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Original Study

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

Stephanie L. Harrison PhD [a,b,*], Gregory Y.H. Lip MD [a,b,c], Ashley Akbari MSc [d,e], Fatemeh Torabi MSc [d], Leona A. Ritchie MPharm [a,b], Asangaedem Akpan MPhil [f,g], Julian Halcox MD [d], Sarah Rodgers PhD [h], Joe Hollinghurst PhD [d], Daniel Harris PhD [d,i], Deirdre A. Lane PhD [a,b,c]

[a] *Liverpool Center for Cardiovascular Science, University of Liverpool and Liverpool Heart and Chest Hospital, Liverpool, United Kingdom*
[b] *Department of Cardiovascular and Metabolic Medicine, Institute of Life Course and Medical Sciences, University of Liverpool, Liverpool, United Kingdom*
[c] *Aalborg Thrombosis Research Unit, Department of Clinical Medicine, Aalborg University, Aalborg, Denmark*
[d] *Population Data Science, Health Data Research UK, Swansea University Medical School, Swansea University, Swansea, Wales*
[e] *Population Data Science, Administrative Data Research Wales, Swansea University Medical School, Swansea University, Swansea, Wales*
[f] *Musculoskeletal and Aging Science, Institute of Life Course and Medical Sciences, University of Liverpool, United Kingdom*
[g] *Liverpool University Hospitals NHS FT, Liverpool, United Kingdom*
[h] *Department of Public Health, Policy and Systems, University of Liverpool, Liverpool, United Kingdom*
[i] *Swansea Bay University Health Board, Swansea, Wales*

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A B S T R A C T

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 person-years [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.

* Address correspondence to Stephanie Harrison, PhD, Liverpool Center for Cardiovascular Science, University of Liverpool and Liverpool Heart and Chest Hospital, William Henry Duncan Building, Liverpool, L7 8TX, UK.
E-mail address: stephanie.harrison@liverpool.ac.uk (S.L. Harrison).

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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.

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.[6] 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.[7] The use of linked routinely collected data are valuable to answer important research questions for this population.[8]

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.[9] The SAIL Databank includes secondary care data for the entire population of Wales and primary care data for approximately ~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 ≥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.[10] 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 ≥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 1
Characteristics 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.

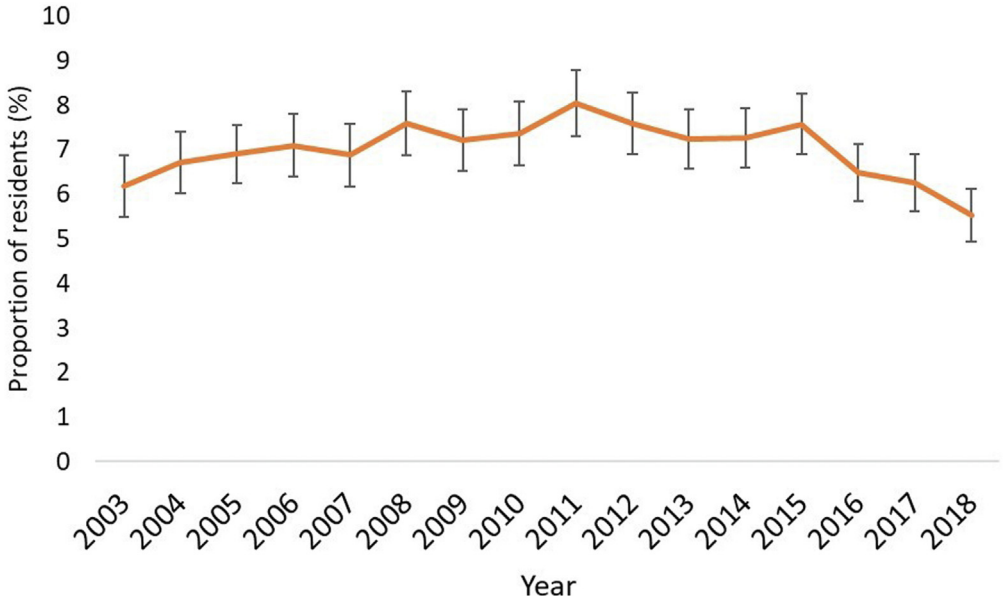

Fig. 1. Changes over time in the proportion of older people entering a care home with a stroke in the 12 months prior to moving to a care home (n = 86,602).

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).

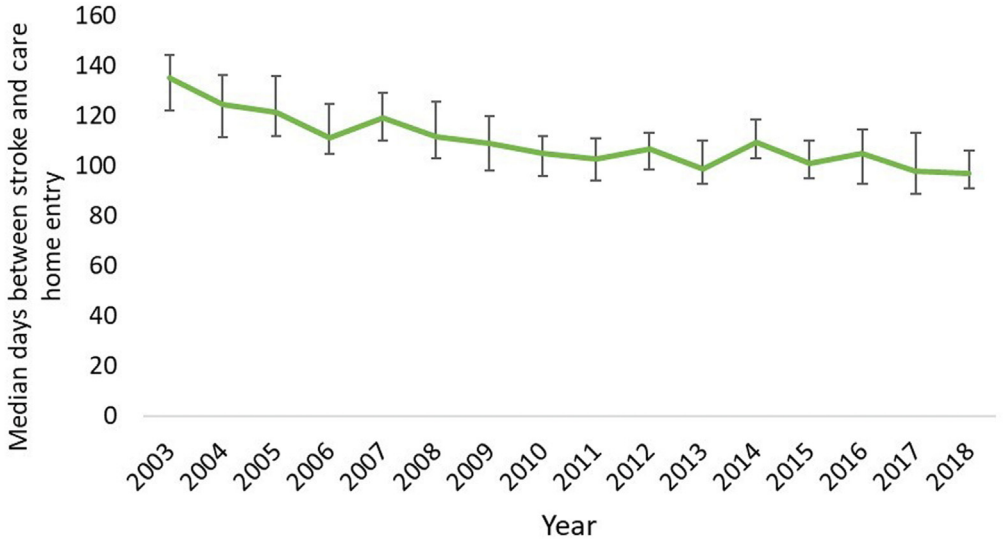

Fig. 2. Changes over time in the median number of days between a stroke and moving to a care home (n = 86,602).

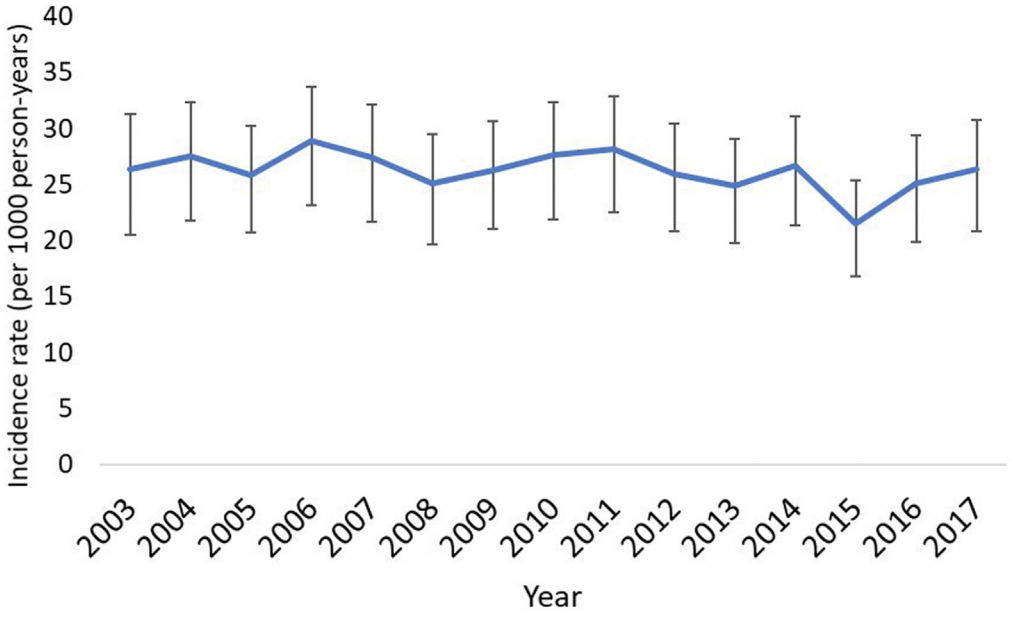

Fig. 3. Changes over time in the incidence of stroke within 12 months of moving to a care home (n = 80,681).

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	61.2 (3707)	63.7 (2602)	48.0 (460)	64.0 (645)	0.44 (0.37, 0.52)	0.88 (0.74, 1.04)
Statin	51.0 (3087)	54.1 (2210)	43.5 (417)	45.6 (460)	0.61 (0.51, 0.72)	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 patient-centered 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 occurred[30]; 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.[1] 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
I602	Subarachnoid hemorrhage from anterior communicating artery
I603	Subarachnoid hemorrhage from posterior communicating artery
I604	Subarachnoid hemorrhage from basilar artery
I605	Subarachnoid hemorrhage from vertebral artery
I606	Subarachnoid hemorrhage from other intracranial arteries
I607	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	Intracranial hemorrhage (nontraumatic)unspecified
Ischemic stroke	
I630	Cerebral infarct due to thrombosis of precerebral arteries
I631	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	Pure motor lacunar stroke syndrome
G466	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
I678	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	Hypertensive heart and renal disease
I15	Secondary hypertension
Atrial fibrillation	
I48	Atrial fibrillation and flutter
Diabetes mellitus	
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	
I210	Acute transmural myocardial infarction of anterior wall
I211	Acute transmural myocardial infarction of inferior wall

(*continued on next page*)

Supplementary Table 1 (*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
I790	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	
I260	Pulmonary embolism with mention of acute cor pulmonale
I269	Pulmonary embolism without mention of acute cor pulmonale

Supplementary Table 2
Read 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 unspecified
13YA	Stroke group member
G6	Cerebrovascular disease

(*continued on next page*)

Supplementary Table 2 (*continued*)

Read Code	Read Code Definition
G6z	Cerebrovascular disease not otherwise specified
G67	Other cerebrovascular disease
8HBJ	Stroke/transient ischemic attack referral
L440	Stroke in the puerperium
14A7	H/O: CVA/stroke
Hypertension	
14A2	H/O: hypertension
G2	Hypertensive disease
G20	Essential hypertension
G200	Malignant essential hypertension
G201	Benign essential hypertension
G202	Systolic hypertension
G203	Diastolic hypertension
G20z	Essential hypertension not otherwise specified
G21	Hypertensive heart disease
G210	Malignant hypertension heart disease
G2100	Malignant hypertension heart disease-no congestive cardiac failure
G2101	Malignant hypertension heart disease + - congestive cardiac failure
G210z	Malignant hypertension heart disease Not otherwise specified
G211	Benign hypertensive heart disease
G2110	Benign hypertensive heart disease - congestive cardiac failure
G2111	Benign hypertensive heart disease + - congestive cardiac failure
G211z	Benign hypertension heart disease Not otherwise specified
G21z.	Hypertensive heart disease Not otherwise specified
G21z0	Hypertensive heart disease Not otherwise specified-no congestive cardiac failure
G21z1	Hypertensive heart disease Not otherwise specified- + congestive cardiac failure
G21zz	Hypertensive heart disease Not otherwise specified
G22	Hypertensive renal disease
G220	Malignant hypertensive renal disease
G221	Benign hypertensive renal disease
G222	Hypertensive renal disease + renal failure
G22z	Hypertensive renal disease Not otherwise specified
G23	Hypertensive heart + renal disease
G230	Malignant hypertensive heart + renal disease
G231	Benign hypertensive heart + renal disease
G232	Hypertensive heart + renal disease + heart failure
G233	Hypertensive heart + renal disease + renal fail
G234	Hypertensive heart + renal disease + both heart + renal failure
G23z	Hypertensive heart + renal disease not otherwise specified
G24	Secondary hypertension
G240	Secondary malignant hypertension
G2400	Secondary malign renovascular hypertension
G240z	Secondary malign hypertension not otherwise specified
G241	Secondary benign hypertension
G2410	Secondary benign renovascular hypertension
G241z	Secondary benign hypertension not otherwise specified
G244	Hypertension secondary endocrine disorder
G24z	Secondary hypertension not otherwise specified
G24z0	Secondary renovascular hypertension not otherwise specified
G24z1	Hypertension secondary to drug
G24zz	Secondary hypertension not otherwise specified
G25	Stage 1 hypertension (NICE 2011)
G250	Stage 1 hypertension without end organ damage
G251	Stage 1 hypertension with end organ damage
G26	Severe hypertension (NICE 2011)
G27	Hypertension resistant to drug therapy
G28	Stage 2 hypertension (NICE 2011)
G2y	Hypertensive disease otherwise specified
G2z	Hypertensive disease not otherwise specified
Atrial fibrillation	
14AN	H/O: atrial fibrillation
14AR	History of atrial flutter
3272	ECG: atrial fibrillation
3273	ECG: atrial flutter
8CMW2	Atrial fibrillation care pathway
G573	Atrial fibrillation/flutter
G5730	Atrial fibrillation
G5731	Atrial flutter
G5732	Paroxysmal atrial fibrillation
G5733	Non-rheumatic atrial fibrillation
G5734	Permanent atrial fibrillation
G5735	Persistent atrial fibrillation
G5736	Paroxysmal atrial flutter
G5737	Chronic atrial fibrillation

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Supplementary Table 2 (*continued*)

Read Code	Read Code Definition
G5738	Typical atrial flutter
G5739	Atypical atrial flutter
G573z	Atrial fibrillation/flutter Not otherwise specified
Diabetes mellitus	
C1001	Non-insulin dependent diabetes mellitus
C10	Diabetes mellitus
C10F	Type 2 diabetes mellitus
C1000	Insulin dependent diabetes mellitus
C10FJ	Insulin treated Type 2 diabetes mellitus
C10E	Type 1 diabetes mellitus
C108	Insulin dependent diabetes mellitus
C101	Diabetes mellitus with ketoacidosis
C104	Diabetic nephropathy
C109	Non-insulin dependent diabetes mellitus
C109	NIDDM - Non-insulin dependent diabetes mellitus
C1087	Insulin dependent diabetes mellitus with retinopathy
C1088	Insulin dependent diabetes mellitus - poor control
C106	Diabetes mellitus with neuropathy
C1097	Noninsulin dependent diabetes mellitus - poor control
C10yy	Other specified diabetes mellitus with other spec comps
C10ED	Type 1 diabetes mellitus with nephropathy
C10EM	Type 1 diabetes mellitus with ketoacidosis
C10B	Diabetes mellitus induced by steroids
C10E	Type I diabetes mellitus
C10FC	Type 2 diabetes mellitus with nephropathy
C10F5	Type 2 diabetes mellitus with gangrene
C104y	Other specified diabetes mellitus with renal complications
C1001	Diabetes mellitus, adult onset, no mention of complication
C1001	Maturity onset diabetes
C103	Diabetes mellitus with ketoacidotic coma
C106	Diabetes mellitus with neurological manifestation
C106	Diabetes mellitus with polyneuropathy
C104	Diabetes mellitus with renal manifestation
C1096	Non-insulin-dependent diabetes mellitus with retinopathy
C108F	Type I diabetes mellitus with diabetic cataract
C108	Type 1 diabetes mellitus
C109	Type 2 diabetes mellitus
C109G	Type II diabetes mellitus with arthropathy
C1090	Type 2 diabetes mellitus with renal complications
C109	Type II diabetes mellitus
C108J	Type 1 diabetes mellitus with neuropathic arthropathy
C109J	Insulin treated Type II diabetes mellitus
C109J	Insulin treated Type 2 diabetes mellitus
C10E7	Type 1 diabetes mellitus with retinopathy
C10FM	Type 2 diabetes mellitus with persistent microalbuminuria
C10FB	Type 2 diabetes mellitus with polyneuropathy
C10F6	Type 2 diabetes mellitus with retinopathy
C108	IDDM-Insulin dependent diabetes mellitus
C10EH	Type 1 diabetes mellitus with arthropathy
C10E5	Type 1 diabetes mellitus with ulcer
C10F0	Type 2 diabetes mellitus with renal complications
9OLA	Diabetes monitored
C102	Diabetes mellitus with hyperosmolar coma
C1080	Type 1 diabetes mellitus with renal complications
C10N	Secondary diabetes mellitus
C106z	Diabetes mellitus not otherwise specified with neurological manifestation
C10EP	Type 1 diabetes mellitus with exudative maculopathy
C10F	Type II diabetes mellitus
C108	Type I diabetes mellitus
C1097	Type II diabetes mellitus - poor control
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 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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Supplementary Table 2 (*continued*)

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
C10F9	Type 2 diabetes mellitus without complication
C109E	Type II diabetes mellitus with diabetic cataract
C10F4	Type 2 diabetes mellitus with ulcer

(*continued on next page*)

Supplementary Table 2 (*continued*)

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 ulcer
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
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
C10FJ	Insulin treated Type II diabetes mellitus
C107z	Diabetes mellitus not otherwise specified with peripheral circulatory disorder
C103z	Diabetes mellitus not otherwise specified with ketoacidotic coma
C10F3	Type 2 diabetes mellitus with multiple complications
C108H	Insulin dependent diabetes mellitus with arthropathy

(*continued on next page*)

Supplementary Table 2 (*continued*)

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
C10E1	Type I diabetes mellitus with ophthalmic complications
C10EE	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
66AJ1	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
C10A3	Malnutrition-related diabetes mellitus + ophthalmic complications
C10A4	Malnutrition-related diabetes mellitus + neurologic complications
C10A5	Malnutrition-related diabetes mellitus + peripheral circulatory complications

(*continued on next page*)

Supplementary Table 2 (*continued*)

Read Code	Read Code Definition
C10A6	Malnutrition-related diabetes mellitus + multiple complications
C10A7	Malnutrition-related diabetes mellitus without complications
C10AW	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
F3722	Asymptomatic diabetic neuropathy
Heart failure	
G58	Heart failure
G580	Congestive heart failure
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 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
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
K0D	End-stage renal disease
K060	Renal impairment
K03	Nephropathy, unspecified
K032	Membranoproliferative nephritis unspecified
K08z	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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