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Original Study

Stroke in Older Adults Living in Care Homes: Results From a National Ocheck for updates Data Linkage Study in Wales



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ABSTRACT

Keywords: Nursing homes cerebrovascular disease antiplatelets anticoagulants

Objectives: To determine the proportion of older people moving to care homes with a recent stroke, incidence of stroke after moving to a care home, mortality following stroke, and secondary stroke prevention management in older care home residents.

Design: Retrospective cohort study using population-scale individual-level linked data sources between 2003 and 2018 in the Secure Anonymized Information Linkage (SAIL) Databank.

Setting and Participants: People aged >65 years residing in long-term care homes in Wales.

Methods: Competing risk models and logistic regression models were used to examine the association between prior stroke, incident stroke, and mortality following stroke.

Results: Of 86,602 individuals, 7.0% (n = 6055) experienced a stroke in the 12 months prior to care home entry. The incidence of stroke within 12 months after entry to a care home was 26.2 per 1000 personyears [95% confidence interval (CI) 25.0, 27.5]. Previous stroke was associated with higher risk of incident stroke after moving to a care home (subdistribution hazard ratio 1.83, 95% CI 1.57, 2.13) and 30-day mortality following stroke (odds ratio 2.18, 95% CI 1.59, 2.98). Severe frailty was not significantly associated with risk of stroke or 30-day mortality following stroke. Secondary stroke prevention included statins (51.0%), antiplatelets (61.2%), anticoagulants (52.4% of those with atrial fibrillation), and antihypertensives (92.1% of those with hypertension).

Conclusions and Implications: At the time of care home entry, individuals with history of stroke in the previous 12 months are at a higher risk of incident stroke and mortality following an incident stroke. These individuals are frequently not prescribed medications for secondary stroke prevention. Further

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The data used in this study are available in the Secure Anonymized Information Linkage (SAIL) Databank at Swansea University, Swansea, United Kingdom, but as restrictions apply they are not publicly available. All proposals to use SAIL data are subject to review by an independent Information Governance Review Panel. Further details are provided in the Supplementary Material.

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evidence is needed to determine the optimal care pathways for older people living in long-term care homes with history of stroke.

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In the United Kingdom there are an estimated 421,000 older people (≥65 years of age) living in care homes.¹ Older people living in care homes often have multiple long-term health conditions, polypharmacy, high levels of disability, and unmet needs, and may have less access to health care services compared with people living in their own homes.²-4 The global age-standardized incidence of stroke declined by 8.1% between 1990 and 2016, and the age-standardized mortality with stroke declined by 36.2%.⁵ Nevertheless, it is unclear if this trend has also been observed in older adults living in care homes, as these individuals are underrepresented in epidemiologic studies and clinical trials.

A report from the Sentinel Stroke National Audit Program (SSNAP) suggested approximately 7% of over 85,000 patients were discharged directly from hospital to care homes for the first-time following stroke in England, Wales, and Northern Ireland in 2017, but this figure had declined from 12% to 15% in previous years. Although the SSNAP can provide a national estimate of the proportion of people being discharged directly to a care home following a stroke, the proportion of people with a recent stroke upon care home entry, and incidence of stroke after moving to a care home remains unclear.

People with history of stroke should receive optimal treatment for secondary stroke prevention, and guidelines state that persistence with these treatments for individuals with previous stroke is critical to long-term risk reduction. However, treatment decisions in older adults living in care homes are complex due to a high prevalence of comorbidities and polypharmacy.

Provision of optimal care for people living in care homes is a recognized health policy challenge worldwide. The use of linked routinely collected data are valuable to answer important research questions for this population.

The objective of this study was to use population-scale individual-level linked routinely collected data sources to determine the proportion of older people moving to care homes with a recent stroke, incidence of stroke after moving to a care home, and mortality following stroke in older care home residents. A secondary objective was to examine secondary stroke prevention management in older care home residents.

Methods

Data Sources

The Secure Anonymized Information Linkage (SAIL) Databank is a privacy-protecting trusted research environment that holds population-scale individual-level linkable anonymized data sources regarding the health and service utilization for the population of Wales. The SAIL Databank includes secondary care data for the entire population of Wales and primary care data for approximately $\sim\!80\%$ of the population.

Care home identifiers in the SAIL Databank have been previously determined using records held by the Care Inspectorate Wales. ¹⁰ Each care home was assigned a Residential Anonymous Linking Field, ¹¹ which were linked to the anonymized address data for participants. Care homes with a classification of either care homes for older adults or care homes for older adults with nursing were included. The inclusion criteria for this study were (1) identified as moving to a care home between January 1, 2003 and December 31, 2018, (2) age

 \geq 65 years at the date of care home entry, and (3) had a minimum of 12-months coverage at a participating general practitioner prior to the date of entry to a care home.

Stroke Definition

Stroke (including ischemic stroke, hemorrhagic stroke, or unspecified stroke) in the 12-month period prior to entering a care home was determined from hospital admissions recorded in Patient Episode Database for Wales (PEDW) and general practitioner data sourced from the Welsh Longitudinal General Practice (WLGP). PEDW uses International Classification of Diseases, 10th Revision (ICD-10) codes and WLGP uses Read codes (version 2). Read codes have been used in the National Health Service (NHS) in the UK since 1985, and this extensive list of codes was based on ICD-10 codes and provides a standard vocabulary for healthcare professionals to record patient diagnoses and procedures. All ICD-10 and Read codes used in this study are provided in Supplementary Tables 1 and 2.

Covariates

Age, sex, Welsh Index of Multiple Deprivation (grouped in to quintiles, with the lowest quintile representing the most deprived postcodes and the highest quintile representing the least deprived postcodes), smoking history, and health conditions including hypertension, diabetes mellitus, renal disease, pulmonary embolism, atrial fibrillation, peripheral vascular disease, myocardial infarction, and heart failure were included in statistical models as covariates. Frailty was determined using the electronic frailty index. The electronic frailty index is based on the internationally established cumulative deficit model, and assigns a frailty score to an individual calculated using 36 variables from primary care data including symptoms, signs, diseases, disabilities, and abnormal laboratory values, referred to as deficits. 10,12,13 Further details are provided in the Supplementary Methods.

Outcomes

Incident stroke after entry to a care home was determined from PEDW or WLGP records, or if stroke was recorded as a cause of death. Date and cause of death were determined from the Annual District Death Extract (ADDE) data sourced from the Office for National Statistics (ONS) mortality register.

Statistical Analyses

The age and sex-standardized proportions of people entering care homes with stroke by year of entry to a care home (2003–2018) were calculated using direct standardization based on a recording of ischemic, hemorrhagic, or unspecified stroke within the 12-month period before moving to a care home. Incidence of stroke in the 12-month period after moving to a care home adjusted for age and sex were calculated by year of entry to care home (2003–2017 only to allow for 12-month follow-up). Poisson regression models adjusted for age and sex were used to determine the annual and absolute change in incidence of stroke over time.

Fine-Gray competing risk models were used to estimate subdistribution hazard ratios (sHRs) for the association between stroke in the previous 12 months before care home entry and incident stroke in the 12 months following entry to a care home, with mortality as a competing risk. The only variable with missing data was the Welsh Index of Multiple Deprivation. Individuals with missing data for this variable were excluded from multivariate analyses as the number was <1% of the total number of participants.

For individuals with history of stroke in the 12 months prior to care home entry, the following medicines, which can be prescribed for secondary stroke prevention management, were examined: antiplatelets, statins, oral anticoagulants, and antihypertensives. Antihypertensives included beta-blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), calcium channel blockers, thiazide and thiazide-like diuretics, alpha blockers, centrally acting antihypertensives, neprilysin inhibitors, and vasodilators. The proportion of individuals who received each type of medicine in the 6 months before care home entry was reported for any stroke and by type of most recent stroke before care home entry. The odds of receiving each type of medicine was examined by type of most recent stroke recorded (ischemic, hemorrhagic, or unspecified), and ischemic stroke was the reference group. Prescriptions of medicines were captured using Read codes from the WLGP. All analyses were completed using Stata v 15 (StataCorp).

Ethical Approval

Approval for the use of anonymized data in this study, provisioned within the SAIL Databank was granted by an independent Information Governance Review Panel under project 0912.

Results

Cohort Characteristics at the Time of Moving to a Care Home

Between 2003 and 2018, 86,602 people aged \geq 65 years became new residents in care homes in Wales and had at least 12 months of primary care data captured within the SAIL Databank prior to care home entry. The median [interquartile range (IQR)] age of the

participants was 86.0 (80.8, 90.6) and 68.1% were female (Table 1). Of the total participants, 0.7% (n=644) had missing data for the Welsh Index of Multiple Deprivation.

Trends in the proportion of people with stroke at time of entry to a care home.

Of the individuals who moved to a care home in Wales between 2003 and 2018, 7.0% [95% confidence interval (CI) 6.8%, 7.2%, n=6055] had a stroke in the 12 months prior to moving to a care home (4.8% (95% CI 4.6%, 4.9%, n=4141) had an ischemic stroke, 1.1% (95% CI 1.0%, 1.2%, n=959) had a hemorrhagic stroke and 1.4% (95% CI 1.3%, 1.5%, n=1202) had a stroke of unspecified origin).

There was no statistically significant change over time in the annual and absolute proportions of participants with a stroke in the 12 months prior to care home entry [age and sex-standardized estimate 6.2% (95% CI 5.5%, 6.9%) in 2003 vs 5.5% (95% CI 4.9%, 6.1%) in 2018; absolute change 2018 vs 2003 adjusted for age and sex: -0.6% (95% CI -1.6%, 0.4%), and annual change adjusted for age and sex: 0.03% (95% CI -0.1%, 0.1%)] (Figure 1).

Time Between Stroke and Care Home Entry

The median (IQR) number of days between the date of stroke and date of care home entry was 109 days (68–172). There was a statistically significant decline in the number of days between stroke and care home entry over time [median (IQR) 135 (75–197) days in 2003 and 97 (70–150) days in 2018; absolute change 2018 vs 2003 adjusted for age and sex –25.1 days (95% CI -38.2, –12.0) and annual change adjusted for age and sex –1.49 days (95% CI -1.95, –1.02) (Figure 2)]. Being in a higher quintile of the Welsh Index of Multiple Deprivation (less deprived) was associated with fewer days between date of stroke and date of care home entry [-2.42 days per increasing quintile (95% CI -3.98, –0.87) after adjusting for covariates].

Trends in the Incidence of Stroke after Care Home Entry

The incidence of stroke within 12 months after entry to a care home was 26.2 per 1000 person-years (95% CI 25.0, 27.5). The

Table 1Characteristics of Adults Age ≥65 Years on Admission to Care Homes Within the SAIL Databank by Prior Stroke Status

	All Participants ($n = 86,602$)	Participants with Stroke in 12 Mo Prior to Care Home Entry $(n=6055)$	Participants with no S Stroke in 12 Mo Prior to Care Home Entry $(n=80,547)$
Age, median (IQR)	86.0 (80.8, 90.6)	84.4 (79.0, 88.9)	86.1 (80.9, 90.7)
Female	58,941 (68.1%)	3869 (63.9%)	55,072 (68.4%)
WIMD-2014 quintile			
1 most deprived	14,695 (17.1%)	1082 (18.0%)	13,613 (17.0%)
2	18,375 (21.4%)	1204 (20.0%)	17,171 (21.5%)
3	20,340 (23.7%)	1370 (22.8%)	18,970 (23.7%)
4	17,395 (20.2%)	1314 (21.9%)	16,081 (20.1%)
5 least deprived	15,123 (17.6%)	1043 (17.3%)	14,080 (17.6%)
Frailty			
No frailty	28,870 (33.3%)	1938 (32.0%)	26,932 (33.4%)
Mild	26,505 (30.6%)	1915 (31.6%)	24,590 (30.5%)
Moderate	21,433 (24.7%)	1525 (25.2%)	19,908 (24.7%)
Severe	9794 (11.3%)	677 (11.2%)	9117 (11.3%)
Smoking history	20,775 (24.0%)	1609 (26.6%)	19,166 (23.8%)
Hypertension	31,850 (36.8%)	2653 (43.8%)	29,197 (36.2%)
Atrial fibrillation	14,528 (16.8%)	1559 (25.8%)	12,969 (16.1%)
Diabetes mellitus	3631 (4.2%)	223 (3.7%)	3408 (4.2%)
Heart failure	9502 (11.0%)	609 (10.1%)	8893 (11.0%)
Myocardial infarction	4469 (5.2%)	330 (5.5%)	4139 (5.1%)
Peripheral vascular disease	3308 (3.8%)	298 (4.9%)	3010 (3.7%)
Renal disease	4158 (5.0%)	252 (4.2%)	3906 (4.9%)
Pulmonary embolism	1656 (1.9%)	113 (1.9%)	1543 (1.9%)

WIMD, Welsh Index of multiple deprivation.

Frailty determined with the electronic frailty index. All characteristics are n (%), unless otherwise stated.

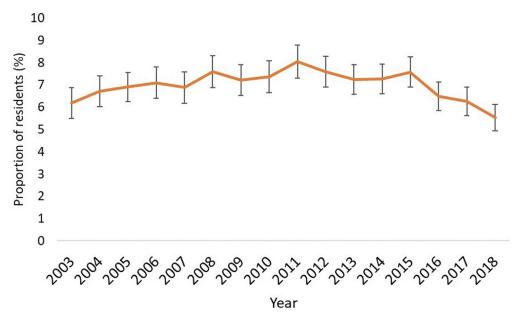


Fig. 1. Changes over time in the proportion of older people entering a care home with a stroke in the 12 months prior to moving to a care home (n = 86,602).

incidence of stroke was 24.6 per 1000 person-years (95% CI 23.4, 25.9) for people with no prior stroke in the 12 months before care home entry, and the incidence of recurrent stroke was 47.1 per 1000 person-years (95% CI 41.1, 54.0) for people with prior stroke.

There was no statistically significant change over time in the annual and absolute incidence of stroke in the 12 months after care home entry [age and sex-adjusted incidence 26.4 per 1000 person-years (95% CI 21.5, 32.3) in 2003 vs 26.5 per 1000 person-years (95% CI 22.0, 32.0) in 2017; incidence rate ratio (IRR) 2017 vs 2003 adjusted for age and sex: 0.94 (95% CI 0.72, 1.24) and annual IRR adjusted for age and sex: 0.99 (95% CI 0.98, 1.00) (Figure 3)].

Associations Between Prior Stroke and Incident Stroke and Mortality

Mortality within 12 months of entry to a care home was similar for individuals entering a care home with and without history of stroke in

the previous 12 months before care home entry (36.0% vs 34.8%). Of the 1653 individuals who experienced an incident stroke within 12 months of entry to a care home, 30-day mortality after the stroke was 49.3% (95% CI 46.9%, 51.7%, n=815). Stroke in the 12 months prior to care home entry was significantly associated with both a higher risk of incident stroke after care home entry (adjusted subdistribution hazard ratio 1.83 95% CI 1.57, 2.13), and 30-day mortality after incident stroke [65.2% (95% CI 58.4%, 71.7%, n=137) vs 47.0% (95% CI 44.4%, 49.6%, n=678), adjusted odds ratio (OR) 2.18 (95% CI 1.59, 2.98)].

Frailty and Stroke Risk

After adjusting for potential confounding factors, severe frailty was not significantly associated with a higher risk of incident stroke after care home entry or 30-day mortality after incident stroke (Supplementary Table 3).

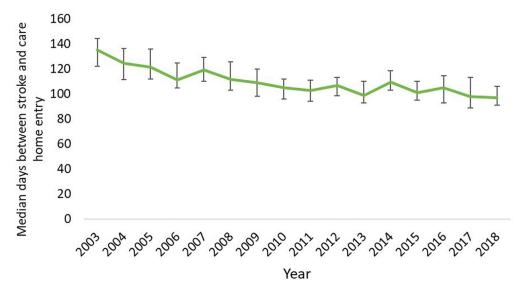


Fig. 2. Changes over time in the median number of days between a stroke and moving to a care home (n = 86,602).

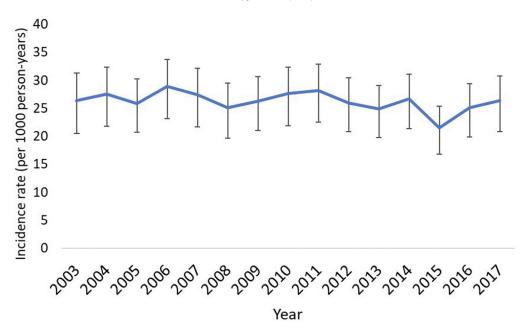


Fig. 3. Changes over time in the incidence of stroke within 12 months of moving to a care home (n = 80,681).

Secondary Stroke Prevention at Time of Entry to a Care Home

At the time of entry to care home, 61.2% (n=3707) of individuals with a stroke in the previous 12 months were prescribed antiplatelets, and 51.0% (n=3087) were prescribed statins. Of those with a stroke in the previous 12 months, 25.8% had a diagnosis of atrial fibrillation (n=1559) and 43.8% had a diagnosis of hypertension (n=2653). Of individuals with prior stroke and hypertension, 92.1% (n=2292) were prescribed antihypertensives. Of individuals with prior stroke and atrial fibrillation, 52.4% (n=817) were prescribed oral anticoagulants, 46.1% (n=718) were prescribed vitamin-K antagonists (VKA), 11.7% (n=183) were prescribed non-VKA oral anticoagulants (NOACs), and 5.4% (n=84) individuals had a record of both VKA and NOACs prescribed in the 6 months before care home entry. Over time, there was a marked increase in the use of oral anticoagulants in those with prior stroke and

atrial fibrillation, from 35.0% (n = 14) in 2003 to 75.0% (n = 66) in 2018. Of all individuals with prior stroke 7.2% (n = 323) were receiving oral anticoagulants with no recorded diagnosis of atrial fibrillation.

The proportions of people with prior stroke receiving medicines for secondary stroke prevention, by type of most recent stroke recorded before care home entry (ischemic, hemorrhagic, or unspecified), are shown in Table 2. Hemorrhagic stroke was associated with significantly lower odds of receiving antiplatelets and statins compared with ischemic stroke [adjusted ORs 0.44 (95% CI 0.37, 0.52) and 0.61 (95% CI 0.51, 0.72), respectively], but there was no significant association for receiving oral anticoagulants or antihypertensives. Unspecified stroke was associated with significantly lower odds of receiving statins [adjusted OR (95% CI 0.59) (0.50, 0.70)] and antihypertensives [adjusted OR 0.59 (95% CI: 0.39, 0.88)] compared with ischemic stroke.

 Table 2

 Proportions of Individuals With Prior Stroke Receiving Medicines for Secondary Stroke Prevention Management in the 6 Months Before Care Home Entry by Type of Stroke

•		•	•	•		
	Any Prior Stroke (n = 6055)	Ischemic Stroke (n = 4088)	Hemorrhagic Stroke (n = 959)	Unspecified Stroke (n = 1008)	Odds of Receiving Medicines Hemorrhagic vs Ischemic Stroke Adjusted OR (95% CI)	Odds of Receiving Medicines Unspecified vs Ischemic Stroke Adjusted OR (95% CI)
Antiplatelet Statin	61.2 (3707) 51.0 (3087)	63.7 (2602) 54.1 (2210)	48.0 (460) 43.5 (417)	64.0 (645) 45.6 (460)	0.44 (0.37, 0.52) 0.61 (0.51, 0.72)	0.88 (0.74, 1.04) 0.59 (0.50, 0.70)
	Any prior stroke and hypertension $(n = 2653)$	Ischemic stroke and hypertension (n = 1185)	Hemorrhagic stroke and hypertension $(n = 394)$	Unspecified stroke and hypertension $(n = 444)$		
Antihypertensive	92.1 (2292)	92.8 (1684)	92.1 (363)	90.5 (402)	0.84 (0.54, 1.30)	0.59 (0.39, 0.88)
	Any prior stroke and AF $(n = 1559)$	Ischemic stroke and AF $(n = 1156)$	Hemorrhagic stroke and AF $(n = 195)$	Unspecified stroke and AF $(n = 208)$		
Oral anticoagulant	52.4 (817)	52.4 (606)	58.0 (113)	47.1 (98)	1.19 (0.85, 1.67)	0.78 (0.57, 1.07)

AF. atrial fibrillation.

Only including individuals who experienced a stroke within 12 months before care home entry. If multiple types of stroke recorded in this time period then the most recent type of stroke was used. All values are % (n), unless otherwise specified.

Odds ratios adjusted for age, sex, Welsh Index of Multiple Deprivation (quintiles), frailty, smoking status, diabetes, hypertension, atrial fibrillation, renal disease, pulmonary embolism and prior cardiovascular disease (peripheral vascular disease, myocardial infarction or heart failure).

Discussion

This study provides several novel findings in a population where there is a relative paucity of outcome data available. Over time, there was no statistically significant change in the proportion of people moving to care homes with a recent stroke or in the incidence of stroke after care home entry. However, there was a decline in the median number of days from experiencing a stroke to moving to a care home. Individuals who moved to a care home with a stroke in the previous 12 months had a higher risk of incident stroke and mortality following an incident stroke. Treatments to reduce risk of secondary stroke were frequently not prescribed in this population.

Previous evidence from data provided by the SSNAP has suggested there has been a decline nationally in the proportion of people moving directly to a care home following a hospitalization with stroke.⁶ In the current study, there was no significant decline observed in the proportion of people with stroke in the 12-month period prior to moving to a care home. In the current study, there was a significant reduction over time in the number of days between previous stroke and care home entry. This could have important implications for the level of care required by individuals entering a care home following a recent stroke; however, data were not available to determine the functional status of the participants, therefore, this could not be explored further. Furthermore, being in a higher quintile of the Welsh Index of Multiple Deprivation (less deprived) was associated with fewer days between stroke and moving to a care home. This may be due to differences in accessibility for care homes depending on socioeconomic status. Previous research using the SAIL Databank has also shown living in less deprived areas was associated with a faster rate of care home admission for people living with dementia.¹⁴

In Wales, annually approximately 7000 people are hospitalized with stroke and 1900 people die from stroke. 15 People with history of stroke are at high-risk of recurrent stroke, with 1 in 4 people experiencing a recurrent stroke within 5 years. 16 The results of this study show people with a prior stroke living in care homes are at higher risk not only for a stroke, but also of mortality following incident stroke. It is, therefore, important to ensure that secondary stroke risk reduction strategies are optimized for all individuals with prior stroke. Decision making regarding optimal stroke prevention pathways in older care home residents is complicated due to high levels of polypharmacy and multimorbidity within this population. 17,18 There has been increased interest in the potential to deprescribe medicines in the older population to reduce inappropriate polypharmacy and reduce the potential burden of medicines which may not be adding quality or length of life. For instance, in a randomized controlled trial, deprescribing statins in older adults with limited life expectancy and no recent active cardiovascular disease resulted in no significant difference in mortality and a potential improvement in quality of life. 19 However, in a recent large observational study of older adults with polypharmacy, deprescribing statins was associated with an increased risk of fatal and non-fatal cardiovascular outcomes.²⁰ Discontinuation of statin therapy between 3 and 6 months after stroke has been associated with higher risk of recurrent stroke within 1 year, ²¹ but the evidence for the long-term use of statins for secondary stroke prevention in older people living in care homes who often have frailty, multimorbidity and polypharmacy is unclear.

The results of this study suggest that many residents with a stroke in the previous 12 months before care home entry were not receiving secondary stroke prevention treatments. Overall, we did find higher rates of secondary stroke prevention prescribing compared with a previous study of the South London Stroke Register, which showed in 427 stroke survivors discharged to care homes, rates of secondary stroke prevention prescribing were lower at 1-year follow-up compared with individuals living in their own homes.¹⁸

Consideration of the use of oral anticoagulants for people with prior stroke and atrial fibrillation is important to optimize risk reduction of

future ischemic stroke.²² In this study, there was a substantial increase in the proportion of people with prior stroke and atrial fibrillation receiving oral anticoagulants, and the introduction of NOACs within the last 10 years will likely have contributed to the observed increase. In the current study, prescription of antiplatelets was significantly lower for people with prior hemorrhagic stroke compared with ischemic stroke. This may be expected as the National Institute for Health and Care Excellence (NICE) guidelines for stroke state that for long-term management following intracerebral hemorrhage, the use of aspirin and oral anticoagulants are not normally recommended, but specialist advice should be sought for individuals with atrial fibrillation and those at a high-risk of future ischemic stroke.²² In this study there was also an observed small proportion of participants with prior stroke receiving oral anticoagulants but with no recorded diagnosis of atrial fibrillation. This may be due to other indications for oral anticoagulants following stroke, such as cardiac source of embolism, cerebral venous thrombosis, or arterial dissection.²² but within the available data it was not possible to explore this further.

Nonpharmacologic strategies to reduce risk of recurrent stroke may be challenging to promote to older adults living in care homes. Physical inactivity may be an important risk factor for primary and recurrent stroke but could not be explored in the current study.²³ Physical rehabilitation interventions in older care home residents may have a small effect on reducing disability with few adverse events.²⁴ A recent review of available evidence suggested improvements in diet quality is likely to reduce recurrent stroke risk.²⁵ However, dietary modifications for older care home residents can be complex as inadequate food intake and malnutrition is common in older care home residents. 3,26 Further research is needed to determine the impact of physical rehabilitation, dietary interventions, or multifaceted nonpharmacologic intervention strategies for older adults living in care homes to reduce risk of recurrent stroke. However, insufficient funding and staffing availability may also limit the ability of care home providers to support physical activity and dietary interventions for residents.

Rehabilitation for people following a stroke should be patientcentered and include multidisciplinary assessment, identification of functional difficulties and their measurement, and treatment planning.²⁷ People with stroke who are transferred from hospital to care homes should be offered assessment and treatment from stroke rehabilitation and social care services to the same standards that they would receive in their own home.²⁷ A structured health and social care review should be offered to people with stroke living in care homes at 6 months and 12 months following the stroke, in addition to community stroke rehabilitation support to identify activities or adaptations to improve quality of life.²⁸ Indeed, a survey of 60 care homes in Ireland suggested almost three-quarters of residents with previous stroke had a high level of dependency, but stroke rehabilitation guidelines were lacking and there was little structured care specifically for stroke survivors.²⁹ This study suggests that although there has been a decline in stroke prevalence in the general population, there has not been a decline in the proportion of older people entering care homes with a recent history of stroke, and 30-day mortality following stroke in older care home residents is high. For those at the highest-risk of stroke, the consideration of care priorities following a stroke in advance care planning is warranted. Further research should determine the level of funding, recognition, and resources required to ensure optimal care for these individuals.

Strengths and Limitations

This study uses a national-level databank with linked data from multiple sources including primary and secondary care data. There are several limitations to consider. The study uses routinely collected health data and, therefore, some variables of interest were not available such as data about the functional status of participants and stroke severity. Within the SAIL Databank records are linked using an individual's NHS number that is supplied in routine NHS data. The use of this as a unique identifier has previously been shown to have specificity values >99.8% and sensitivity values >94.6%, and error rates were <0.2%.9 Previous studies have shown recording of ICD codes in electronic medical records may vary by factors such as age, number of comorbidities, severity of illness, length of hospitalization, and whether in-hospital death occurred³⁰; however, using multiple linked data sources, rather than relying on a single data source will have improved the accuracy of the dataset to identify the different health conditions of interest. Identification of care homes in the SAIL Databank was based on anonymized addresses of care homes from Care Inspectorate Wales, but the study may not capture all care home residents. However, the results are deemed to be generalizable to the wider population of Wales.

Conclusions and Implications

Older people moving to a care home with a recent stroke are at a higher risk of incident stroke and mortality with incident stroke. Medications to reduce risk of secondary stroke are often not prescribed in this population. Further evidence is needed to determine the optimal care pathways for older people living in care homes with history of stroke. A greater understanding of the epidemiology of stroke in older care home residents is useful to improve planning and provision of services.

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Supplementary Methods

Covariates

Demographic information was taken from the Welsh Demographic Service Dataset. The Welsh Demographic Service Dataset includes the week of birth, sex, and the Lower-layer Super Output Area used to derive the Welsh Index of Multiple Deprivation, version 2014. The age of each individual was calculated based on the week of birth and date of entry to a care home. Health conditions including hypertension, diabetes mellitus, renal disease, pulmonary embolism, atrial fibrillation, peripheral vascular disease, myocardial infarction, and heart failure were determined at the time of entry to a care home from PEDW and WLGP records. History of smoking was also determined from WLGP records.

Frailty was determined using the electronic frailty index (eFI), which was calculated using the WLGP data for 10-years prior to the date of care home entry. The eFI is based on the internationally established cumulative deficit model and assigns a frailty score to an individual calculated using 36 variables from primary care data including symptoms, signs, diseases, disabilities, and abnormal laboratory values, referred to as deficits.¹⁻³ The 36 eFI deficits are activity limitation, anemia and hematinic deficiency, arthritis, atrial fibrillation, cerebrovascular disease, chronic kidney disease, diabetes, dizziness, dyspnea, falls, foot problems, fragility fracture, hearing impairment, heart failure, heart valve disease, housebound, hypertension, hypotension/syncope, ischemic heart disease, memory and cognitive problems, mobility and transfer problems, osteoporosis, Parkinsonism and tremor, peptic ulcer, peripheral vascular disease, polypharmacy, requirement for care, respiratory disease, skin ulcer, sleep disturbance, social vulnerability, thyroid disease, urinary incontinence, urinary system disease, visual impairment, and weight loss and anorexia.

The eFI score is the number of deficits present, expressed as an equally weighted proportion of the total. An individual with a single deficit would be assigned an eFI of 1/36 (0.03); another with nine deficits would be assigned an eFI of 9/36 (0.25). The eFI score is then used to categorize individuals as fit (eFI value of 0–0.12), mild (>0.12–0.24), moderate (>0.24–0.36), or severely frail (>0.36).

Information Governance Review Panel

The Information Governance Review Panel (IGRP) has a membership comprised of senior representatives from the British Medical Association, the National Research Ethics Service, Public Health Wales and NHS Wales Informatics Service. Usage of additional data was granted by data owner. The SAIL Databank is General Data Protection Regulations and the UK Data Protection Act compliant. Before any data can be accessed, approval must be given by the IGRP. The IGRP gives careful consideration to each project to ensure proper and appropriate use of SAIL data. When access has been granted, it is gained through a privacy protecting safe haven and remote access system referred to as the SAIL Gateway. SAIL has established an application process to be followed by anyone who would like to access data via SAIL at https://www.saildatabank.com/application-process.

References for Supplementary Methods

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Supplementary Table 1 ICD-10 Codes to Identify Conditions in the PEDW

ICD-10 Code	ICD-10 Definition	
Hemorrhagic stroke		
I600	Subarachnoid hemorrhage from carotid siphon and bifurcation	
I601	Subarachnoid hemorrhage from middle cerebral artery	
1602	Subarachnoid hemorrhage from anterior communicating artery	
I603	Subarachnoid hemorrhage from posterior communicating artery	
I604	Subarachnoid hemorrhage from basilar artery	
1605 1606	Subarachnoid hemorrhage from vertebral artery	
I607	Subarachnoid hemorrhage from other intracranial arteries Subarachnoid hemorrhage from intracranial artery unspecified	
I608	Other subarachnoid hemorrhage	
I609	Subarachnoid hemorrhage unspecified	
I610	Intracerebral hemorrhage in hemisphere subcortical	
I611	Intracerebral hemorrhage in hemisphere cortical	
I612	Intracerebral hemorrhage in hemisphere unspecified	
I613	Intracerebral hemorrhage in brain stem	
I614	Intracerebral hemorrhage in cerebellum	
I615	Intracerebral hemorrhage intraventricular	
I616	Intracerebral hemorrhage multiple localized	
I618	Other intracerebral hemorrhage	
I619	Intracerebral hemorrhage unspecified	
I620	Subdural hemorrhage (acute) (nontraumatic)	
I621	Nontraumatic extradural hemorrhage, Nontraumatic epidural hemorrhage	
I629 Ischemic stroke	Intracranial hemorrhage (nontraumatic)unspecified	
I630	Cerebral infarct due to thrombosis of precerebral arteries	
I631	Cerebral infarct due to thrombosis of precerebral arteries Cerebral infarction due to embolism of precerebral arteries	
I632	Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries	
I633	Cerebral infarction due to thrombosis of cerebral arteries	
I634	Cerebral infarction due to embolism of cerebral arteries	
I635	Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries	
I636	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic	
I638	Other cerebral infarction	
I639	Cerebral infarction unspecified	
G460	Middle cerebral artery syndrome	
G461	Anterior cerebral artery syndrome	
G462	Posterior cerebral artery syndrome	
G463	Brain stem stroke syndrome	
G464	Cerebellar stroke syndrome	
G465 G466	Pure motor lacunar stroke syndrome Pure sensory lacunar syndrome	
G467	Other lacunar syndromes	
G468	Other vascular syndromes of brain in cerebrovascular diseases	
G450	Vertebro-basilar artery syndrome	
G451	Carotid artery syndrome (hemispheric)	
G452	Multiple and bilateral precerebral artery syndromes	
Unspecified stroke		
I64X	Stroke not specified as hemorrhage or infarction	
1678	Other specified cerebrovascular diseases	
I679	Cerebrovascular disease, unspecified	
I688	Other cerebrovascular disorders in diseases classified elsewhere	
Hypertension		
I10	Essential [primary] hypertension	
I11	Hypertensive heart disease	
I12	Hypertensive renal disease	
I13 I15	Hypertensive heart and renal disease Secondary hypertension	
Atrial fibrillation	Secondary hypertension	
I48	Atrial fibrillation and flutter	
Diabetes mellitus	The first term and reactive	
E10	Insulin-dependent diabetes mellitus	
E11	Non-insulin-dependent diabetes mellitus	
E12	Malnutrition-related diabetes mellitus	
E13	Other specified diabetes mellitus	
E14	Unspecified diabetes mellitus	
Heart failure		
I50	Congestive heart failure	
I110	Left ventricular failure	
I130	Hypertensive heart disease with congestive heart failure	
I132	Hypertensive heart and renal disease with congestive heart failure and renal failure	
I420	Dilated cardiomyopathy	
Myocardial infarction	Acute transmural myocardial infarction of anterior wall	
1210		
I210 I211	· · · · · · · · · · · · · · · · · · ·	
I210 I211	Acute transmural myocardial infarction of inferior wall	(continued on next page)

$\textbf{Supplementary Table 1} \ (\textit{continued} \)$

ICD-10 Code	ICD-10 Definition
I212	Acute transmural myocardial infarction of other sites
I213	Acute transmural myocardial infarction of unspecified site
I214	Acute subendocardial myocardial infarction
I219	Acute myocardial infarction unspecified
I220	Subsequent myocardial infarction of anterior wall
I221	Subsequent myocardial infarction of inferior wall
I228	Subsequent myocardial infarction of other sites
I229	Subsequent myocardial infarction of unspecified site
I230	Hemopericardium as current complication following acute myocardial infarction
I231	Atrial septal defect as current complication following acute myocardial infarction
I232	Ventricular septal defect as current complication following acute myocardial infarction
I233	Rupture of cardiac wall without hemopericardium as current complication following acute myocardial infarction
I234	Rupture of chordae tendineae as current complication following acute myocardial infarction
I235	Rupture of papillary muscle as current complication following acute myocardial infarction
I236	Thrombosis of atrium, auricular appendage, and ventricle as current complications following acute myocardial infarction
I238	Other current complications following acute myocardial infarction
I252	Old myocardial infarction
I241	Dressler syndrome (post myocardial infarction syndrome)
Peripheral vascular disease	
I702	Atherosclerosis of arteries of extremities
I710	Dissection of aorta any part
I711	Thoracic aortic aneurysm, ruptured
I712	Thoracic aortic aneurysm, without mention of rupture
I713	Abdominal aortic aneurysm, ruptured
I714	Abdominal aortic aneurysm, without mention of rupture
I715	Thoracoabdominal aortic aneurysm ruptured
I716	Thoracoabdominal aortic aneurysm, without mention of rupture
I718	Aortic aneurysm of unspecified site, ruptured
1719	Aortic aneurysm of unspecified site, without mention of rupture
1790	Aneurysm of aorta in diseases classified elsewhere
Renal disease	
I12	Hypertensive renal disease
I13	Hypertensive heart and renal disease
N01	Rapidly progressive nephritic syndrome
N03	Chronic nephritic syndrome
N18	Chronic kidney disease
N19	Unspecified kidney failure
N25	Disorders resulting from impaired renal tubular function
N00	Acute nephritic syndrome
N04	Nephrotic syndrome
N05	Unspecified nephritic syndrome
N07	Hereditary nephropathy, not elsewhere classified
N11	Chronic tubulo-interstitial nephritis
N14	Drug- and heavy-metal-induced tubulo-interstitial and tubular conditions
N17	Acute renal failure
Q61	Cystic kidney disease
Pulmonary embolism	
1260	Pulmonary embolism with mention of acute cor pulmonale
1269	Pulmonary embolism without mention of acute cor pulmonale

Supplementary Table 2Read Codes Version 2 to Identify Conditions in the WLGP Data Source

Read Code	Read Code Definition	
Hemorrhagic stroke		
G60	Subarachnoid hemorrhage	
G61z	Intracerebral hemorrhage not otherwise specified	
G621	Subdural hemorrhage - nontraumatic	
G61	Intracerebral hemorrhage	
G614	Pontine hemorrhage	
G604	Subarachnoid hemorrhage from posterior communicating artery	
G613	Cerebellar hemorrhage	
G60X	Subarachnoid hemorrhage from intracranial artery, unspecified	
G622	Subdural hematoma - nontraumatic	
G623	Subdural hemorrhage not otherwise specified	
G61X1	Right sided intracerebral hemorrhage, unspecified	
G602	Subarachnoid hemorrhage from middle cerebral artery	
G60z	Subarachnoid hemorrhage not otherwise specified	
G61X0	Left sided intracerebral hemorrhage, unspecified	
G600	Ruptured berry aneurysm	
G616	External capsule hemorrhage	
G617	Intracerebral hemorrhage, intraventricular	
G61X	Intracerebral hemorrhage in hemisphere, unspecified	
G610	Cortical hemorrhage	
G620	Extradural hemorrhage - nontraumatic	
G611	Internal capsule hemorrhage	
G605	Subarachnoid hemorrhage from basilar artery	
	· · · · · · · · · · · · · · · · · · ·	
G603	Subarachnoid hemorrhage from anterior communicating artery	
G612	Basal nucleus hemorrhage	
G601	Subarachnoid hemorrhage from carotid siphon and bifurcation	
G618	Intracerebral hemorrhage, multiple localized	
G606	Subarachnoid hemorrhage from vertebral artery	
G615	Bulbar hemorrhage	
G61	CVA - cerebrovascular accident due to intracerebral hemorrhage	
G62z	Intracranial hemorrhage not otherwise specified	
G61	Stroke due to intracerebral hemorrhage	
G62	Other and unspecified intracranial hemorrhage	
G619	Lobar cerebral hemorrhage	
Ischemic stroke		
G64z	Cerebral infarction not otherwise specified	
G64	Cerebral arterial occlusion	
G64z2	Left sided cerebral infarction	
G64z3	Right sided cerebral infarction	
G641	Cerebral embolism	
G640	Cerebral thrombosis	
G64z0	Brainstem infarction	
G64z4	Infarction of basal ganglia	
G6410	Cerebral infarction due to embolism of cerebral arteries	
G6400	Cerebral infarction due to thrombosis of cerebral arteries	
G64	Infarction - cerebral	
G64	CVA - cerebral artery occlusion	
G64z	Cerebellar infarction	
G64	Stroke due to cerebral arterial occlusion	
G64z	Brainstem infarction not otherwise specified	
G63y0	Cerebral infarct due to thrombosis of precerebral arteries	
G63y1	Cerebral infarction due to embolism of precerebral arteries	
G6X	Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries	
G641	Cerebral embolus	
G6760	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic	
G6W	Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries	
G63	Infarction — precerebral	
G64z1	Wallenberg syndrome	
G663	Brain stem stroke syndrome	
G664	Cerebellar stroke syndrome	
G661	Anterior cerebral artery syndrome	
G662	Posterior cerebral artery syndrome	
G665.	Pure motor lacunar syndrome	
G666	Pure sensory lacunar syndrome	
Unspecified stroke		
G66	CVA unspecified	
G66	CVA - Cerebrovascular accident unspecified	
G667	Left sided CVA	
G668	Right sided CVA	
G66	Stroke and cerebrovascular accident unspecified	
G66	Stroke and cerebrovascular accident unspecified Stroke unspecified	
13YA	Stroke dispectived Stroke group member	
G6	Cerebrovascular disease	
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G5734 Permanent atrial fibrillation	
G5735 Persistent atrial fibrillation	
G5736 Paroxysmal atrial flutter	
G5737 Chronic atrial fibrillation	
GS757 CHIUHIC dti idi HUHHIdtiUH	(continued on next page)

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Clob Insulin treated Type 2 diabetes mellitus			
Cited Type 1 diabetes mellitus		**	
Cipe Type diabetes mellitus with keroacidosis Cipe		•	
CIO8 Insulin dependent diabetes melitus Diabetes melitus with tereadodis CIO4	•	••	
CIOI Diabetic perhopathy CIO9 Non-insulin dependent diabetes mellitus CIO9 Non-insulin dependent diabetes mellitus CIO9 Non-insulin dependent diabetes mellitus CIO9 CIO08 Insulin dependent diabetes mellitus CIO08 CIO08 Insulin dependent diabetes mellitus CIO09 CIO09 Non-insulin dependent diabetes mellitus por control CIO09		**	
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C1000 Diabetes mellitus, juvenile type, no mention of complication C109G Non-insulin dependent diabetes mellitus with arthropathy C108B Insulin dependent diabetes mellitus with mononeuropathy C109C Type 2 diabetes mellitus with nephropathy C10FQ Type 2 diabetes mellitus with exudative maculopathy C10F7 Type 2 diabetes mellitus - poor control C10FL Type 2 diabetes mellitus with persistent proteinuria C10B0 Steroid induced diabetes mellitus without complication C1084 Unstable insulin dependent diabetes mellitus C1099 Non-insulin-dependent diabetes mellitus C10EL Type 1 diabetes mellitus with persistent microalbuminuria C10EK Type 1 diabetes mellitus with persistent proteinuria C1089 Insulin dependent diabetes maturity onset C107 Diabetes mellitus with gangrene			
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C108B Insulin dependent diabetes mellitus with mononeuropathy C109C Type 2 diabetes mellitus with nephropathy C10FQ Type 2 diabetes mellitus with exudative maculopathy C10F7 Type 2 diabetes mellitus - poor control C10FL Type 2 diabetes mellitus - poor control C10BO Steroid induced diabetes mellitus with out complication C1084 Unstable insulin dependent diabetes mellitus C1099 Non-insulin-dependent diabetes mellitus without complication C10EL Type 1 diabetes mellitus with persistent microalbuminuria C10EK Type 1 diabetes mellitus with persistent proteinuria C1089 Insulin dependent diabetes maturity onset C107 Diabetes mellitus with gangrene			
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C10EL Type 1 diabetes mellitus with persistent microalbuminuria C10EK Type 1 diabetes mellitus with persistent proteinuria C1089 Insulin dependent diabetes maturity onset C107 Diabetes mellitus with gangrene		•	
C10EK Type 1 diabetes mellitus with persistent proteinuria C1089 Insulin dependent diabetes maturity onset C107 Diabetes mellitus with gangrene			
C1089 Insulin dependent diabetes maturity onset C107 Diabetes mellitus with gangrene			
C107 Diabetes mellitus with gangrene		**	
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(continued on next page	C107	Diabetes menitus with gangrene	(and the second
			(continued on next page)

Read Code	Read Code Definition
C107	Diabetes with gangrene
C10FN	Type 2 diabetes mellitus with ketoacidosis
C105	Diabetes mellitus with ophthalmic manifestation
C10y	Diabetes mellitus with other specified manifestation
C1072	Diabetes mellitus, adult with gangrene
C10A1	Malnutrition-related diabetes mellitus with ketoacidosis
C10F2	Type 2 diabetes mellitus with neurological complications
C105z	Diabetes mellitus not otherwise specified with ophthalmic manifestation
C10FK	Hyperosmolar non-ketotic state in type 2 diabetes mellitus
C1094	Non-insulin dependent diabetes mellitus with ulcer
C1041	Diabetes mellitus, adult onset, with renal manifestation
C104z	Diabetes mellitus with nephropathy not otherwise specified
C10E8	Type 1 diabetes mellitus - poor control
C10FH	Type 2 diabetes mellitus with neuropathic arthropathy
C107	Diabetes mellitus with peripheral circulatory disorder
C109K	Hyperosmolar non-ketotic state in type 2 diabetes mellitus
C10D	Diabetes mellitus autosomal dominant type 2
C109J	Insulin treated non-insulin dependent diabetes mellitus
C10FF	Type 2 diabetes mellitus with peripheral angiopathy
C10K	Type A insulin resistance
C1087	Type I diabetes mellitus with retinopathy
C101y	Other specified diabetes mellitus with ketoacidosis
C100	Diabetes mellitus with no mention of complication
C10EE	Type 1 diabetes mellitus with hypoglycemic coma
C1061	Diabetes mellitus, adult onset, + neurological manifestation
C108J	Insulin dependent diabetes mellitus with neuropathic arthropathy
C1020	Diabetes mellitus, juvenile type, with hyperosmolar coma
C1095	Non-insulin dependent diabetes mellitus with gangrene
C10E9	Type 1 diabetes mellitus maturity onset
C10EN	Type 1 diabetes mellitus with ketoacidotic coma
C109H	Non-insulin dependent d m with neuropathic arthropathy
C1087	Type 1 diabetes mellitus with retinopathy
C1051	Diabetes mellitus, adult onset, + ophthalmic manifestation
C108C	Insulin dependent diabetes mellitus with polyneuropathy
C101z	Diabetes mellitus not otherwise specified with ketoacidosis
C1030	Diabetes mellitus, juvenile type, with ketoacidotic coma
C108E	Type I diabetes mellitus with hypoglycemic coma
C1096	Type 2 diabetes mellitus with retinopathy
C10E2	Type 1 diabetes mellitus with neurological complications
C1021	Diabetes mellitus, adult onset, with hyperosmolar coma
C10F3	Type II diabetes mellitus with multiple complications
C10C	Diabetes mellitus autosomal dominant
C109D	Noninsulin dependent diabetes mellitus with hypoglycemic coma
C10M.	Lipoatrophic diabetes mellitus
C10E4	Unstable type 1 diabetes mellitus
C108F	Insulin dependent diabetes mellitus with diabetic cataract
C108E	Insulin dependent diabetes mellitus with hypoglycemic coma
C1085	Insulin dependent diabetes mellitus with ulcer
C109E	Type 2 diabetes mellitus with diabetic cataract
C10FE	Type 2 diabetes mellitus with diabetic cataract
C10E3	Insulin dependent diabetes mellitus with multiple complications
C109B	Non-insulin dependent diabetes mellitus with polyneuropathy
C10z	Diabetes mellitus with unspecified complication
C1097	Type 2 diabetes mellitus - poor control
C1088	Type 1 diabetes mellitus - poor control
C1092	Type 2 diabetes mellitus with neurological complications
C1095	Type 2 diabetes mellitus with gangrene
C108y	Other specified diabetes mellitus with multiple comps
C10EC	Type 1 diabetes mellitus with polyneuropathy
C10C	Maturity onset diabetes in youth
C1088	Type I diabetes mellitus - poor control
C10FD	Type 2 diabetes mellitus with hypoglycemic coma
C1080	Insulin-dependent diabetes mellitus with renal complications
C10F7	Type II diabetes mellitus - poor control
C10F1	Type 2 diabetes mellitus with ophthalmic complications
C105y	Other specified diabetes mellitus with ophthalmic complications
C109B	Type II diabetes mellitus with polyneuropathy
C10E0	Type 1 diabetes mellitus with renal complications
C10E1	Type 1 diabetes mellitus with ophthalmic complications
C10E3	Type 1 diabetes mellitus with multiple complications
C109H	Type II diabetes mellitus with neuropathic arthropathy
	Type 2 diadetes meliitus without combilication
C10F9	Type 2 diabetes mellitus without complication Type II diabetes mellitus with diabetic cataract
	Type I diabetes mellitus with diabetic cataract Type 2 diabetes mellitus with diabetic cataract Type 2 diabetes mellitus with ulcer

Read Code	Read Code Definition	
C1082	Type I diabetes mellitus with neurological complications	
C1081	Insulin-dependent diabetes mellitus with ophthalmic comps	
C10EF	Type 1 diabetes mellitus with diabetic cataract	
C10F6	Type II diabetes mellitus with retinopathy	
C109G	Type 2 diabetes mellitus with arthropathy	
C10E4	Unstable type I diabetes mellitus	
C1090	Type II diabetes mellitus with renal complications	
C1091	Non-insulin-dependent diabetes mellitus with ophthalmic complications	
C10FB	Type II diabetes mellitus with polyneuropathy	
C109A	Type II diabetes mellitus with mononeuropathy	
C100z	Diabetes mellitus not otherwise specified with no mention of complication	
C10E	Insulin dependent diabetes mellitus	
C10G	Secondary pancreatic diabetes mellitus	
C10FP	Type 2 diabetes mellitus with ketoacidotic coma	
C1085	Type I diabetes mellitus with actorition coma	
C1083	**	
	Insulin dependent diabetes mellitus with multiple complications	
C10A	Malnutrition-related diabetes mellitus	
C1082	Insulin-dependent diabetes mellitus with neurological comps	
C1090	Non-insulin-dependent diabetes mellitus with renal comps	
C1010	Diabetes mellitus, juvenile type, with ketoacidosis	
C10F9	Type II diabetes mellitus without complication	
C10EJ	Type 1 diabetes mellitus with neuropathic arthropathy	
C109F	Non-insulin-dependent d m with peripheral angiopathy	
C10E4	Unstable insulin dependent diabetes mellitus	
C1011	Diabetes mellitus, adult onset, with ketoacidosis	
C109F	Type II diabetes mellitus with peripheral angiopathy	
C1094	Type II diabetes mellitus with ulcer	
C10EQ	Type 1 diabetes mellitus with gastroparesis	
C1092	Non-insulin-dependent diabetes mellitus with neuro comps	
C109D	Type II diabetes mellitus with hypoglycemic coma	
	31 31 33	
C108A	Insulin-dependent diabetes without complication	
C1074	NIDDM with peripheral circulatory disorder	
C10K0	Type A insulin resistance without complication	
C10F0	Type II diabetes mellitus with renal complications	
C108D	Insulin dependent diabetes mellitus with nephropathy	
C1096	Type II diabetes mellitus with retinopathy	
C10FG	Type 2 diabetes mellitus with arthropathy	
C103y	Other specified diabetes mellitus with coma	
C109C	Non-insulin dependent diabetes mellitus with nephropathy	
C1091	Type II diabetes mellitus with ophthalmic complications	
C106	Diabetic amyotrophy	
C10D	Maturity onset diabetes in youth type 2	
C1084	Unstable type I diabetes mellitus	
C108J	Type I diabetes mellitus with neuropathic arthropathy	
•		
C1086	Insulin dependent diabetes mellitus with gangrene	
C109F	Type 2 diabetes mellitus with peripheral angiopathy	
C10FL	Type II diabetes mellitus with persistent proteinuria	
C109D	Type 2 diabetes mellitus with hypoglycemic coma	
C10H	Diabetes mellitus induced by nonsteroid drugs	
C1080	Type I diabetes mellitus with renal complications	
C106y	Other specified diabetes mellitus with neurological comps	
C1082	Type 1 diabetes mellitus with neurological complications	
C1095	Type II diabetes mellitus with gangrene	
C1093	Non-insulin-dependent diabetes mellitus with multiple comps	
C10EM	Type I diabetes mellitus with ketoacidosis	
C108H	Type I diabetes mellitus with arthropathy	
C10EA	Type I diabetes mellitus without complication	
C10FA	Type 2 diabetes mellitus with mononeuropathy	
C1089	Type I diabetes mellitus maturity onset	
	**	
C1071	Diabetes mellitus, adult, + peripheral circulatory disorder	
C10y1	Diabetes mellitus, adult, + other specified manifestation	
8CR2	Diabetes clinical management plan	
C10FR	Type 2 diabetes mellitus with gastroparesis	
C10z1	Diabetes mellitus, adult onset, + unspecified complication	
C10zy	Other specified diabetes mellitus with unspecified comps	
C10zz	Diabetes mellitus not otherwise specified with unspecified complication	
C108G	Insulin dependent diabetes mellitus with peripheral angiopathy	
C108z	Unspecified diabetes mellitus with multiple complications	
C109C	Type II diabetes mellitus with nephropathy	
	Insulin treated Type II diabetes mellitus	
C10FJ	Diabetes mellifits not otherwise specified with peripheral circulatory disorder	
C10FJ C107z	Diabetes mellitus not otherwise specified with peripheral circulatory disorder	
C10FJ C107z C103z	Diabetes mellitus not otherwise specified with ketoacidotic coma	
C10FJ C107z		

Read Code	Read Code Definition	
C1094	Type 2 diabetes mellitus with ulcer	
C10EN	Type I diabetes mellitus with ketoacidotic coma	
C10A0	Malnutrition-related diabetes mellitus with coma	
C108D	Type I diabetes mellitus with nephropathy	
C109H	Type 2 diabetes mellitus with neuropathic arthropathy	
C10H0	DM induced by non-steroid drugs without complication	
C1060	Diabetes mellitus, juvenile, + neurological manifestation	
C1092	Type II diabetes mellitus with neurological complications	
	**	
C10EB	Type 1 diabetes mellitus with mononeuropathy	
C1085	Type 1 diabetes mellitus with ulcer	
C10z0	Diabetes mellitus, juvenile type, + unspecified complication	
C1031	Diabetes mellitus, adult onset, with ketoacidotic coma	
C1073	IDDM with peripheral circulatory disorder	
C109E	Non-insulin dependent diabetes mellitus with diabetic cataract	
C10EA	Type 1 diabetes mellitus without complication	
C1050	Diabetes mellitus, juvenile type, + ophthalmic manifestation	
C10E6	Type 1 diabetes mellitus with gangrene	
C1091	Type 2 diabetes mellitus with ophthalmic complications	
C1070	Diabetes mellitus, juvenile + peripheral circulatory disorder	
C108E	Type 1 diabetes mellitus with hypoglycemic coma	
C10yz	Diabetes mellitus not otherwise specified with other specified manifestation	
C109A	Non-insulin dependent diabetes mellitus with mononeuropathy	
C102z	Diabetes mellitus not otherwise specified with hyperosmolar coma	
C10E8	Insulin dependent diabetes mellitus - poor control	
66Ao	Diabetes type 2 review	
66An	Diabetes type 1 review	
C10FM	Type II diabetes mellitus with persistent microalbuminuria	
C10F4	Type II diabetes mellitus with ulcer	
C10E3	Type I diabetes mellitus with multiple complications	
C10EC	Type I diabetes mellitus with polyneuropathy	
C10N1	Cystic fibrosis related diabetes mellitus	
C10EG	· · · · · · · · · · · · · · · · · · ·	
	Type 1 diabetes mellitus with peripheral angiopathy	
C10FE	Type II diabetes mellitus with diabetic cataract	
C10E7	Insulin dependent diabetes mellitus with retinopathy	
C10E5	Type I diabetes mellitus with ulcer	
C1040	Diabetes mellitus, juvenile type, with renal manifestation	
C10N0	Secondary diabetes mellitus without complication	
C10E7	Type I diabetes mellitus with retinopathy	
C10FA	Type II diabetes mellitus with mononeuropathy	
C10FS	Maternally inherited diabetes mellitus	
C10ER	Latent autoimmune diabetes mellitus in adult	
C108A	Type I diabetes mellitus without complication	
C10E9	Type I diabetes mellitus maturity onset	
C10G0	Secondary pancreatic diabetes mellitus without complication	
C1089	Type 1 diabetes mellitus maturity onset	
C1084	Unstable type 1 diabetes mellitus	
C10E9	Insulin dependent diabetes maturity onset	
C10EP	Type I diabetes mellitus with exudative maculopathy	
C10E1	Insulin-dependent diabetes mellitus with ophthalmic comps	
C10C.	Maturity onset diabetes in youth type 1	
C10F2	Type II diabetes mellitus with neurological complications	
C10E5	Insulin dependent diabetes mellitus with ulcer	
C10FD	Type II diabetes mellitus with hypoglycemic coma	
C108B	Type I diabetes mellitus with mononeuropathy	
C106B	Type I diabetes mellitus with monoricuropathy Type I diabetes mellitus with ophthalmic complications	
C10E1	Insulin dependent diabetes mellitus with hypoglycemic coma	
C10EA	Insulin-dependent diabetes without complication	
C10A5	Malnutrition-related diabetes mellitus with peripheral circulatory complications	
C10EF	Insulin dependent diabetes mellitus with diabetic cataract	
C10F1	Type II diabetes mellitus with ophthalmic complications	
1434	H/O: diabetes mellitus	
66AJ	Diabetic - poor control	
66AJ0	Chronic hyperglycemia	
66A[1	Brittle diabetes	
66AJz	Diabetic - poor control not otherwise specified	
C1001	Diab.mell.no comp adult	
C100z	Diab.mell.no comp onset not otherwise specified	
	•	
C107y	Other specified diabetes mellitus + peripheral circulatory complications	
C1085	Insulin dependent diabetes mellitus + ulcer	
C108B	Insulin dependent diabetes mellitus with mononeuropathy	
C10A2	$Malnutrition-related\ diabetes\ mellitus+renal\ complications$	
04040	Malnutrition-related diabetes mellitus + ophthalmic complications	
C10A3		
C10A3 C10A4	Malnutrition-related diabetes $\operatorname{mellitus} + \operatorname{neurologic}$ complications	
	Malnutrition-related diabetes mellitus + neurologic complications Malnutrition-related diabetes mellitus + peripheral circulatory complications	

$\textbf{Supplementary Table 2} \ (continued \)$

C10A6 Malnutrition-related diabetes mellitus + multiple complications C10A7 Malnutrition-related diabetes mellitus + unspecified complications C10AX Malnutrition-related diabetes mellitus + unspecified complications C10AX Malnutrition-related diabetes mellitus + other specified complications C10L Fibrocalculous pancreatopathy C10L0 Fibrocalculous pancreatopathy without complications C10M0 Lipoatrophic diabetes mellitus without complications F372 Polyneuropathy in diabetes F3720 Acute painful diabetic neuropathy F3721 Chron painful diabetic neuropathy F3721 Chron painful diabetic neuropathy F3722 Asymptomatic diabetic neuropathy F3723 Asymptomatic diabetic neuropathy F3724 G580 Congestive heart failure G58 Heart failure G58 Congestive heart failure G580 Congestive heart failure G5801 Chroncongestive heart failure G5802 Decompensated cardiac failure G5803 Compensated cardiac failure G5804 Cong heart failure due to valve disease G581 Left ventricular failure G582 Acute heart failure G582 Acute heart failure G583 Heart failure G584 Right ventricular failure G585 Acute heart failure G586 Heart failure norn eject frac G587 Heart failure norn eject frac G588 Right ventricular failure G589 Heart failure norn eject frac G580 Congenial infarction G32 Old myocardial infarction G32 Old myocardial infarction G32 Old myocardial infarction G32 Old myocardial infarction G34 Other peripheral vascular disease	
C10AW Malnutrition-related diabetes mellitus + unspecified complications C10AX Malnutrition-related diabetes mellitus + other specified complications Fibrocalculous pancreatopathy C10L0 Fibrocalculous pancreatopathy without complications C10M0 Lipoatrophic diabetes mellitus without complications F372 Polyneuropathy in diabetes F3720 Acute painful diabetic neuropathy F3721 Chron painful diabetic neuropathy F3722 Asymptomatic diabetic neuropathy F3722 Asymptomatic diabetic neuropathy F3723 Chron painful diabetic neuropathy F3724 Chron painful diabetic neuropathy F3725 Asymptomatic diabetic neuropathy F3726 Asymptomatic diabetic neuropathy F3727 Asymptomatic diabetic neuropathy F3728 Chron painful diabetic neuropathy F3729 Asymptomatic diabetic neuropathy F3720 Asymptomatic diabetic neuropathy F3720 Asymptomatic diabetic neuropathy F3721 Chron painful diabetic neuropathy F3722 Asymptomatic diabetic neuropathy F3722 Asymptomatic diabetic neuropathy F3724 Chron painful diabetic neuropathy F3725 Chron painful diabetic neuropathy F3726 Asymptomatic diabetic neuropathy F3726 Acute neart failure G580 Congestive heart failure G5801 Chroncongestive heart failure G5803 Compensated cardiac failure G5804 Cong heart failure due to valve disease G581 Left ventricular failure G581 Left ventricular failure G582 Acute heart failure G582 Acute heart failure G583 Heart failure norm eject frac G584 Right ventricular failure G584 Right ventricular failure F384 Right ventricular failure G585 Heart failure not otherwise specified Myocardial infarction G32 Old myocardial infarction F393 Other peripheral vascular disease	
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G5800 Acute congestive heart failure G5801 Chroncongestive heart failure G5802 Decompensated cardiac failure G5803 Compensated cardiac failure G5804 Cong heart failure due to valve disease G581 Left ventricular failure G5810 Acute left ventricular failure G582 Acute heart failure G583 Heart failure G584 Right ventricular failure G585 Heart failure norm eject frac G584 Right ventricular failure G582 Old myocardial infarction G32 Old myocardial infarction G32 Peripheral vascular disease G73 Other peripheral vascular disease	
G5801 Chroncongestive heart failure G5802 Decompensated cardiac failure G5803 Compensated cardiac failure G5804 Cong heart failure due to valve disease G581 Left ventricular failure G5810 Acute left ventricular failure G582 Acute heart failure G583 Heart failure norm eject frac G584 Right ventricular failure G58z Heart failure G58z Old myocardial infarction G32 Old myocardial infarction G73 Other peripheral vascular disease	
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G5803 Compensated cardiac failure G5804 Cong heart failure due to valve disease G581 Left ventricular failure G5810 Acute left ventricular failure G582 Acute heart failure G583 Heart failure norm eject frac G584 Right ventricular failure G582 Heart failure norm eject frac G584 Right ventricular failure G582 Heart failure G582 Old myocardial infarction G32 Old myocardial infarction Peripheral vascular disease G73 Other peripheral vascular disease	
G5804 Cong heart failure due to valve disease G581 Left ventricular failure G5810 Acute left ventricular failure G582 Acute heart failure G583 Heart failure norm eject frac G584 Right ventricular failure G58z Heart failure not otherwise specified Myocardial infarction G32 Old myocardial infarction Peripheral vascular disease G73 Other peripheral vascular disease	
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G583 Heart failure norm eject frac G584 Right ventricular failure G582 Heart failure not otherwise specified Myocardial infarction G32 Old myocardial infarction Peripheral vascular disease G73 Other peripheral vascular disease	
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G32 Old myocardial infarction Peripheral vascular disease G73 Other peripheral vascular disease	
Peripheral vascular disease G73 Other peripheral vascular disease	
G73 Other peripheral vascular disease	
1 1	
C724	
G734 Peripheral arterial disease	
G73y Other specified peripheral vascular disease	
G73z Peripheral vascular disease not otherwise specified	
G73z0 Intermittent claudication	
G73zz Peripheral vascular disease not otherwise specified	
Gyu74 Other specified peripheral vascular disease	
Renal disease	
K05 Chronic renal failure	
K050 End stage renal failure	
K060 Impaired renal function	
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K060 Renal impairment	
K03 Nephropathy, unspecified	
K032 Membranoproliferative nephritis unspecified	
KOSz Impaired renal function disorder not otherwise specified	
K05 End stage renal failure	
1Z13 Chronic kidney disease stage 4	
1Z14 Chronic kidney disease stage 5	
1Z1H CKD stage 4 with proteinuria	
1Z1J CKD stage 4 without proteinuria	
1Z1K CKD stage 5 with proteinuria	
1Z1L CKD stage 5 without proteinuria	
K054 Chronic kidney disease stage 4	
K055 Chronic kidney disease stage 5	
Pulmonary embolism	
14AC H/O: pulmonary embolus	
G401 Pulmonary embolism	
G4010 Postoperative pulmonary embolism	
G4011 Recurrent pulmonary embolism	

Read codes shown up to fifth character.

Supplementary Table 3
Associations Between Prior Stroke or Severe Frailty, Incident Stroke and 30-Day Mortality Following Incident Stroke

	Unadjusted Estimate (95% CI)	Adjusted Estimate (95% CI)
Prior stroke in 12 mo before care home entry		
Incident stroke	sHR 1.92 (1.65, 2.22)	sHR 1.83 (1.57, 2.13)
30-d mortality following incident stroke	OR 2.12 (1.57, 2.86)	OR 2.18 (1.59, 2.98)
Severe frailty		
Incident stroke	sHR 1.27 (1.11, 1.46)	sHR 1.10 (0.95, 1.28)
30-d mortality following incident stroke	OR 0.98 (0.74, 1.30)	OR 0.95 (0.69, 1.29)

sHR, subdistribution hazard ratio.

Incident stroke refers to any incident stroke in the 12-months after care home entry. Frailty determined with the electronic frailty index.

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