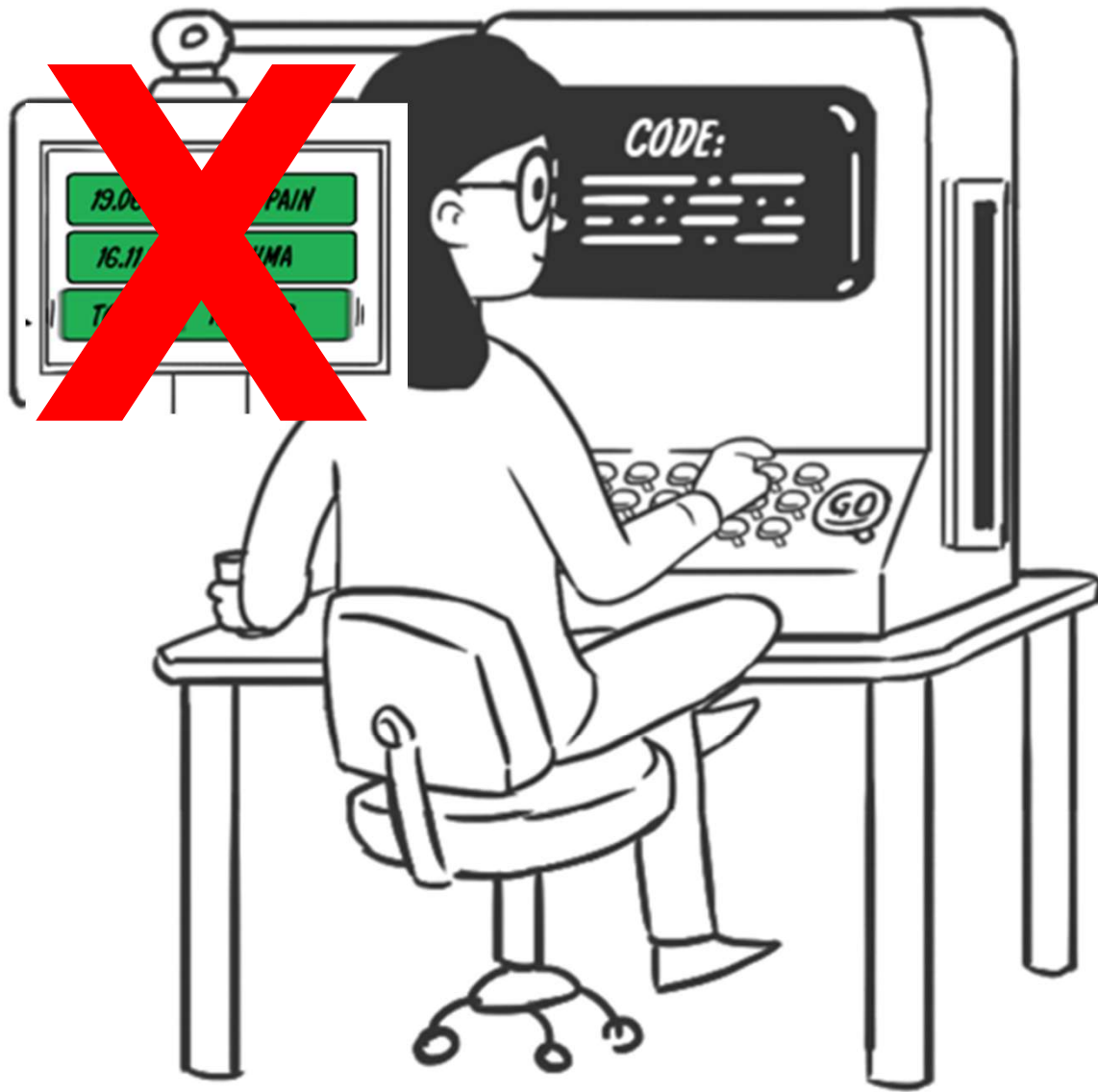
19.06.20 | KNEE PAIN

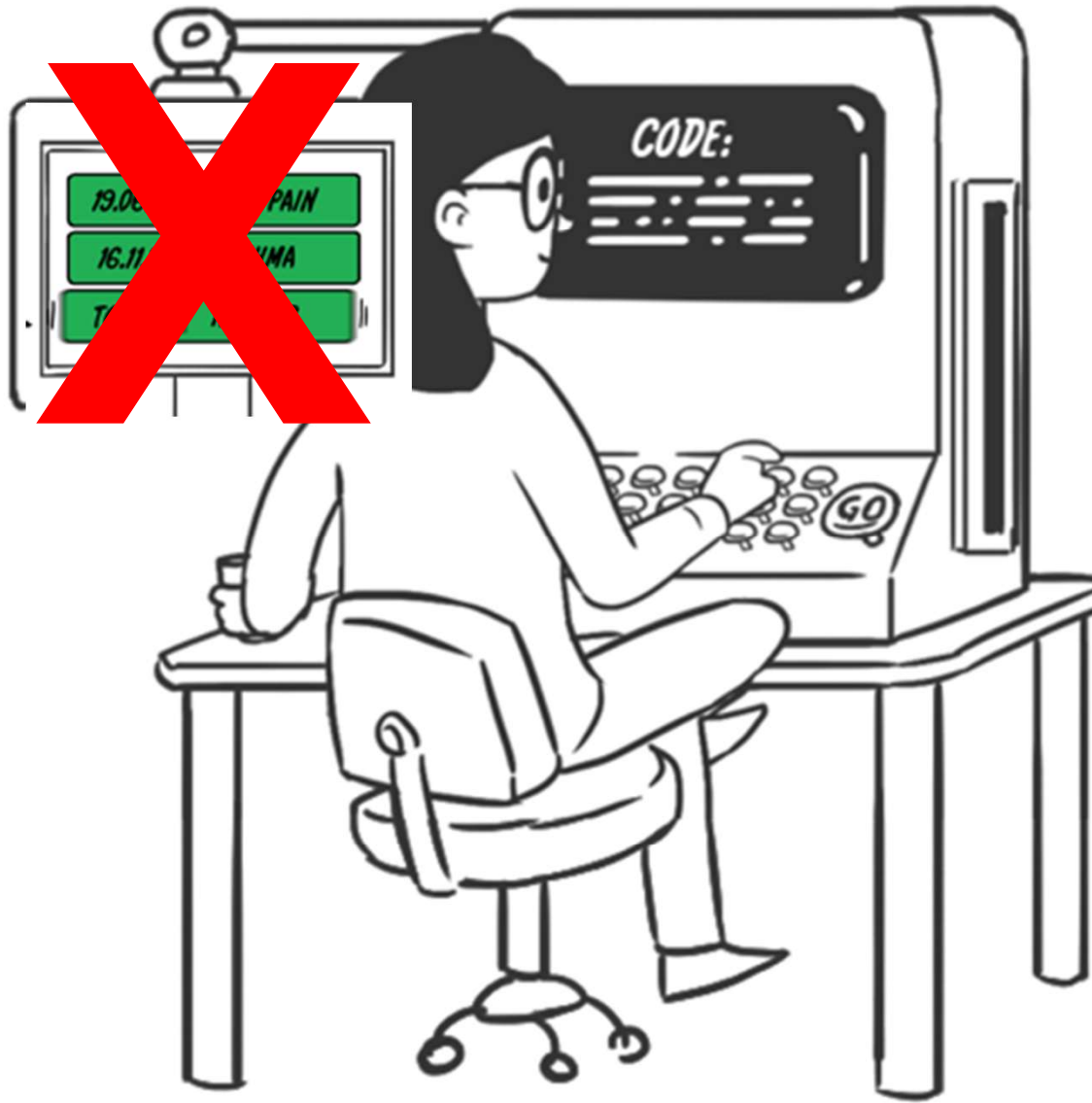
16.11.22 | ASTHMA

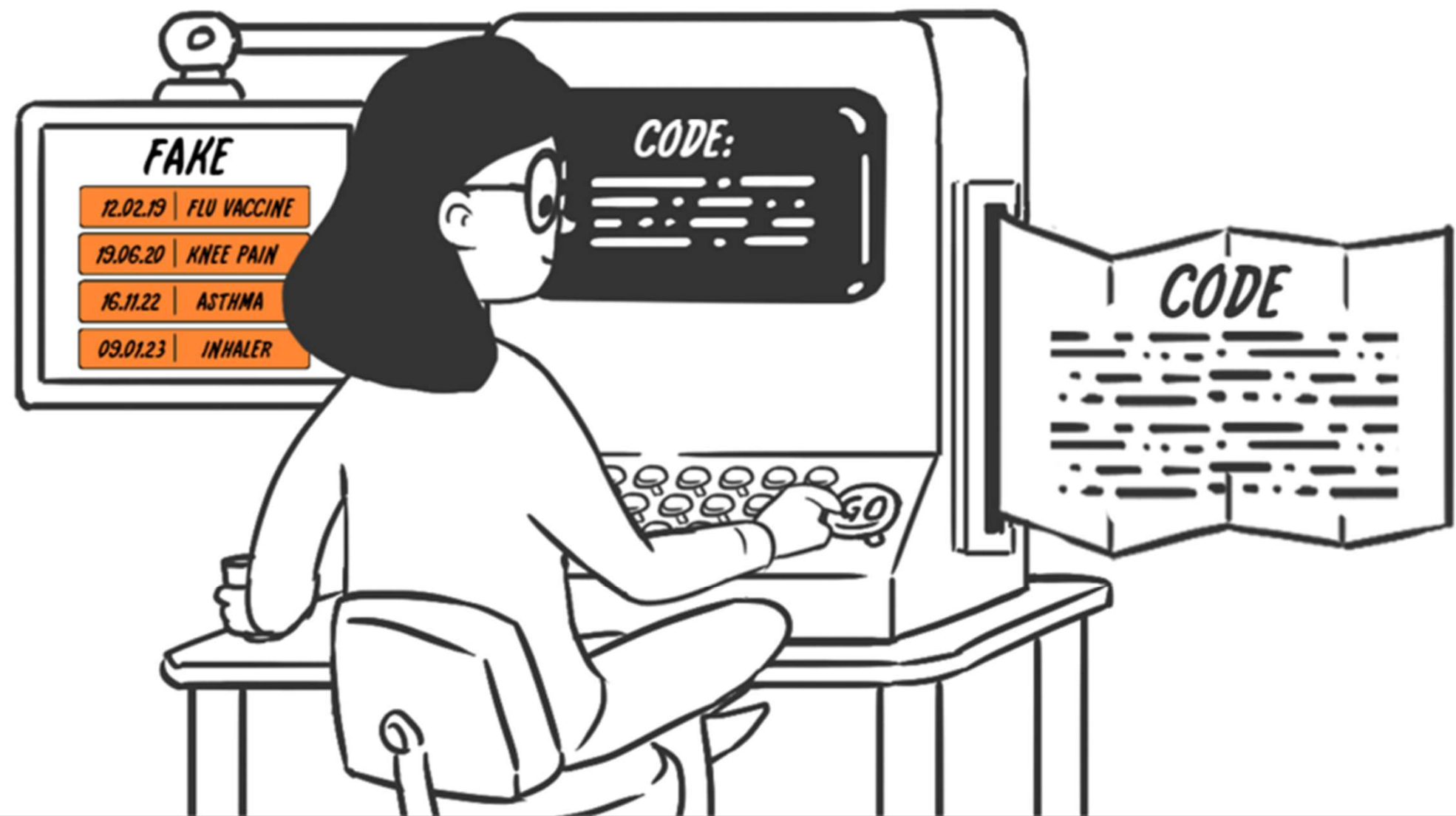
TODAY | INHALER

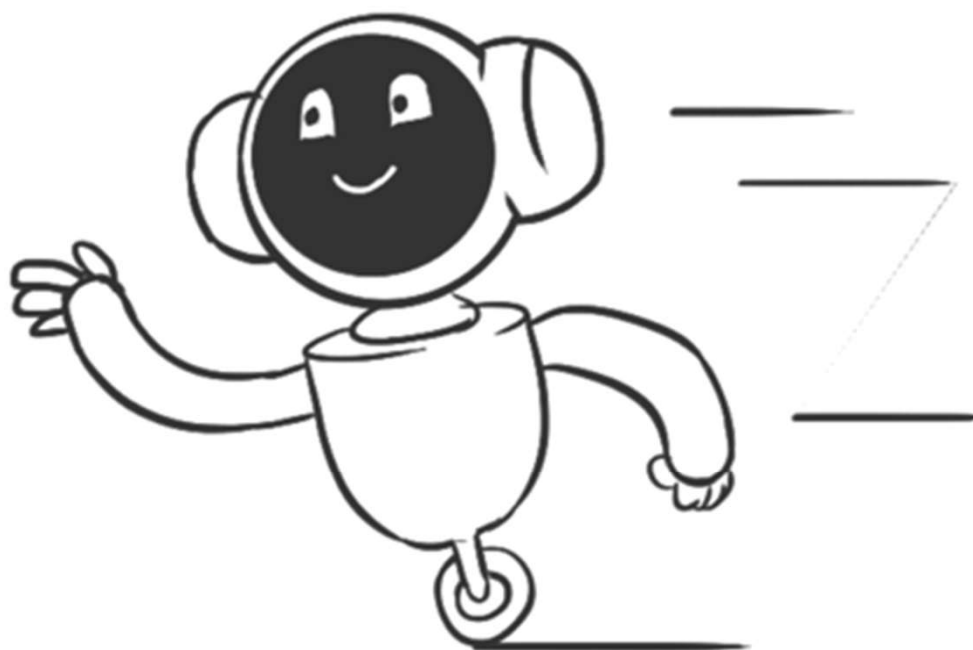
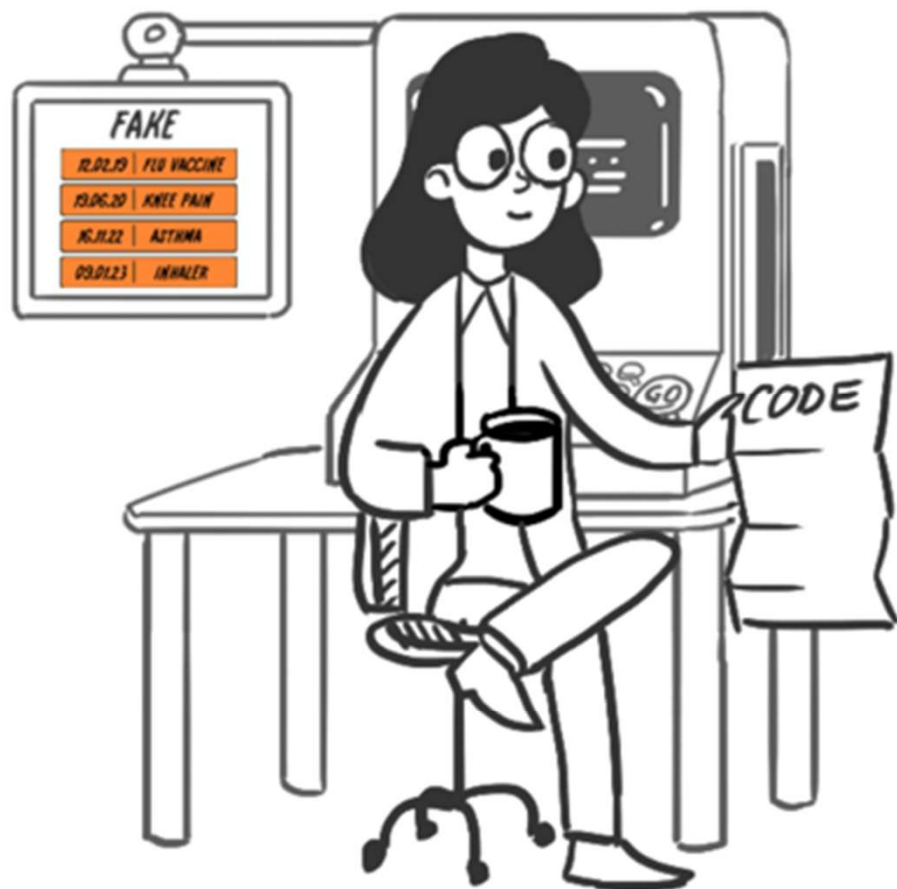
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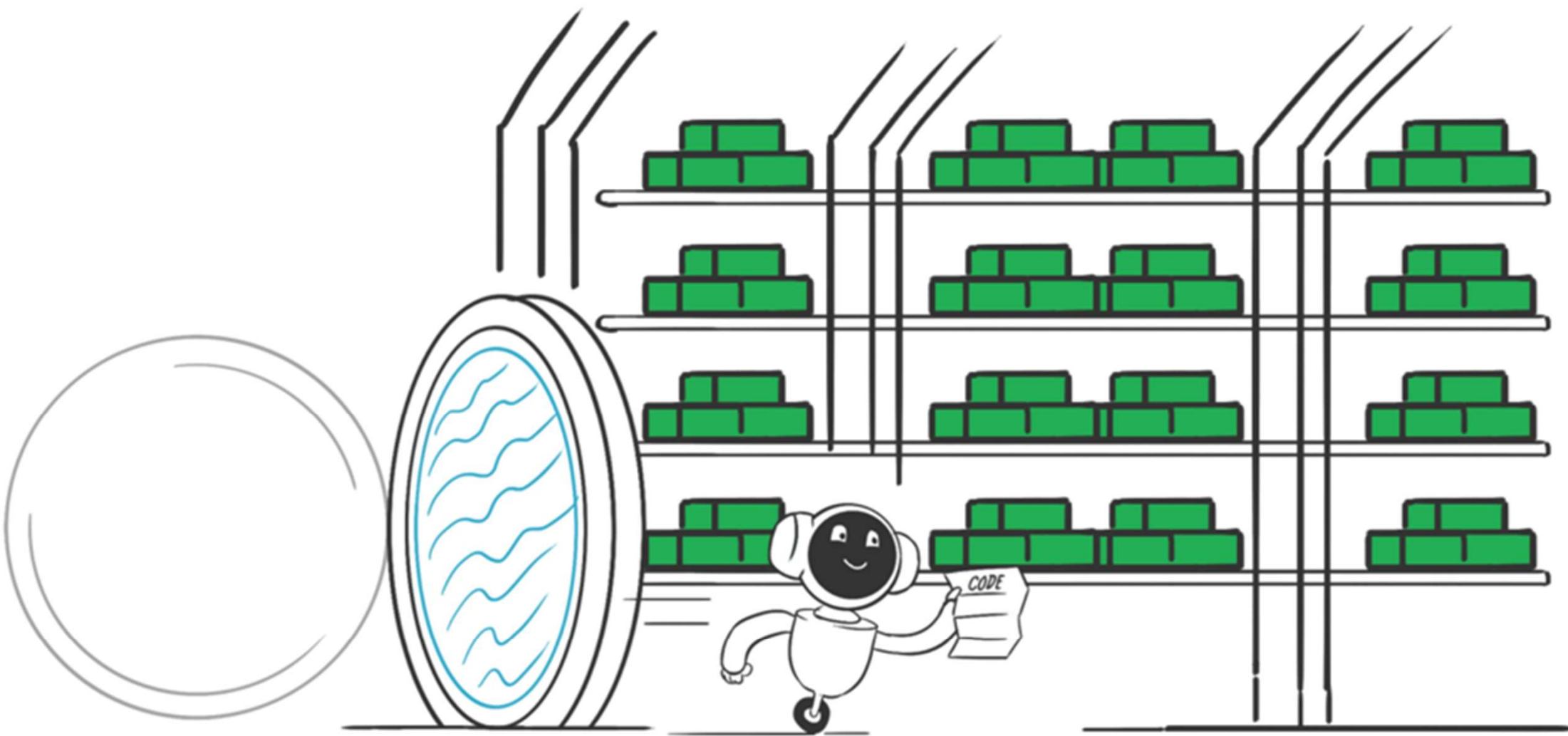
GO

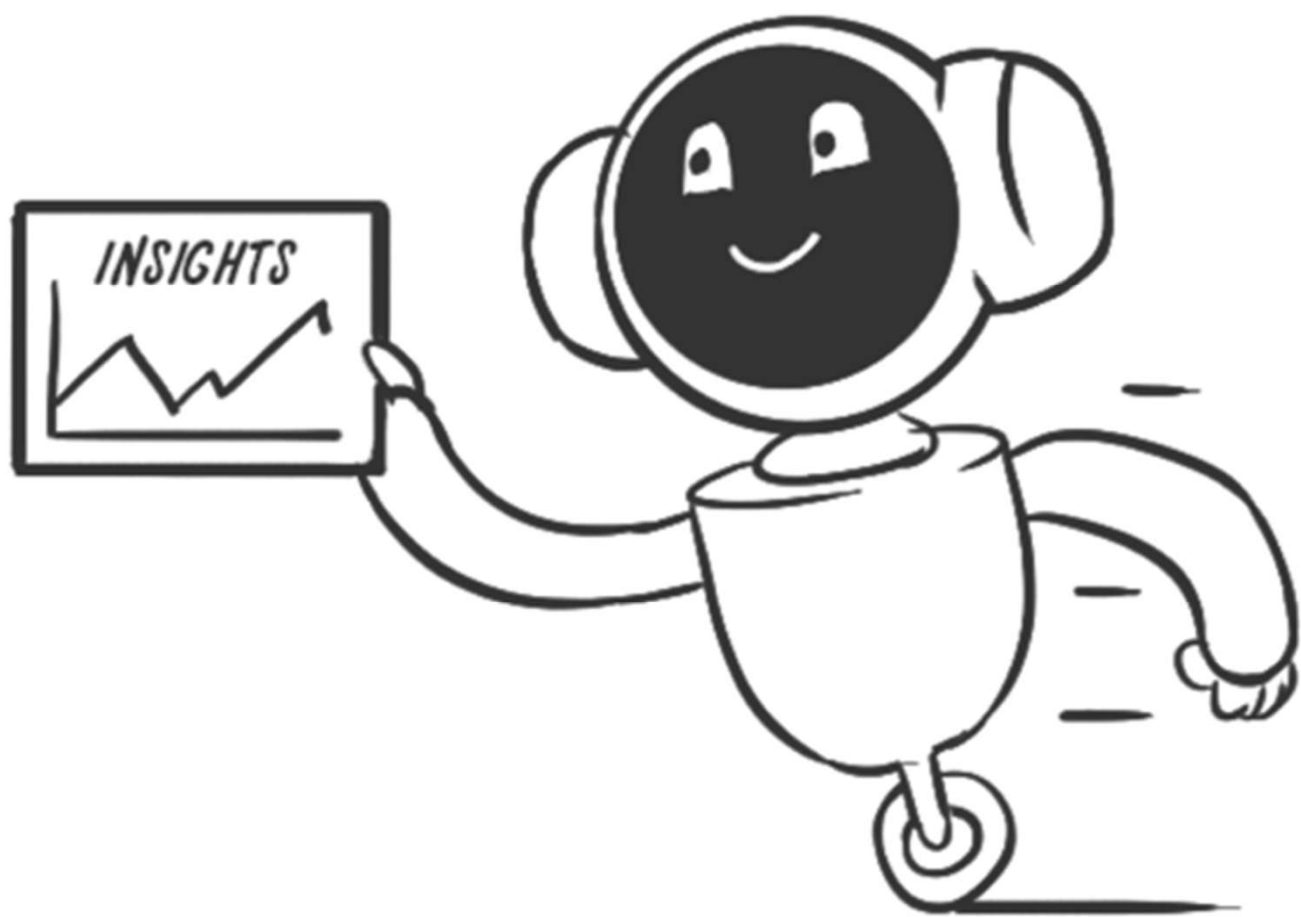












Trust

NHSE and GP as data controller

Records don't move

Users work on dummy data

Total, “code-level” transparency





OpenSAFELY Core

The code that runs the OpenSAFELY platform

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Python 35 stars 11 forks

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Python 25 stars 8 forks

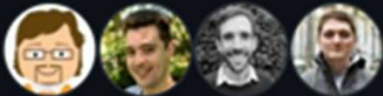
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A client for running jobs in an

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A server for mediating jobs that can be

People



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Status	Organisation	Project	User	Started	
	The London School of Hygiene & Tropical Medicine	Effectiveness safety sotrovimab molnupiravir	Bang Zheng	16 hours ago	View
	The London School of Hygiene & Tropical Medicine	Descriptive cohort analysis of Long COVID and vaccination status	Alasdair Henderson	2 days, 18 hours ago	View
	University of Bristol	Investigating events following SARS-CoV-2 infection	Marwa Al Arab	2 days, 19 hours ago	View
	The London School of Hygiene & Tropical Medicine	Descriptive cohort analysis of Long COVID and vaccination status	Alasdair Henderson	2 days, 20 hours ago	View
	DataLab	OpenSAFELY Internal	Simon Davy	Pending	View

Job request: 17508

sotrovimab_molnupiravir </> tfux2p2qqc5kstep

View repo

View project.yaml

This page shows the technical details of what happened when authorised researcher **Bang Zheng** requested one or more actions to be run against real patient data in the [project](#), within a secure environment.

By cross-referencing the indicated Requested Actions with the Pipeline section below, you can infer what [security level](#) various outputs were written to. Outputs marked as **highly_sensitive** can never be viewed directly by a researcher; they can only request that code runs against them. Outputs

Timeline



Created:
16 hours ago



Started:
16 hours ago

opensafely / sotrovimab-and-molnupiravir Public

generated from opensafely/research-template

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d0280264c8 sotrovimab-and-molnupiravir / project.yaml

Go to file

bangzheng2217 Update project.yaml

Latest commit 7ba879c 16 hours ago History

1 contributor

158 lines (135 sloc) 4.87 KB

Raw

Blame

```
1 version: '3.0'
2
3 expectations:
4   population_size: 500000
5
6 actions:
7
8   generate_study_population:
9     run: cohortextractor:latest generate_cohort --study-definition study_definition
10    outputs:
11      highly_sensitive:
12        cohort: output/input.csv
```



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OpenSAFELY

Studies from the OpenSAFELY collaborative. The framework code itself is over at <https://github.com/opensafely-core>

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This is the code and configuration for our paper, OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients

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<https://opensafely.org/research/2021/covid-vaccine-coverage/>

HTML ☆ 10 🍴 6

ethnicity-covid-research Public

Study to examine the relationship between ethnicity and adverse covid outcomes in England

Stata ☆ 1 🍴 1

research-template Public template

Template for new research using the OpenSAFELY framework

Python ☆ 13 🍴 10

long-covid Public

post-covid-outcomes-research Public

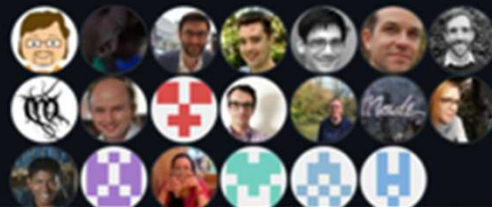
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People



Science & technology | Health data

The pandemic has spawned a new way to study medical records

It preserves confidentiality while liberating useful information



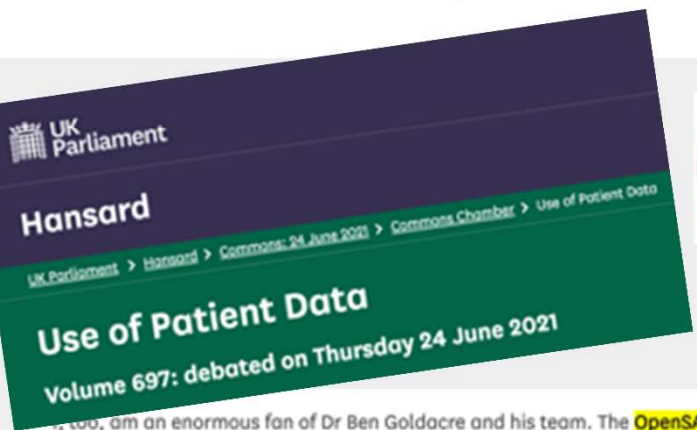
Commissioned by:

NIHR | Applied Research Collaboration Greater Manchester

NHS^x

NDG | National Data Guardian for health and social care

Designed and delivered by:



...too, am an enormous fan of Dr Ben Goldacre and his team. The **OpenSAFELY** project has shown the benefits that TREs can bring, because they allow us to support urgent research and to find the insights in the data while protecting privacy. During the pandemic, the project was absolutely fundamental to our response. In fact, it existed before the pandemic, but really came into its own during the pandemic. For instance, it was the first project to find underlying risk factors for covid-19. **OpenSAFELY** was the first project around the world to find statistically and significantly that obesity makes it more likely that someone will die of covid. That was an important fact, discovered through this project and without disclosing anybody's body mass index in doing so. That is therefore the approach that we will take.

Data Sharing in a Pandemic: Three Citizens' Juries Juries' Report

Incidence and management of inflammatory arthritis in England before and during the COVID-19 pandemic
 We used OpenSAFELY to replicate key metrics from the National Early Inflammatory Arthritis Audit (NEAA), and to assess the impact of COVID-19 on the delivery of care for people with autoimmune inflammatory arthritis in England.
 August 2022

Changes in COVID-19-related mortality across key demographic and clinical subgroups
 This paper describes how COVID-19 related mortality has changed over time during the pandemic. Rates of COVID-19 related death are calculated for many demographic and clinical patient groups.
 August 2022

Waning effectiveness of BNT162b2 and ChAdOx1 COVID-19 vaccines over six months since second dose
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 April 2022

Association between oral anticoagulants and COVID-19 related outcomes
 This paper investigates the association between oral anticoagulants and COVID-19 outcomes in those with atrial fibrillation and a CHA2DS2-VASc score of 2.
 April 2022

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Trends, regional variation and clinical characteristics of recipients of antivirals and neutralising monoclonal antibodies
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 March 2022

Comparison of methods for predicting COVID-19 related death in the general population using the OpenSAFELY platform
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 March 2022

Potentially inappropriate prescribing of DOACs to people with mechanical heart valves
 National guidance was issued during the COVID-19 pandemic to search patients on warfarin to direct and anticoagulants (DOACs) where appropriate as these require less frequent blood testing. DOACs are not recommended for patients with mechanical heart valves. We conducted a retrospective cohort study of DOAC prescribing in people with a record of a mechanical heart valve between September 2019 and May 2021, and describe the characteristics of this population.
 September 2021

Severity of Severe Acute Respiratory System Coronavirus 2 (SARS-CoV-2 Alpha Variant B.1.1.7) in England
 This paper aims to describe the severity of the alpha variant in terms of the pathway of disease from being positive to hospital admission and death.
 September 2021

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 August 2021

Recording of "COVID-19 vaccine declined" among vaccination priority groups
 A description of the patterns of usage of codes for COVID-19 vaccines being declined.
 August 2021

HIV infection and COVID-19 death
 This paper uses the OpenSAFELY platform to investigate whether HIV infection is associated with risk of COVID-19 death.
 August 2021

Recording of "COVID-19 vaccine declined" among vaccination priority groups
 A description of the patterns of usage of codes for COVID-19 vaccines being declined.
 August 2021

Overall and competing risk of hospitalisation and death after COVID-19 hospitalisation
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 August 2021

Risk factors for COVID-19 infection
 Working on behalf of NHS England, this paper used the OpenSAFELY platform to quantify ethnic differences in SARS-CoV-2 or COVID-19 outcomes during the first and second waves of the COVID-19 pandemic in England.
 May 2021

Hydroxychloroquine and COVID-19 mortality
 Working on behalf of NHS England, this paper used the OpenSAFELY platform to investigate the effectiveness of hydroxychloroquine for prevention of COVID-19 mortality. We found no evidence of benefit after adjusting for important differences between those who had the same health conditions prescribed hydroxychloroquine and those who did not.
 December 2020

Warfarin, DOACs, and COVID-19
 Working on behalf of NHS England, this study investigates which people were switched from warfarin to DOACs following national guidance during the first wave of the COVID-19 pandemic; seeks to identify potentially unsafe or prescribing of anticoagulants, and assesses whether abnormal clotting results have become more frequent during the pandemic.
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 December 2020

Effectiveness of BNT162b2 booster doses in England
 We estimate the effectiveness of boosting with BNT162b2 compared with no boosting in eligible adults who had received two primary course vaccine doses in England.
 June 2022

Safety of COVID-19 vaccination and acute events
 This paper investigates the potential association of COVID-19 vaccination with acute neurological events, Sudden Death Syndrome (SDS), myocardial infarction and Bell's palsy.
 June 2022

Impact of national guidance on switching anticoagulant therapy during COVID-19
 This paper describes which people were switched from warfarin to DOACs during the COVID-19 pandemic following an update in national guidance.
 November 2021

OpenSAFELY NHS Service Restoration Observatory 1
 Working on behalf of NHS England, this study used the OpenSAFELY platform to describe the volume and variation of coded clinical activity in general practice between January 2019 and September 2020, taking respiratory disease and laboratory procedures as examples.
 November 2021

Rates of serious clinical outcomes in survivors of hospitalisation with COVID-19
 Patients with COVID-19 are thought to be at higher risk of cardiovascular and pulmonary complications, but quantification of that risk is limited. Working on behalf of NHS England, this study aimed to describe the overall burden of these complications in survivors of severe COVID-19 using OpenSAFELY.
 April 2021

Case fatality risk of the SARS-CoV-2 variant of concern B.1.1.7
 Working on behalf of NHS England, this paper uses the OpenSAFELY platform to estimate the risk of death following confirmation of SARS-CoV-2 infection in England, comparing infection with B.1.1.7 to non-B.1.1.7 after adjusting for demographic factors and comorbidities.
 March 2021

Ethnic differences in COVID-19 infection, hospitalisation, and mortality
 Working on behalf of NHS England, the aim of this study was to identify ethnic differences in the risk of COVID-19 infection, hospitalisation and mortality using a large general population cohort in England.
 September 2020

Association between living with children and outcomes from COVID-19
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 July 2020

opensafely.org/research

Association between household composition and severe COVID-19 outcomes in older people
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 April 2022

Association between oral anticoagulants and COVID-19 related outcomes
 This paper investigates the association between oral anticoagulants and COVID-19 outcomes in those with atrial fibrillation and a CHA2DS2-VASc score of 2.
 April 2022

Waning effectiveness of BNT162b2 and ChAdOx1 COVID-19 vaccines over six months since second dose
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 April 2022

Trends, regional variation and clinical characteristics of recipients of antivirals and neutralising monoclonal antibodies
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 March 2022

Comparison of methods for predicting COVID-19 related death in the general population using the OpenSAFELY platform
 This paper aims to quantify the association between household composition and risk of severe COVID-19 by ethnicity for older individuals.
 March 2022

Potentially inappropriate prescribing of DOACs to people with mechanical heart valves
 National guidance was issued during the COVID-19 pandemic to search patients on warfarin to direct and anticoagulants (DOACs) where appropriate as these require less frequent blood testing. DOACs are not recommended for patients with mechanical heart valves. We conducted a retrospective cohort study of DOAC prescribing in people with a record of a mechanical heart valve between September 2019 and May 2021, and describe the characteristics of this population.
 September 2021

Severity of Severe Acute Respiratory System Coronavirus 2 (SARS-CoV-2 Alpha Variant B.1.1.7) in England
 This paper aims to describe the severity of the alpha variant in terms of the pathway of disease from being positive to hospital admission and death.
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 August 2021

Recording of "COVID-19 vaccine declined" among vaccination priority groups
 A description of the patterns of usage of codes for COVID-19 vaccines being declined.
 August 2021

HIV infection and COVID-19 death
 This paper uses the OpenSAFELY platform to investigate whether HIV infection is associated with risk of COVID-19 death.
 August 2021

Recording of "COVID-19 vaccine declined" among vaccination priority groups
 A description of the patterns of usage of codes for COVID-19 vaccines being declined.
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Overall and competing risk of hospitalisation and death after COVID-19 hospitalisation
 This paper aims to describe the severity of the alpha variant in terms of the pathway of disease from being positive to hospital admission and death.
 August 2021

Risk factors for COVID-19 infection
 Working on behalf of NHS England, this paper used the OpenSAFELY platform to quantify ethnic differences in SARS-CoV-2 or COVID-19 outcomes during the first and second waves of the COVID-19 pandemic in England.
 May 2021

Hydroxychloroquine and COVID-19 mortality
 Working on behalf of NHS England, this paper used the OpenSAFELY platform to investigate the effectiveness of hydroxychloroquine for prevention of COVID-19 mortality. We found no evidence of benefit after adjusting for important differences between those who had the same health conditions prescribed hydroxychloroquine and those who did not.
 December 2020

Warfarin, DOACs, and COVID-19
 Working on behalf of NHS England, this study investigates which people were switched from warfarin to DOACs following national guidance during the first wave of the COVID-19 pandemic; seeks to identify potentially unsafe or prescribing of anticoagulants, and assesses whether abnormal clotting results have become more frequent during the pandemic.
 December 2020

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 This paper aims to describe the severity of the alpha variant in terms of the pathway of disease from being positive to hospital admission and death.
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 December 2020

Effectiveness of BNT162b2 booster doses in England
 We estimate the effectiveness of boosting with BNT162b2 compared with no boosting in eligible adults who had received two primary course vaccine doses in England.
 June 2022

Safety of COVID-19 vaccination and acute events
 This paper investigates the potential association of COVID-19 vaccination with acute neurological events, Sudden Death Syndrome (SDS), myocardial infarction and Bell's palsy.
 June 2022

Impact of national guidance on switching anticoagulant therapy during COVID-19
 This paper describes which people were switched from warfarin to DOACs during the COVID-19 pandemic following an update in national guidance.
 November 2021

OpenSAFELY NHS Service Restoration Observatory 1
 Working on behalf of NHS England, this study used the OpenSAFELY platform to describe the volume and variation of coded clinical activity in general practice between January 2019 and September 2020, taking respiratory disease and laboratory procedures as examples.
 November 2021

Rates of serious clinical outcomes in survivors of hospitalisation with COVID-19
 Patients with COVID-19 are thought to be at higher risk of cardiovascular and pulmonary complications, but quantification of that risk is limited. Working on behalf of NHS England, this study aimed to describe the overall burden of these complications in survivors of severe COVID-19 using OpenSAFELY.
 April 2021

Case fatality risk of the SARS-CoV-2 variant of concern B.1.1.7
 Working on behalf of NHS England, this paper uses the OpenSAFELY platform to estimate the risk of death following confirmation of SARS-CoV-2 infection in England, comparing infection with B.1.1.7 to non-B.1.1.7 after adjusting for demographic factors and comorbidities.
 March 2021

Ethnic differences in COVID-19 infection, hospitalisation, and mortality
 Working on behalf of NHS England, the aim of this study was to identify ethnic differences in the risk of COVID-19 infection, hospitalisation and mortality using a large general population cohort in England.
 September 2020

Association between living with children and outcomes from COVID-19
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 July 2020

**What does it look
like to a user?**



The screenshot displays a JupyterLab environment with the following components:

- EXPLORER:** A file browser on the left showing a project structure with folders like `.devcontainer`, `.vscode`, `codelists`, and `dummy_tables`. The file `dataset_definition.py` is selected.
- Code Editor:** The main area shows a Python script `dataset_definition.py` with the following code:

```
29 nhsd-primary-care-domain-refsets-dmres_cod.  
30 csv",  
31 column="code")  
32  
33 last_diagnosis_date = (  
34     clinical_events.where(clinical_events.  
35     snomedct_code.is_in(diabetes_codes))  
36     .sort_by("date")  
37     .where(clinical_events.date <= index_date)  
38     .last_for_patient()  
39     .date  
40 )  
41  
42 last_resolved_date = (  
43     clinical_events.where(clinical_events.  
44     snomedct_code.is_in(resolved_codes))  
45     .sort_by("date")  
46     .where(clinical_events.date <= index_date)  
47     .last_for_patient()  
48     .date  
49 )  
50  
51 show(last_diagnosis_date, last_resolved_date)
```
- Output:** A table titled "ehrQL Dataset Output" showing the results of the script. The table has three columns: `patient_id`, `series_1`, and `series_2`. The data is as follows:

patient_id	series_1	series_2
3	2023-04-17	
4	2023-03-13	
5	2023-02-04	
6	2022-06-19	
7	2022-08-30	
8	2024-02-08	
10	2023-06-21	
11	2023-09-04	
12	2024-01-07	
13	2022-09-22	
14	2022-11-23	
15	2022-11-10	
17	2023-08-19	
18	2022-12-02	
19	2022-09-18	
20	2022-08-14	
21	2024-03-07	2023-08-17
22	2022-07-17	
23	2023-01-19	
24	2022-08-24	
25	2023-07-18	
- Terminal:** A terminal window at the bottom shows the command prompt `@eli-miriam → /workspaces/ehrql-tutorial (main) $` and a message: "Follow the tutorial at <https://docs.opensafely.org/ehrql/tutorial/>. You will not need this panel for the tutorial. You can close it by clicking on the X or by pressing Ctrl+J."

R, Stata, Python etc



Pick a backend to run your Jobs in:

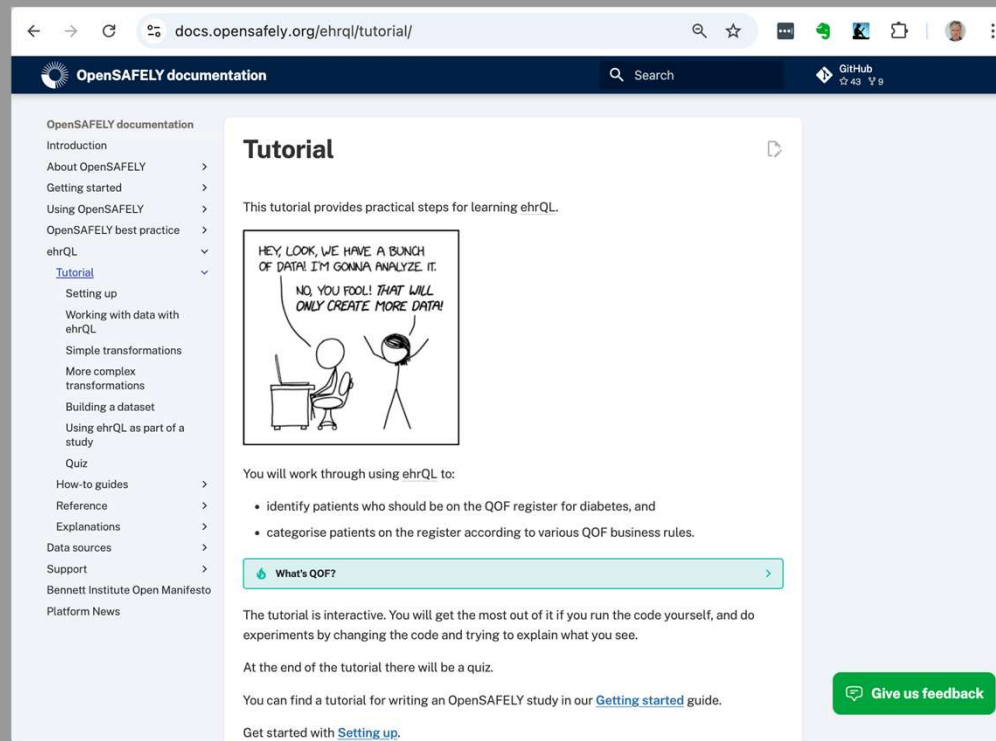
EMIS

TPP

Pick one or more actions to run:

Select	Action	Previously run	Status
<input checked="" type="checkbox"/>	<code>generate_dataset</code>	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	<code>analyse_dataset</code>	<input checked="" type="checkbox"/>	<input type="button" value="Needs"/>
<input type="checkbox"/>	<code>run_all</code>		<input type="button" value="Needs"/>

docs.opensafely.org



The screenshot shows a web browser displaying the 'Tutorial' page on the 'docs.opensafely.org' website. The browser's address bar shows the URL 'docs.opensafely.org/ehrql/tutorial/'. The website header includes the 'OpenSAFELY documentation' logo, a search bar, and a GitHub repository link. A left-hand navigation menu lists various sections, with 'Tutorial' highlighted under the 'ehrQL' category. The main content area features a 'Tutorial' heading, a brief introduction, a cartoon illustration of two characters discussing data analysis, a list of tasks to be completed using ehrQL, a 'What's QOF?' section, and a 'Give us feedback' button.

docs.opensafely.org/ehrql/tutorial/

OpenSAFELY documentation

Search

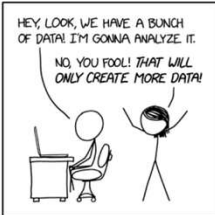
GitHub

OpenSAFELY documentation

- Introduction
- About OpenSAFELY
- Getting started
- Using OpenSAFELY
- OpenSAFELY best practice
- ehrQL
 - Tutorial**
 - Setting up
 - Working with data with ehrQL
 - Simple transformations
 - More complex transformations
 - Building a dataset
 - Using ehrQL as part of a study
 - Quiz
- How-to guides
- Reference
- Explanations
- Data sources
- Support
- Bennett Institute Open Manifesto
- Platform News

Tutorial

This tutorial provides practical steps for learning ehrQL.



You will work through using ehrQL to:

- identify patients who should be on the QOF register for diabetes, and
- categorise patients on the register according to various QOF business rules.

What's QOF?

The tutorial is interactive. You will get the most out of it if you run the code yourself, and do experiments by changing the code and trying to explain what you see.

At the end of the tutorial there will be a quiz.

You can find a tutorial for writing an OpenSAFELY study in our [Getting started](#) guide.

Get started with [Setting up](#).

Give us feedback

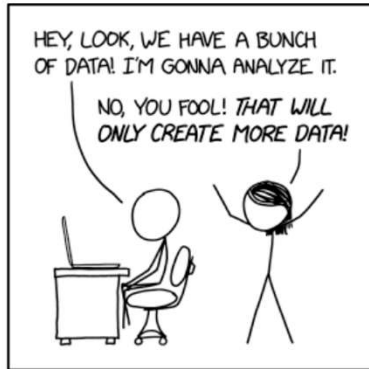


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OpenSAFELY documentation

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- ehrQL >
- Data sources ▾
 - Overview
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 - EMIS primary care
 - Covid-19 test results
 - Covid-19 therapeutics
 - Emergency attendances
 - High Cost Drugs
 - Hospital admissions
 - In-hospital deaths (covid-19 only)
 - Intensive care admissions (covid-19 only)
 - International Severe Acute Respiratory and emerging Infection Consortium
 - Registered deaths
 - UK Renal Registry
- Support >
- Bennett Institute Open Manifesto
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Data Sources

- [Overview](#)
- [SystemOne primary care](#)
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- [Covid-19 therapeutics](#)
- [Emergency attendances](#)
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- [International Severe Acute Respiratory and emerging Infection Consortium](#)
- [Registered deaths](#)
- [UK Renal Registry](#)



OpenSAFELY documentation

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 - Analysis workflow
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 - GitHub repositories
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 - Actions ▾
 - Overview
 - The project pipeline
 - Scripted actions
 - Reusable actions
- Jobs site
- Level 4 server
- Viewing and releasing outputs >
- Reports >
- Managing your OpenSAFELY project >
- Adding your pre-print/paper to OpenSAFELY.org
- Information for system integrators
- Legacy >

Reusable actions

Like [scripted actions](#), reusable actions are logical units of analytic code. However, whereas a scripted action is written to solve a problem for one study and must be copied-and-pasted to solve a similar problem for another study, a reusable action is written to solve a problem for several studies *without copying-and-pasting between them*. This makes reusable actions ideal for tasks that must be completed by several studies, such as joining datasets or producing deciles charts.

Running reusable actions

You can browse existing reusable actions at <https://actions.opensafely.org>. Although each is different, they have a common [API](#). Consider the following extract from a study's *project.yaml*:

```
actions:
  generate_dataset:
    run: ehrql:v1 generate-dataset analysis/dataset_definition.py --output output/da
    outputs:
      highly_sensitive:
        dataset: output/dataset.csv.gz

  run_a_reusable_action:
    # We will run version `v1.0.0` of the reusable action called `a_reusable_action`
    # The reusable action accepts an argument; in this case, a path to a file.
    run: a_reusable_action:v1.0.0 output/dataset.csv.gz
    # The reusable action accepts a configuration option;
    # in this case, an output format.
    config:
      output-format: PNG
```

Table of contents

- Running reusable actions
- Developing reusable actions





**BENNETT
INSTITUTE**
FOR APPLIED
DATA SCIENCE

OpenSAFELY co-pilot programme: assisting users on their OpenSAFELY journey

Posted:
5 Aug 2021

Written by:
Amelia Green

Categories:
[OpenSAFELY](#)



Self-service data preparation tools

ehrQL

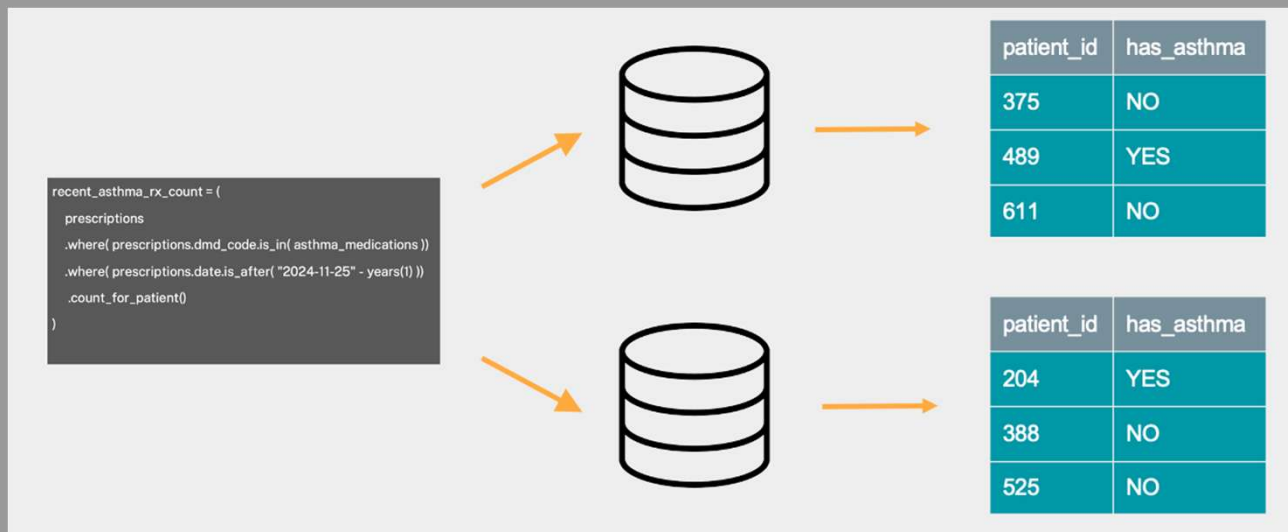
```
recent_asthma_rx_count = (  
  prescriptions  
  .where( prescriptions.dmd_code.is_in( asthma_medications ))  
  .where( prescriptions.date.is_after( "2024-11-25" - years(1) ))  
  .count_for_patient()  
)
```

Every user can **see** every other user's work: **understand** it, **re-use** it, **adapt** it, and **improve** it.



Efficiency

Standardised code (“ehrQL”)



OpenCodeLists.org

The screenshot shows a web browser displaying the OpenCodeLists.org website. The page title is "3-in-1 Diphtheria tetanus and polio vaccine administration codes". The browser address bar shows the URL: `opencodelists.org/codelist/nhsd-primary-care-domain-refsets/3in1vac...`. The website header includes the OpenCodeLists logo and navigation links for "Docs", "Register", and "Log in".

Below the title, there is a table with the following data:

Coding system	Coding system release	Organisation	Codelist ID	Version Tag	Version ID	Number of codes included
SNOMED CT (UK Clinical Edition)	41.0.0	NHSD Primary Care Domain Refsets	nhsd-primary-care-domain-refsets/3in1vac_cod	20250912	5a9175da	14

On the left side, there are three buttons: "Download CSV", "Download definition", and "Clone this codelist". Below these is a "Versions" section with a list of published versions:

- 20250912** (Published) - Created: 24 Oct 2025 at 14:35
- 20250627** (Published) - Created: 18 Jul 2025 at 07:21
- 20241205** (Published) - Created: 24 Dec 2024 at 12:43
- 20211221** (Published) - Created: 03 Mar 2022 at

The main content area has tabs for "About", "Full list", and "Tree". The "Description" tab is active, showing the following text:

Description
Taken from the '3IN1VAC_COD' refset published by NHSD. Contains public sector information licensed under the UK Open Government Licence v3.0 (<https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>).

References

- [Primary Care Domain Reference Set Portal](#)

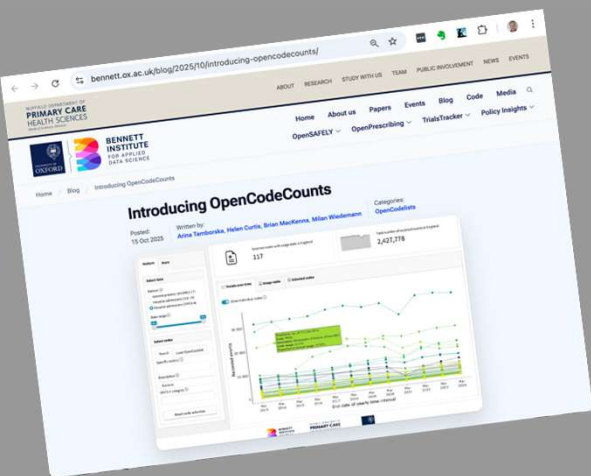
Below the references, there is a paragraph of text:

Codelists are developed by a broad community of users for individual study purposes, which may or may not meet the needs of other studies. They should not be thought of as universal definitions of a particular condition. We don't offer any guarantees about what they do or don't identify. Users should carefully check that any codelist meets their needs, and seek clinical input where appropriate.

At the bottom right of the main content area, there is a green button that says "Give us feedback".



OpenCodeCounts



Analyse **More**

Select data

Dataset [?]

- General practice (SNOMED CT)
- Hospital admissions (ICD-10)
- Hospital admissions (OPCS-4)

Date range [?]

2013 2024

Select codes

Search Load OpenCodelist

Specific code(s) [?]

Description [?]

fracture

OPCS-4 category [?]

Reset code selection

Selected codes with usage data in England

117

Total number of recorded events in England

2,427,778

Trends over time **Usage table** **Selected codes**

Show individual codes [?]

Recorded events

End date of yearly time interval

Timeframe: Apr 2013 to Mar 2014
Code: W262
Description: Manipulation of fracture of bone NEC
Code usage: 22,370
Proportion of annual usage: 10.80%

BENNETT INSTITUTE FOR APPLIED DATA SCIENCE

NUFFIELD DEPARTMENT OF PRIMARY CARE HEALTH SCIENCES
Medical Sciences Division

UNIVERSITY OF OXFORD



The data is locked down

Everything else is open

The full technical user manual docs.opensafely.org

All the code for the platform github.com/opensafely-core

All the code for every analysis github.com/opensafely

Real-time logs of all code run jobs.opensafely.org

All the approved projects opensafely.org/approved-projects

All the outputs opensafely.org/research



What's next?

Cautious expansion to non-COVID work

New features for users

Non-health data (OpenSAFELY-schools)

Non-UK data



**What's
next?**



What's next?

non-COVID with NHSE

The screenshot shows the NHS England website's news section. At the top, there is a blue navigation bar with links for Home, News, Publications, Statistics, Blogs, Events, and Contact us. Below this is the NHS England logo and a secondary navigation bar with links for About us, Our work, Commissioning, and Get involved. A search bar is located in the top right corner. The main content area features a 'Search news' section with filters for Keyword, Topic, and Date range. The featured news article is titled 'NHS expands use of secure COVID-19 research platform to help find new treatments for major killer conditions', dated 17 November 2023, with tags for 'Coronavirus' and 'Digital'. The article text discusses the NHS's plan to expand a research platform to other major diseases like cancer, diabetes, and asthma, aiming to help researchers understand more about medicines, treatments, and evidence to support better clinical practice.

Home News Publications Statistics Blogs Events Contact us

NHS
England

About us Our work Commissioning Get involved

Search

Search news
You can use the filters to show only news items that match your interests

Keyword

Topic

Date range

News

NHS expands use of secure COVID-19 research platform to help find new treatments for major killer conditions

17 November 2023

Coronavirus Digital

The NHS is to expand the use of a research platform behind the roll-out of new Covid-19 treatments to help drive life-saving advances for other major diseases.

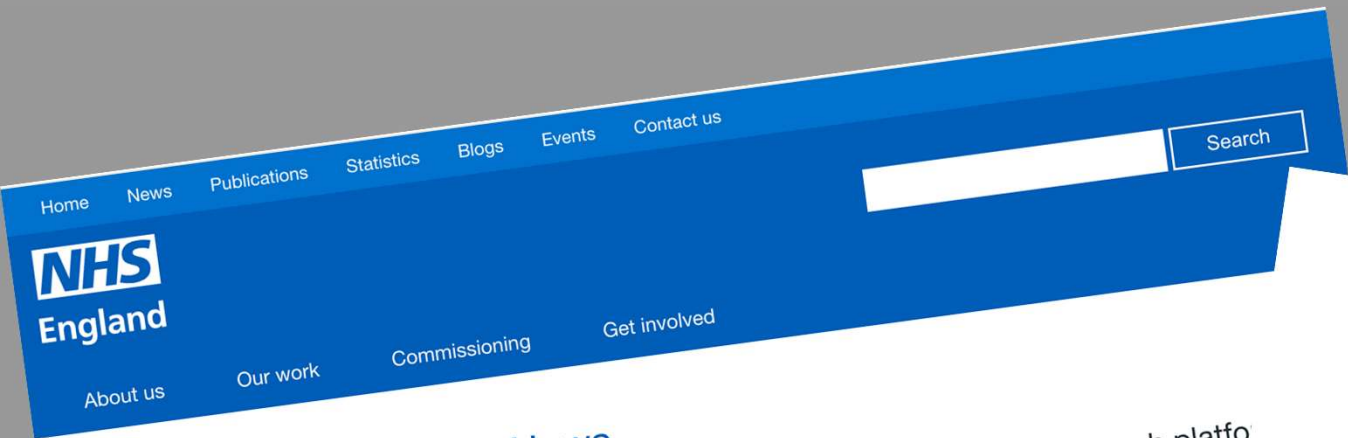
With the support of GPs and academic researchers, the NHS is widening the use of the service to allow scientists to securely analyse data in GP systems – without seeing patient-identifiable information – in a plan which could lead to the discovery of new treatments for other major conditions such as cancer, diabetes and asthma.

This data will help researchers understand more about medicines, treatments and evidence to support better clinical practice and provide crucial evidence



What's next?

non-COVID with NHSE



Search news
You can use the filters to show only news items that match your interests

Keyword

Topic

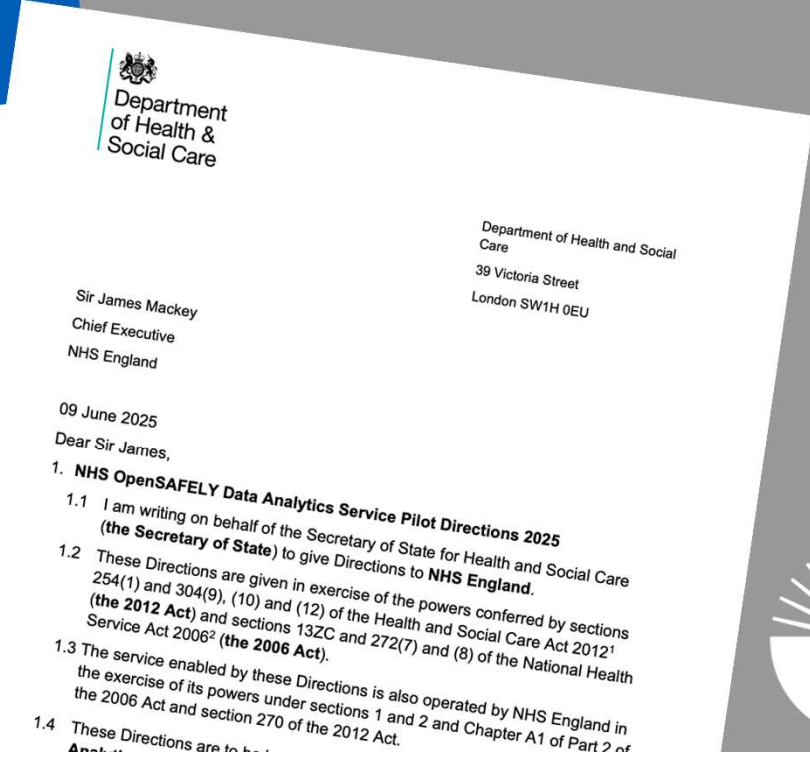
Date range

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NHS expands use of secure COVID-19 research platform to help find new treatments for major killer conditions

17 November 2023
Coronavirus Digital

The NHS is to expand the use of a research platform behind the roll-out of treatments to help drive life-saving advances for other major diseases. With the support of GPs and academic researchers, the NHS is widening service to allow scientists to securely analyse data in GP systems – with identifiable information – in a plan which could lead to the discovery of other major conditions such as cancer, diabetes and asthma.



What's next?

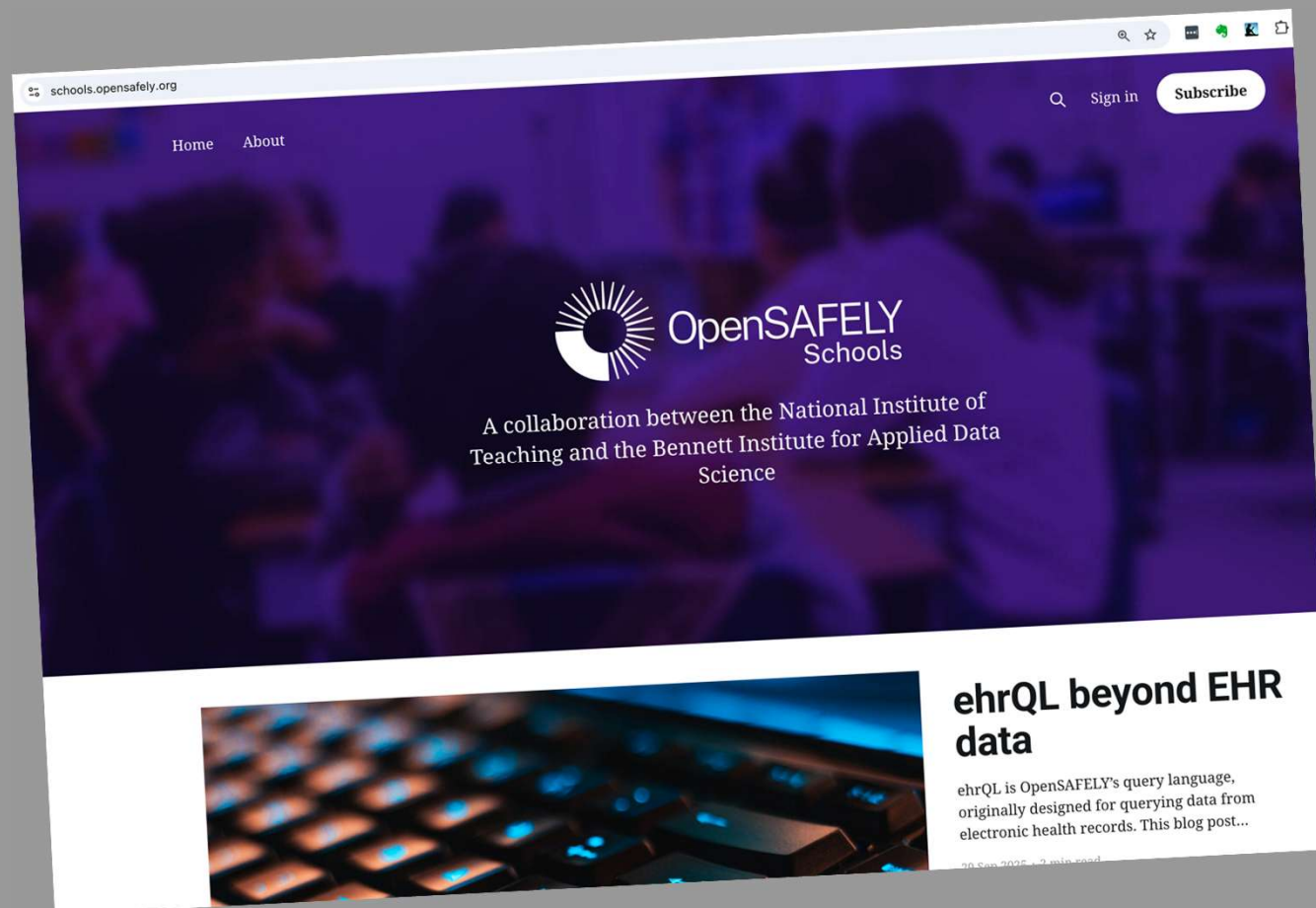
re-opening the EMIS service

The screenshot shows the NHS England website's news section. At the top is a blue navigation bar with links for Home, News, Publications, Statistics, Blogs, Events, and Contact us. Below this is the NHS England logo and a secondary navigation bar with links for About us, Our work, Commissioning, and Get involved. A search bar is located in the top right of the blue bar. The main content area features a 'Search news' section with filters for Keyword, Topic (a dropdown menu), and Date range. The featured news article is titled 'NHS expands use of secure COVID-19 research platform to help find new treatments for major killer conditions', dated 17 November 2023, with tags for 'Coronavirus' and 'Digital'. The article text discusses the NHS's expansion of a research platform to help drive life-saving advances for other major diseases, mentioning the support of GPs and academic researchers in widening the use of the service to securely analyze data in GP systems without seeing patient-identifiable information.

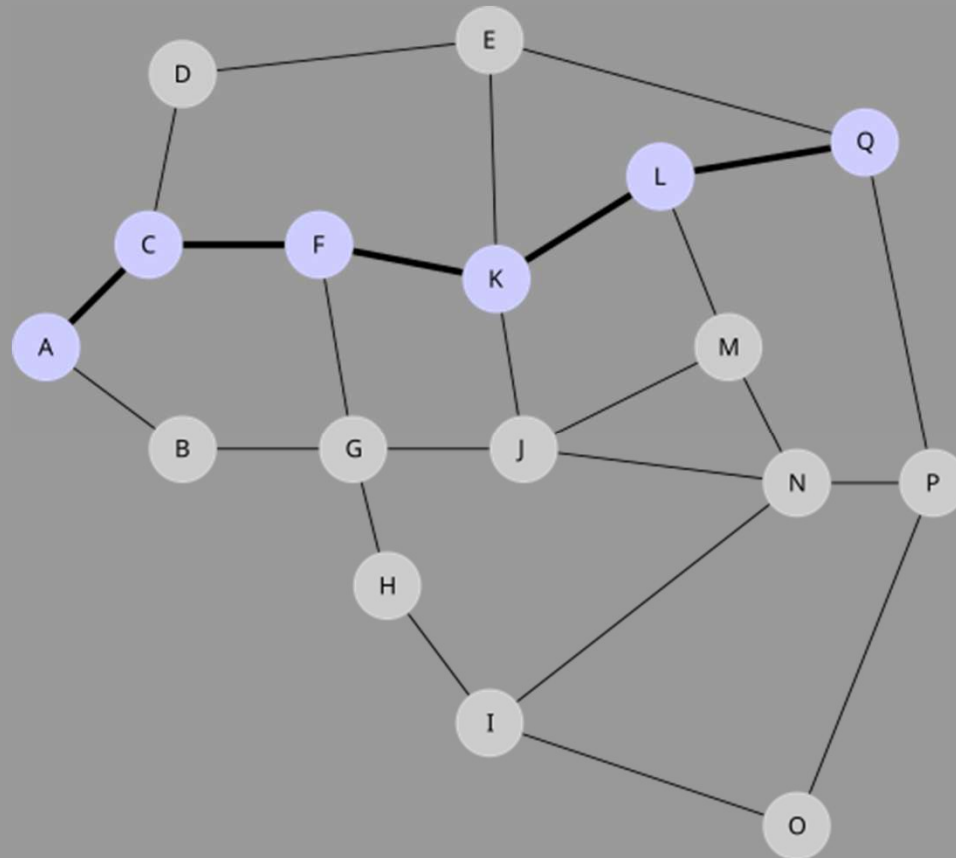


What's next?

OpenSAFELY-Schools



What's next?



Get involved

team@opensafely.org

Users

Use OpenSAFELY to access NHS data for research via NHS England.

Collaborate on the platform

Develop your own code modules in OpenSAFELY (EHR curation, automated output checking, automated workflows, more).

Use our tools in your data centre

Full OpenSAFELY installs; or just single modules (eg GP and EHR data preparation tools).

Get our help designing data ecosystems

We design efficient, accountable, end-to-end ecosystems, re-using the services, tools and teams that work.





NHS England OpenSAFELY GP Data Service

- 58 million** patients' records
- 181** projects
- 31** organisations
- >100** completed outputs
- 42 days** from first shovel to first output
- £10 million** spend to date, new funding to scale



Thank you!

Wellcome, RCGP, BMA, JGPITC, National Data Guardian, TPP, EMIS, NHS England, NIHR, MRC, LSHTM, Bristol, Manchester, and all our productive users!



OpenSAFELY



Working with EHR data
is hard



“Raw” GP data is different to “analysis-ready” GP data

Raw GP data

Patient ID	Event code	Associated variable	Event definition	Date, Time	Location
979384758	38341003		“Diagnosis of hypertension”	30/6/2021 10:31am	City Surgery, Birmingham B1 1AA
979384758	271649006	155	Blood Pressure systolic reading	30/6/2021 10:31am	City Surgery, Birmingham B1 1AA
979384758	VMP 318855006	28 tablets	Prescription for Enalapril	30/6/2021 10:31am	City Surgery, Birmingham B1 1AA

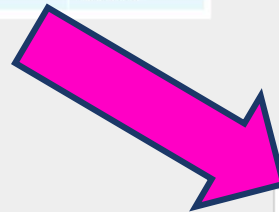
Analysis-ready GP data

Patient ID	HT active in 2019	Cancer in prev 5 yrs	Total Oral Morphine Equivalent Prescribed in 2022
923459023490	Yes	No	2,200mg
239047293489089	No	No	0mg
23098409283490	No	Yes	120mg



Converting raw GP data into analysis-ready GP data is hard

Patient ID	Event code	Associated variable	Event definition	Date, Time	Location
979384758	38341003		"Diagnosis of hypertension"	30/6/2021 10:31am	City Surgery, Birmingham B1 1AA
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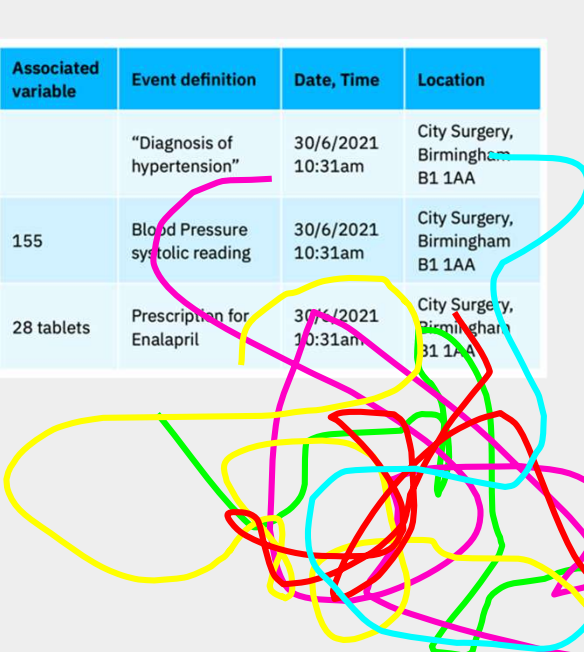


Patient ID	HT active in 2019	Cancer in prev 5 yrs	Total Oral Morphine Equivalent Prescribed in 2022
923459023490	Yes	No	2,200mg
239047293489089	No	No	0mg
23098409283490	No	Yes	120mg



Converting raw GP data into analysis-ready GP data is hard and everyone does it differently!

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Patient ID	HT active in 2019	Cancer in prev 5 yrs	Total Oral Morphine Equivalent Prescribed in 2022
239451023490	Yes	No	2,200mg
239047293189089	No	No	0mg
23098409283490	No	Yes	120mg



Converting raw GP data into analysis-ready GP data is hard and everyone does it differently!

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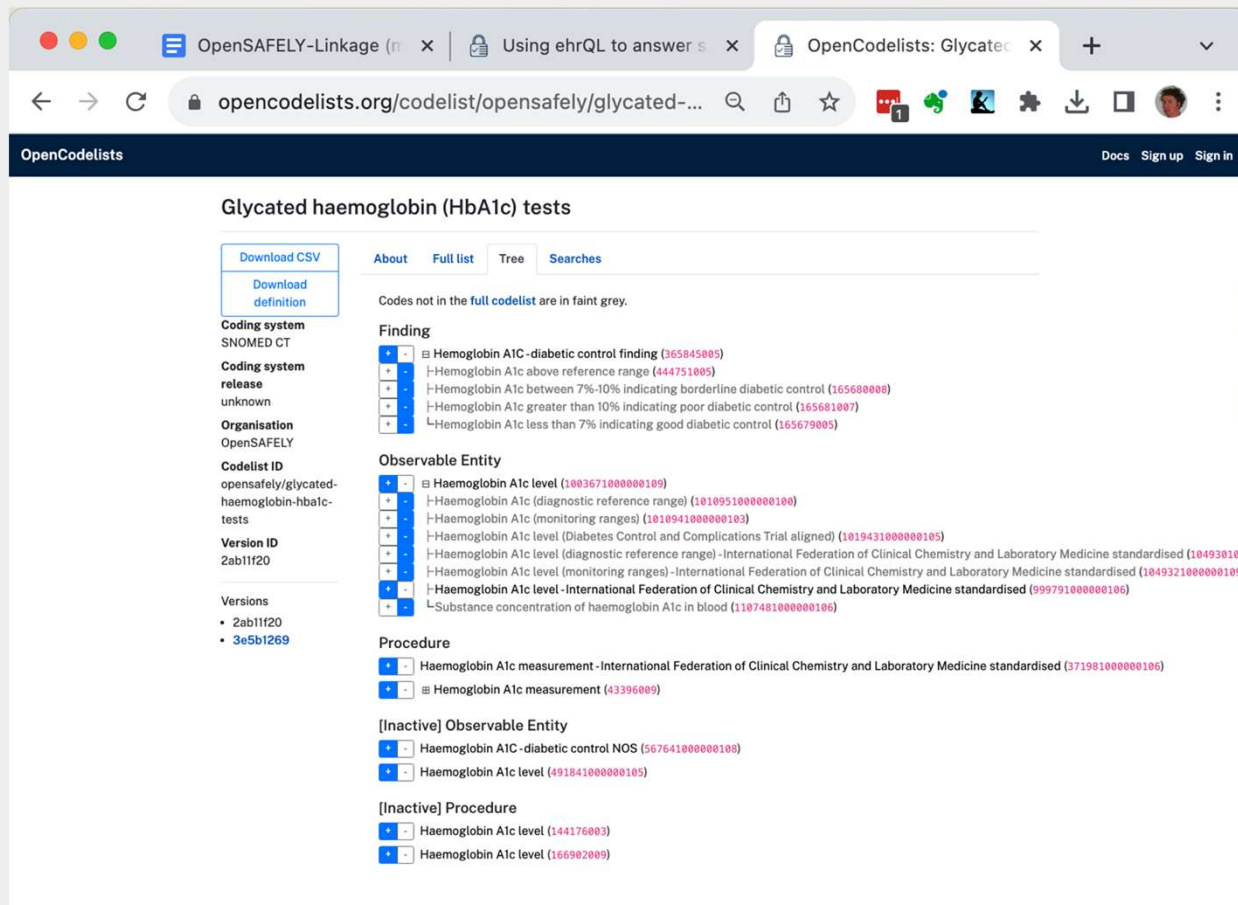
We wanted (and needed) to standardise EHR data management



Patient ID	HT active in 2019	Cancer in prev 5 yrs	Total Oral Morphine Equivalent Prescribed in 2022
239451023490	Yes	No	2,200mg
239047293189089	No	No	0mg
23098409283490	No	Yes	120mg



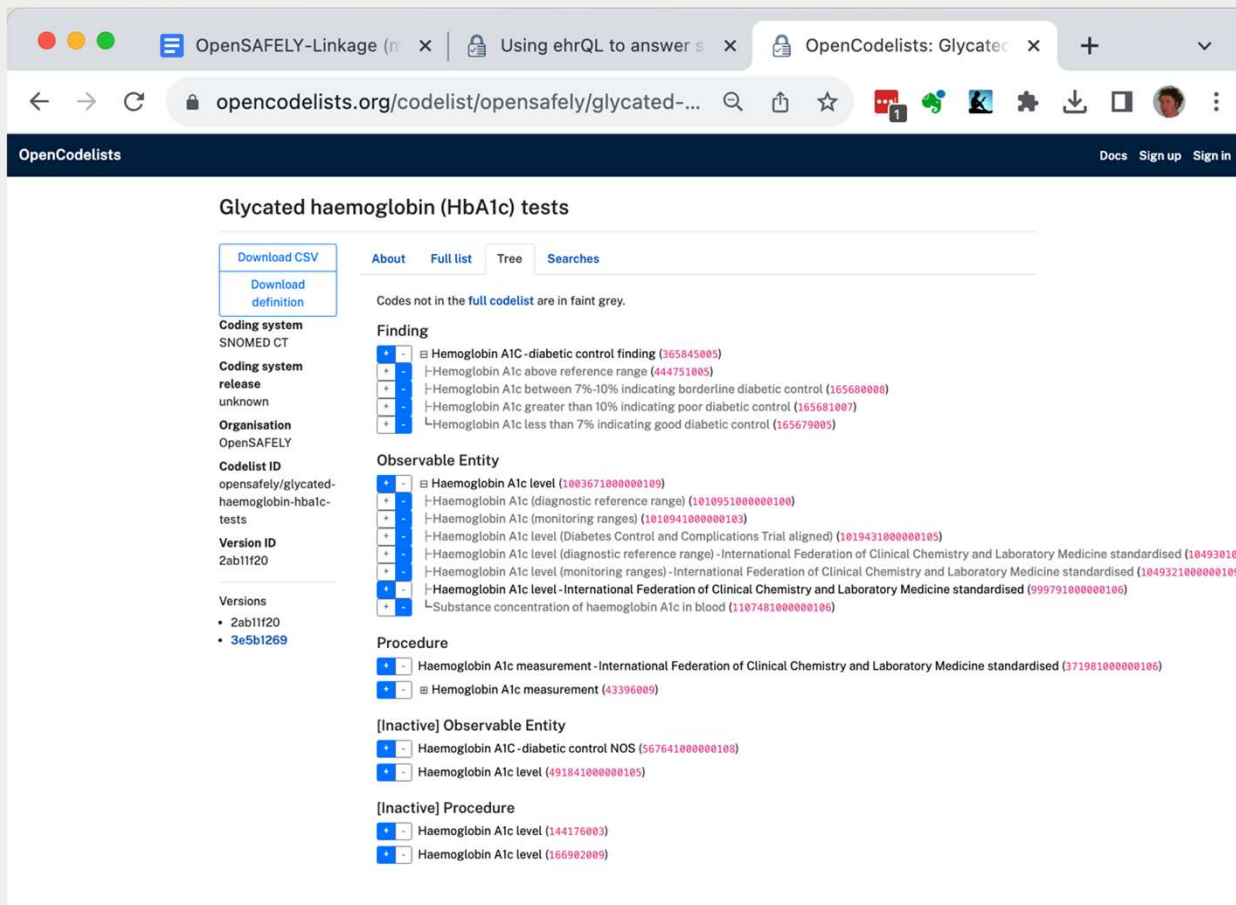
In OpenSAFELY, we made point and click tools to make, share, and assure “codelists”



The screenshot shows a web browser window with the URL `opencodelists.org/codelist/opensafely/glycated-...`. The page title is "Glycated haemoglobin (HbA1c) tests". On the left, there are navigation links: "Download CSV", "Download definition", "Coding system SNOMED CT", "Coding system release unknown", "Organisation OpenSAFELY", "Codelist ID opensafely/glycated-haemoglobin-hba1c-tests", "Version ID 2ab11f20", and "Versions 2ab11f20, 3e5b1269". The main content area has tabs for "About", "Full list", "Tree", and "Searches". Below the tabs, it says "Codes not in the full codelist are in faint grey." The "Finding" section lists several findings with expandable arrows and code IDs: "Hemoglobin A1c -diabetic control finding (365845005)", "Hemoglobin A1c above reference range (444751005)", "Hemoglobin A1c between 7%-10% indicating borderline diabetic control (165680000)", "Hemoglobin A1c greater than 10% indicating poor diabetic control (165681007)", and "Hemoglobin A1c less than 7% indicating good diabetic control (165679005)". The "Observable Entity" section lists: "Haemoglobin A1c level (1003671000000109)", "Haemoglobin A1c (diagnostic reference range) (1010951000000100)", "Haemoglobin A1c (monitoring ranges) (1010941000000103)", "Haemoglobin A1c level (Diabetes Control and Complications Trial aligned) (1019431000000105)", "Haemoglobin A1c level (diagnostic reference range)-International Federation of Clinical Chemistry and Laboratory Medicine standardised (1049301000000106)", "Haemoglobin A1c level (monitoring ranges)-International Federation of Clinical Chemistry and Laboratory Medicine standardised (1049321000000109)", "Haemoglobin A1c level -International Federation of Clinical Chemistry and Laboratory Medicine standardised (999791000000106)", and "Substance concentration of haemoglobin A1c in blood (1107481000000106)". The "Procedure" section lists: "Haemoglobin A1c measurement -International Federation of Clinical Chemistry and Laboratory Medicine standardised (371981000000106)" and "Haemoglobin A1c measurement (43396009)". The "[Inactive] Observable Entity" section lists: "Haemoglobin A1c -diabetic control NOS (567641000000100)" and "Haemoglobin A1c level (491841000000105)". The "[Inactive] Procedure" section lists: "Haemoglobin A1c level (144176003)" and "Haemoglobin A1c level (166902009)".



In OpenSAFELY, we made point and click tools to make, share, and assure “codelists”



The screenshot shows a web browser window with the URL `opencodelists.org/codelist/opensafely/glycated-...`. The page title is "Glycated haemoglobin (HbA1c) tests". On the left, there are buttons for "Download CSV" and "Download definition". Below these are sections for "Coding system" (SNOMED CT), "Coding system release" (unknown), "Organisation" (OpenSAFELY), "Codelist ID" (opensafely/glycated-haemoglobin-hba1c-tests), "Version ID" (2ab11f20), and "Versions" (2ab11f20, 3e5b1269). The main content area has tabs for "About", "Full list", "Tree", and "Searches". A note states "Codes not in the full codelist are in faint grey." The "Finding" section lists several findings with their SNOMED CT codes, such as "Hemoglobin A1c -diabetic control finding (365845005)". The "Observable Entity" section lists entities like "Haemoglobin A1c level (1003671000000109)". The "Procedure" section lists "Haemoglobin A1c measurement -International Federation of Clinical Chemistry and Laboratory Medicine standardised (371981000000106)". There are also sections for "[Inactive] Observable Entity" and "[Inactive] Procedure".

These don't rely on OpenSAFELY.

You can easily use OpenCodelists yourselves, to make codelists for HES, GP data... that you already hold on your own machine...



In OpenSAFELY, we use a dynamic set of standard code and tools for EHR data preparation

Getting properties of an event matching some criteria

What is the code of the first/last clinical event matching some criteria?

```
from ehrql import create_dataset, codelist_from_csv
from ehrql.tables.beta.core import clinical_events, patients

asthma_codelist = codelist_from_csv("XXX", column="YYY")

dataset = create_dataset()
dataset.first_asthma_diagnosis_date = clinical_events.where(
    clinical_events.snomedct_code.is_in(asthma_codelist)
).where(
    clinical_events.date.is_on_or_after("2022-07-01")
).sort_by(
    clinical_events.date
).first_for_patient().snomedct_code
dataset.define_population(patients.exists_for_patient())
```

Performing arithmetic on numeric values of clinical events

Finding the mean observed value of clinical events matching some criteria

```
from ehrql import create_dataset, codelist_from_csv
from ehrql.tables.beta.core import clinical_events, patients

hba1c_codelist = codelist_from_csv("XXX", column="YYY")

dataset = create_dataset()
dataset.mean_hba1c = clinical_events.where(
    clinical_events.snomedct_code.is_in(hba1c_codelist)
).where(
    clinical_events.date.is_on_or_after("2022-07-01")
).numeric_value.mean_for_patient()
dataset.define_population(patients.exists_for_patient())
```



Performing arithmetic on numeric values of clinical events

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).numeric_value.mean_for_patient()
dataset.define_population(patients.exists_for_patient())
```

**ehrQL standardises and
makes EHR code:**

- **readable**
- **reusable**
- **portable**



ehrQL is readable

```
recent_asthma_rx_count = (  
  prescriptions  
  .where( prescriptions.dmd_code.is_in( asthma_medications ))  
  .where( prescriptions.date.is_after( "2024-11-25" - years(1) ))  
  .count_for_patient()  
)
```



ehrQL is readable

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recent_asthma_rx_count = (  
  prescriptions  
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ehrQL is readable

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  .count_for_patient()  
)
```



ehrQL is **readable** for clinicians!

```
recent_asthma_rx_count = (  
  prescriptions  
  .where( prescriptions.dmd_code.is_in( asthma_medications ) )  
  .where( prescriptions.date.is_after( "2024-11-25" - years(1) ) )  
  .count_for_patient()  
)
```



ehrQL is reusable

```
has_asthma = (  
    asthma_diagnosis | ( recent_asthma_rx_count > 3 )  
)
```



ehrQL is reusable

```
dataset.define_population(  
  variables_library.has_asthma  
)
```

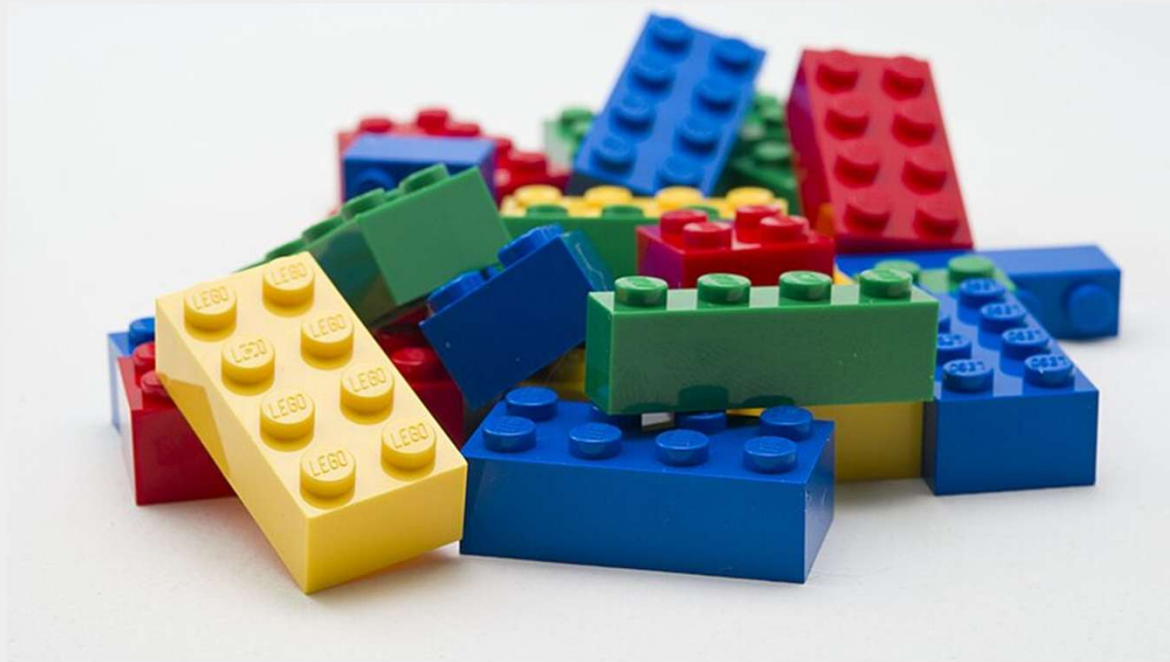


ehrQL is reusable

```
dataset.define_population(  
  variables_library.has_recent_asthma(years=5)  
)
```



ehrQL is composable



ehrQL is portable

```

# Diabetes Mellitus variables library
# Business Rules for Quality and Outcomes Framework (OOP) 2023/22 (Version 46)
# Clinical Data Definition Template
from variable_lib helper import (
    first_matching_event,
    last_matching_event,
    max_of,
    practice_registration_as_of,
    get_events_on_or_before,
)

import codeLists

# Define a dataset including all variables needed for the diabetes mellitus (dm)
def make_dm_dataset(index_date):
    # Initialize dataset
    dataset = create_empty_dataset()

    # Extract main events for further use in variable definitions below
    prior_events = clinical_events.where(
        clinical_events.date.is_on_or_before(index_date)
    )

    # Field number 2
    # REG DAT: The most recent date that the patient registered for QMS, where
    # this registration occurred on or before the achievement date
    dataset.reg_dat = practice_registration_as_of(index_date).start_date

    # Field number 3
    # REG DAT: The first occurrence of the patient deregistering from QMS
    # following the latest QMS registration
    dataset.dereg_dat = practice_registration_as_of(dataset.reg_dat).end_date

    # Field number 4
    # PAT AGI: The age of the patient in full years at the achievement date
    dataset.pat_age = age_as_of(index_date)

    # Field number 5
    # DM DAT: Date of the first diabetes diagnosis up to and including the
    # achievement date
    dataset.dm_dat = first_matching_event(prior_events, codeLists.dm.cod).date

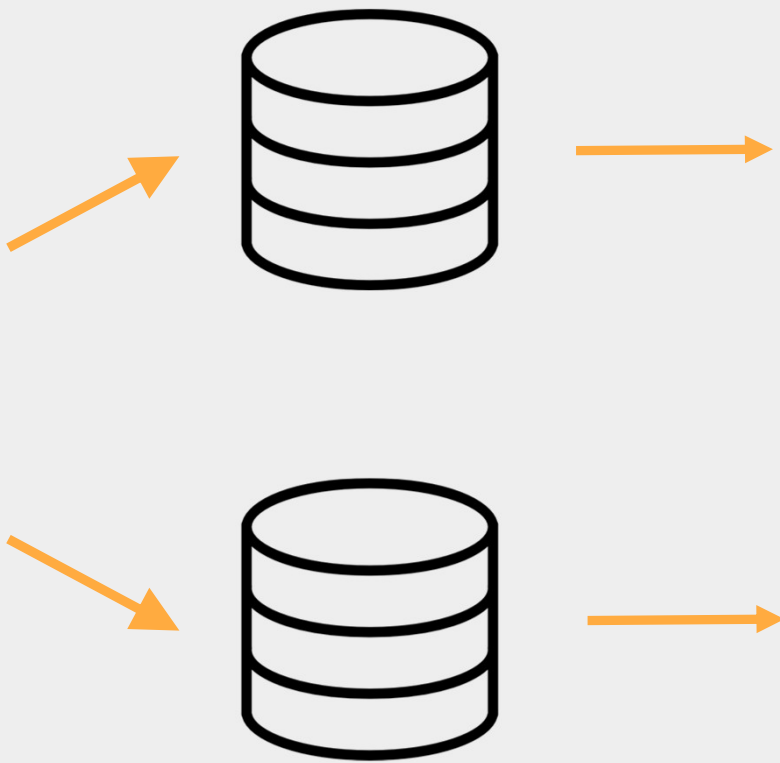
    # Field number 6
    # DMAT DAT: Date of the most recent diabetes diagnosis up to and
    # including the achievement date
    dataset.dmat_dat = last_matching_event(prior_events, codeLists.dm.cod).date

    # Field number 7
    # DMRS DAT: Date of the most recent diabetes diagnosis required code
    # recorded after the most recent diabetes diagnosis and up to and
    # including the achievement date
    dataset.dhrs_dat = last_matching_event(prior_events, codeLists.dhrs.cod).date

    # Field number 8
    # DMMS DAT: Date of the most recent maximum tolerated diabetes treatment
    # code up to and including the achievement date
    dataset.dmsx_dat = last_matching_event(prior_events, codeLists.dmsx.cod).date

    # Field number 9
    # DFRM DAT: Date of the most recent DFRM monitoring range code up

```



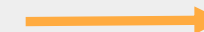
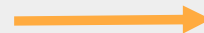
patient_id	has_asthma
375	NO
489	YES
611	NO

patient_id	has_asthma
204	YES
388	NO
525	NO



ehrQL is portable

```
recent_asthma_rx_count = (  
  prescriptions  
  .where( prescriptions.dmd_code.is_in( asthma_medications ))  
  .where( prescriptions.date.is_after( "2024-11-25" - years(1) ))  
  .count_for_patient()  
)
```



patient_id	has_asthma
375	NO
489	YES
611	NO

patient_id	has_asthma
204	YES
388	NO
525	NO

