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Does higher quality primary health care reduce stroke admissions?

a national cross-sectional study

Abstract

Background
Hospital admission rates for stroke are strongly associated with population factors. The supply and quality of primary care services may also affect admission rates, but there is little previous research.

Aim
To determine if the hospital admission rate for stroke is reduced by effective primary and secondary prevention in primary care.

Design and setting
National cross-sectional study in an English population (52 763 586 patients registered with 7969 general practices in 152 primary care trusts).

Method
A combination of data on hospital admissions for 2006–2009, primary healthcare staffing, practice clinical quality and access indicators, census sources, and prevalence estimates was used. The main outcome measure was indirectly standardised hospital admission rates for stroke, for each practice population.

Results
Mean (3 years) annual stroke admission rates per 100 000 population varied from zero to 476.5 at practice level. In a practice-level multivariable Poisson regression, observed stroke prevalence, deprivation, smoking prevalence, and GPs/100 000 population were all risk factors for hospital admission. Protective healthcare factors included the percentage of stroke or transient ischaemic attack patients whose last measured total cholesterol was ≤5 mmol/l (P<0.001), and ability to book an appointment with a GP (P<0.003). All effect sizes were relatively small.

Conclusion
Associations of stroke admission rates with deprivation and smoking highlight the need for smoking-cessation services. Of the stroke and hypertension clinical quality indicators examined, only reaching a total cholesterol target was associated with reduced admission rates. Patient experience of access to primary care may also be clinically important. In countries with well-developed primary healthcare systems, the potential to reduce hospital admissions by further improving the clinical quality of primary healthcare may be limited.

Keywords
hospitals, utilization; health care quality, access, and evaluation; primary health care, standards; stroke, prevention and control.

INTRODUCTION

European projections suggest that the population of over 65 year olds, in which most stroke events occur, will increase from 20% of the total population in 2000 to 35% in 2050, increasing the disease burden of stroke in the absence of further improvements in prevention.[1] Care for stroke victims is already costly. In the UK, the costs of treatment and productivity loss are £8.9 billion a year, with stroke treatment costs accounting for 5% of total NHS costs.[2]

Reducing emergency hospital admissions in the future will play a critical role in ensuring that health systems meet the challenge of future slow growth or real-terms reductions in resources.[3] Lists of ambulatory or 'primary care-sensitive conditions' for which some hospital admissions may be avoided by high-quality primary care, have been produced by expert consensus in several countries.[4–6] Associations between emergency admission rates and primary care quality indicators have already been found for chronic obstructive pulmonary disease,[7] coronary heart disease,[8] and diabetes.[9] While stroke and transient ischaemic attack (TIA) are not included in most 'primary care-sensitive conditions' lists, there is extensive evidence demonstrating the effectiveness of long-term secondary stroke prevention, and national guidelines promote this.[10,11] Primary prevention of stroke by effective management of hypertension in primary care should also reduce stroke admissions.[12]

The UK has a very high use of electronic patient records by GPs,[13] and the Quality and Outcomes Framework (QOF) pay-for-performance programme rewards GPs for registering patients with chronic diseases, including stroke, on practice computer systems, and managing them effectively. As a result, national data are available on registered stroke prevalence and quality indicator achievement for almost all practices.[14] Over 920 000 patients are on combined practice stroke and TIA registers in England, but a mathematical prevalence model estimates that the number with previous stroke (excluding TIA) is about 1.04 million.[15]

It was hypothesised that the risk of hospital admission would be reduced by effective primary and secondary prevention of stroke in primary care. The study aim was to investigate the associations between rates of hospital admission for stroke, population factors (deprivation, ethnicity, and smoking prevalence), and a range of primary healthcare factors (access, GP supply, and stroke and hypertension quality indicators). It was also hypothesised that admission rates would be affected by QOF-registered

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How this fits in

Although population demography is known to be strongly associated with hospital admission rates, comparatively weak associations with primary care quality indicators have also been found for chronic obstructive pulmonary disease, coronary heart disease, and diabetes. In this cross-sectional national practice-level study of stroke admission rates, associations are shown with population factors, GP supply, reaching a total cholesterol target, and ease of access to primary care. In primary care services with already high levels of achievement of clinical quality indicators, reducing stroke admission rates may be best achieved by ensuring equitable supply of services, and increasing delivery of smoking-cessation interventions.

and undiagnosed prevalence rates ('undiagnosed' meaning expected minus registered prevalence). Although overall nearly 90% of expected cases (from the prevalence model) are on QOF registers, this proportion varies widely at practice level. A recent report found some associations between overall healthcare costs and overall QOF stroke scores.[16] However, to the best of the authors' knowledge, this study is the first to analyse associations between stroke admissions and specific quality standards.

METHOD

Hospital Episodes Statistics data

NHS-funded hospitals in England provide data to the Hospital Episode Statistics (HES) database. This study used HES practice-level stroke admission counts obtained from the NHS Comparators website.[17] Admissions were selected where the primary diagnosis was haemorrhagic or thrombotic cerebrovascular disease (International Classification of Diseases–10 codes I60.4 to I67.9) for all patients admitted as an emergency during the financial years 2006–2007, 2007–2008, and 2008–2009 to maximise the number of admissions per practice.

Quality and Outcomes Framework data

QOF data from the The NHS Information Centre website for April 2008 to March 2009 were used.[18] This includes standardised information on the quality of care provided to 54 310 660 patients by 8229 general practices in 152 English primary care trusts. The QOF clinical quality domain includes 129 evidence-based indicators, including eight for stroke. The study used the four stroke indicators that best represented outcomes rather than processes of care and hence would be most likely to be associated with admission risk (Table 1). The hypertension indicator BP 5 was also included, which measures actual blood pressure control.

To measure broad access to care from the perspective of patients, two new patient-experience indicators derived from the national GP Patient Survey were used, which measure ability to access a GP consultation within 2 days (PE 7), and ability to book an appointment more than 2 days ahead (PE 8). For prevalence, the study used the number of stroke patients recorded by general practices (registered prevalence), and the total list sizes per practice as denominators, as used by the NHS Information Centre.

Table 1. 2008–2009 Quality and Outcomes Framework indicators for stroke management and patient experience that were analysed

Indicator	QOF points	Payment thresholds, %[a]
Stroke quality indicators		
Stroke 6: Percentage of patients with TIA or stroke in whom the last blood pressure reading is ≤150/90 mmHg	5	40–70
Stroke 8: Percentage of patients with TIA or stroke whose last measured total cholesterol was ≤5 mmol/l	5	40–60
Stroke 10: Percentage of patients with TIA or stroke who had influenza immunisation in the preceding 6 months	2	40–85
Stroke 12: Percentage of patients with a non-haemorrhagic stroke or TIA, who have a record that an antiplatelet agent or combination, or an anticoagulant is being taken (unless contraindicated)	4	40–90
Hypertension quality indicator		
BP 5: Percentage of patients with hypertension (excluding those on the stroke/TIA register) in whom the last blood pressure (measured in previous 9 months) is ≤150/90 mmHg	57	40–70
Patient experience indicators		
PE 7: Patient experience of access (1): Percentage of patients who, in the national survey, indicated that they are able to obtain a consultation with their GP	23.5	70–90
PE 8: Patient experience of access (2): Percentage of patients who, in the national survey, indicated that they are able to book an appointment with their GP more than 2 days ahead	35	60–90

[a]*Lower and upper achievement levels required to receive the minimum and maximum payment. TIA = transient ischaemic attack.*

Practice staffing

The NHS Information Centre provided data on GPs per 100 000 population at practice level, as of September 2009 (practice nurse numbers are not available at practice level).

Undiagnosed prevalence data

Practice-level predictions of stroke prevalence from the Association of Public Health Observatories website were used.[16] This uses patient-reported doctor-diagnosed stroke data from the Health Survey for England to produce prevalence estimates for population subgroups. Patient reports of a previous diagnosis have been well validated.[19–22] The model includes practice-level values of age, sex, deprivation, and smoking status to estimate overall stroke prevalence, and has been validated against estimates from population surveys. Practice-registered stroke prevalence was then subtracted to estimate undiagnosed stroke prevalence.

Population data

Practice population age/sex breakdowns were obtained from the Department of Health Practice Based Commissioning Toolkit.[23] The Care Quality Commission provided a deprivation weighting for each practice produced by aggregating Index of Multiple Deprivation scores from postcodes of individual registered patients, and an estimate of the Black/Black British ethnic minority population for each practice, derived from small area ethnicity breakdowns of HES data, which have been externally validated.[24,25]

Statistical analysis

The basic unit of analysis was the practice population. Indirect standardisation is generally accepted as more robust when counts are relatively small, so indirectly standardised admission counts were calculated for each practice, based on the England age- and sex-specific rates and practice population age/sex breakdowns. These were compared to the observed practice-level admission numbers. Mean 3-year registered and estimated stroke prevalence figures were summarised, and undiagnosed prevalence was calculated.

Because of low admission numbers at practice level, Poisson regression models were fitted. The dependent variable was the observed count of admissions and the offset was the expected count. Poisson regression returns incidence rate ratios (IRRs), which in this context are admission rate ratios. To take possible overdispersion into account, standard errors were scaled using the square root of the deviance-based dispersion. Microsoft Excel and Access were used to manage the data, and Stata (version 11) for statistical analysis.

RESULTS

The 7969 practices for which all data could be matched (98.6% of QOF practices) had a total registered population of 52 763 586 patients. Practice populations varied from 984 to 38 343 (mean 6621) (Table 2). Estimated smoking prevalence varied from 13.2% to 51.7%. QOF scores were generally high; however, there was a lower mean achievement (<80%) for Stroke 8 (proportion

Table 2. Characteristics of practice populations and Quality and Outcomes Framework (QOF) achievement

	Mean	SD	Minimum	Maximum	Median	IQR
Practice characteristics						
Practice population, *n*	6621	4003	984	38 343	5797	5612
Population black/black other, %	3.4	7.4	0.0	72.4	0.5	2.4
Smoking prevalence, %	24.9	6.4	13.2	51.7	23.7	9.2
Deprivation (IMD 2004) score[a]	23.7	12.6	2.2	71.9	21.3	18.6
Standardised stroke admissions/100 000 population	103.7	39.1	0.0	476.5	99.3	24.1
Observed stroke prevalence, %	1.6	0.7	0.0	18.6	1.6	0.9
Undiagnosed stroke prevalence, %,	0.8	0.6	–15.9	3.3	0.8	0.7
GPs/100 000 practice population	56.1	18.1	0.0	337.1	55.1	19.5
QOF achievement, %[b]						
Stroke 6 achievement	88.1	6.7	0.0	100.0	88.6	7.5
Stroke 8 achievement	76.8	9.3	0.0	100.0	77.6	11.1
Stroke 10 achievement	89.7	7.6	0.0	100.0	90.4	7.1
Stroke 12 achievement	94.6	5.5	0.0	100.0	94.7	5.1
Hypertension 5 achievement	78.9	6.4	22.2	100.0	79.0	7.9
Patient Experience 7 achievement	84.2	14.1	0.00	100.0	87.3	13.6
Patient Experience 8 achievement	77.1	17.5	0.0	100.0	80.8	23.0

[a]Weighting for each practice produced by aggregating IMD scores from postcodes of individual registered patients. [b]Total points/available, %. IMD = Index of Multiple Deprivation. IQR = interquartile range.

Table 3. Bivariate regression analyses

	IRR	SE	95% CI	*P*-value
Practice characteristics				
Population black/black other, %	1.0034	0.0006	1.0023 to 1.0045	<0.001
Smoking prevalence, %	1.0175	0.0005	1.0166 to 1.0185	<0.001
Deprivation (IMD 2004)	1.0093	0.0002	1.0088 to 1.0097	<0.001
Observed stroke prevalence, %	1.0459	0.0052	1.0358 to 1.0562	<0.001
Undiagnosed stroke prevalence, %	1.0631	0.0083	1.0470 to 1.0796	<0.001
GPs/100 000 practice population	1.0004	0.0002	1.0000 to 1.0008	0.046
QOF achievement				
Stroke 6 achievement, %	0.9984	0.0006	0.9973 to 0.9996	0.008
Stroke 8 achievement, %	0.9988	0.0004	0.9981 to 0.9996	0.003
Stroke 12 achievement, %	0.9994	0.0008	0.9978 to 1.0011	0.490
Hypertension 5 achievement, %	0.9988	0.0006	0.9977 to 0.9999	0.027
Patient Experience 7 achievement, %	0.9986	0.0002	0.9982 to 0.9991	<0.001
Patient Experience 8 achievement, %	0.9987	0.0002	0.9983 to 0.9990	<0.001

IMD = Index of Multiple Deprivation. IRR = incidence rate ratio. SE = standard error.

Table 4. Multivariable regression analysis[a]

	IRR	SE	95% CI	*P*-value
Practice characteristics				
Smoking prevalence	1.0061	0.0017	1.0028 to 1.0094	<0.001
Deprivation (IMD 2004)	1.0072	0.0009	1.0054 to 1.0089	<0.001
Observed stroke prevalence	1.0604	0.0058	1.0491 to 1.0718	<0.001
Undiagnosed stroke prevalence	0.9640	0.0088	0.9468 to 0.9815	<0.001
GPs/100 000 practice population	1.0004	0.0002	1.0000 to 1.0001	0.037
QOF achievement				
Stroke 8[b]	0.9976	0.0004	0.9968 to 0.9984	<0.001
Patient Experience 8[c]	0.9995	0.0002	0.9992 to 0.9998	0.003

[a]Stepwise Poisson regression, dependent variable: observed admission count. [b]Stroke 8: Percentage of patients with TIA or stroke whose last measured total cholesterol is ≤5 mmol/l. [c]Patient Experience 8: score for ability to book an appointment with a GP more than 2 days ahead. IMD = Index of Multiple Deprivation. IRR = incidence rate ration. SE = standard error. TIA = transient ischaemic attack.

of patients with stroke/TIA whose last measured total cholesterol is ≤5 mmol/l), and BP 5 (the percentage of patients with hypertension in whom the last blood pressure is ≤150/90 mmHg), reflecting the greater difficulty in achieving intermediate outcomes. The range of QOF Patient Experience scores also tended to be lower than other scores. Mean prevalence of registered stroke in England is 1.61%, and the estimated prevalence of undiagnosed stroke is 0.82%. Mean 3-year annual admission rates for stroke per 100 000 population varied from 0 to 476.5 (median 99.28, interquartile range 44.75).

Regression modelling

In the bivariate regression of exposure variables against hospital admission rates (Table 3), observed prevalence, undiagnosed prevalence, deprivation, smoking prevalence, black/black other ethnicity, and GP supply were all statistically significant and positively associated with admission rates. In contrast, QOF indicators Stroke 6, Stroke 8, Hypertension 5, Patient Experience 7, and Patient Experience 8 were all statistically significant and negatively associated, although the effect sizes, as measured by IRRs, were small (Table 3). Because of this, results have been reported to four decimal places. For example, an IRR of 1.0459 for QOF-registered stroke prevalence is associated with an increase in the stroke admission rate of 4% for every percentage point increase in stroke prevalence. On the other hand, stroke prevalence is only 2.4% in the population of over 16 year olds.[26]

Table 4 shows the multivariable practice-level analysis using Poisson regression with the variables retained after reverse stepwise variable selection. The highest IRR was estimated for observed stroke prevalence (IRR 1.0604, $P<0.001$); deprivation, smoking prevalence, and undiagnosed stroke prevalence were also retained in the final model using stepwise removal and entry probabilities of 0.10 and 0.05 respectively.

In terms of service quality and supply, QOF indicators Stroke 8 (the percentage of stroke/TIA patients whose last total cholesterol is ≤5 mmol/l) and Patient Experience 8 (ability to book an appointment more than 2 days ahead) had IRRs less than unity; that is, they protected against admission, while GPs/100 000 practice population had an IRR just over unity.

DISCUSSION

Summary

In this cross-sectional study of hospital admissions for stroke, practice deprivation, estimated practice smoking prevalence, and observed stroke prevalence were all associated with higher stroke admission rates.[27] The percentage of patients with TIA or stroke whose last measured total cholesterol is ≤5 mmol/l, and ease of access, as measured by ability to book an appointment with a GP more than 2 days ahead, were shown to be protective factors.

A positive association between registered stroke prevalence and admissions is plausible, especially as admissions and readmissions were not differentiated in the NHS Comparators data used in this study. Moreover, practices may have added patients to stroke registers in 2008–2009 after they were admitted in 2006–2008. The authors cannot explain the finding that higher undiagnosed stroke prevalence in practices appears to be protective, apart from noting that the expected prevalence model has not been externally validated as yet. Model methodology is described elsewhere.[15]

Strengths and limitations

The study was strengthened by using data from a national population, giving a high level of statistical power, and by combining practice-level data and estimates from a number of sources that were previously unavailable nationally. An alternative interpretation of the findings is that associations were found after adjustment for population factors. This study was able to include several new QOF clinical quality and patient experience indicators. The study findings would be strengthened by further analyses of other chronic diseases.

Limitations include incorrect hospital or practice diagnostic coding. However, the advent of diagnosis-based payment for hospitals has improved data quality; the study only considered primary or principal diagnosis, and 87.2% of these are coded correctly.[28] Because the source of hospital admission data used provided only the aggregate number of admissions for each general practice, it was not possible to separate first and subsequent stroke admissions. Primary prevention by control of hypertension will affect first admissions, and secondary prevention after a stroke only subsequent admissions. This may have obscured some associations.

Annual hospital admission counts per practice were relatively low, even using means of 3 years' data (mean per year 8.1). Appropriate methods were used to deal with this. A number of UK agencies use practice-level admission data to support commissioning and quality improvement, so their use should prompt similar scrutiny to that of hospital-level data.

Reported practice populations may overestimate actual numbers, especially in urban areas with high population mobility. Conversely, a small number of residents may not be registered with a practice. There is also a high level of achievement of many QOF indicators, resulting in a 'ceiling effect', reducing the ability to detect real differences in clinical quality. The impact on hospital admission of recent changes in quality of care may be delayed, but changes in QOF scores between years were small.

Other data covered slightly different periods. Patient survey data may suffer from response bias: response rates are lower in deprived urban populations. HES data do not include privately funded hospital admissions, but the vast majority of unplanned admissions for stroke are to NHS hospitals. Practice-level stroke and smoking prevalence estimates are based on the limited range of risk-factor data available locally. Finally, other factors that could affect admission rates include the quality of out-of-hours services, the presence of practice and specialist nurse services, and the supply and quality of hospital services.

Comparison with existing literature

Associations with deprivation and smoking have been described previously.[29–32] The authors are not aware of any other studies that have analysed associations between primary care quality and stroke admission rates, but the present findings can be compared to other studies of other chronic diseases. Calderón-Larrañaga *et al* showed that higher levels of patient-reported access to consultations within 2 days and better primary care staffing were associated with lower chronic obstructive pulmonary disease admission rates.[7]

Purdy *et al* showed that a higher overall QOF score for coronary heart disease was negatively associated with the risk of admission for angina, and being a training practice and having a higher GP supply were associated with lower admission rates for myocardial infarction.[8] Dusheiko *et al* have shown that practices with better quality of diabetes care had fewer emergency admissions for short-term diabetes complications.[9]

Implications for practice and research

This study illustrates the potential benefits of further population-wide reductions in smoking.[33] The current QOF only incentivises smoking-cessation interventions in patients with established disease, whereas it should encourage practices to offer interventions to all smokers annually. Only QOF Stroke indicator 8, the percentage of stroke/TIA patients whose last measured total cholesterol is ≤5 mmol/l, was associated with lower admission rates.

A meta-analysis showed that statins are effective at decreasing stroke risk.[34] Given the strong evidence base for the use of antiplatelet agents or an anticoagulant for secondary prevention, an association with Stroke 12 might have been expected, but as the QOF mean level of achievement for this indicator is 95%, there may be a 'ceiling effect' which obscures the relationship. Similarly, given the high attributable risk of hypertension for stroke (around 35%),[12] together with the comparatively low mean level of achievement (79%) for BP 5, this might predict an association between control of hypertension in patients without stroke/TIA and stroke admissions. However, many strokes occur in people who are not on hypertension registers, because they

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have undetected hypertension or other risk factors.

Differences in the quality of hypertension management between practices may be relatively small, and they may be outweighed by the effect of population factors. There is some evidence that there is a poor correlation between QOF scores for stroke and adherence to other quality standards.[35] In addition, the lack of association between stroke admission rates and hypertension management at practice level suggests that more challenging QOF thresholds or different indicators may be needed if pay-for-performance schemes are to reduce the burden of stroke.

Unfortunately, the access indicators analysed here, which formed part of the QOF patient survey domain, have been dropped from the 2011–2012 QOF. The study analysis suggests that they may be clinically important, and the NHS should consider retaining them to reflect patient needs for clinical care. The maldistribution of GPs remains a problem,[27] so it is surprising that GP supply was positively associated with admission rates. However, inpatient stroke care is changing markedly in the UK, and it is possible that recently more cases are being referred and admitted.

In summary, the effect sizes, as measured by the IRRs demonstrated, were all close to unity. This possibly reflects the high and uniform quality of primary healthcare services in England, at least for the QOF disease indicators. Effect sizes might be greater in countries where primary health care is less well developed and more variable. Conversely, the study analysis suggests that the potential for reductions in stroke emergency admissions by further improving the clinical quality of general practices in England (as measured here), or in other countries with well-developed primary healthcare systems, may be limited. Further improving ease of access, especially in deprived populations, could be tested for an effect on admission rates.

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