Trends in atrial fibrillation hospitalisation in Scotland: an increasing cost burden

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The objective of our study was to evaluate the impact of atrial fibrillation (AF) on secondary care costs in Scotland. Patient hospitalisation data from the Information and Statistics Division (ISD) of the Scottish National Health Service (NHS) from 2004 to 2008 were analysed to estimate trends in hospital episodes in the 5.2 million population of Scotland. The associated costs were estimated using the tariff prices in Scotland for the respective years.

Over the five-year period, AF-related hospital discharges increased by 33% compared with 20% for all cardiovascular discharges (29 and 37 per 1,000 population respectively). There were increases of: 21% in number of patients hospitalised; 27% in AF-related hospital admissions; and 15% in total patient bed days. Despite decreasing trends, mean length of inpatient stay for AF remained higher than for total cardiovascular conditions (10.9 *vs.* 8.7 days), as did inpatient cost per patient (£6,009 *vs.* £5,586). AF-related hospital costs increased from £138.9 million in 2004 to £162.5 million in 2008, accounting for 24% of all cardiovascular hospital costs. Overall, the burden of AF was higher among women and increased progressively with age.

In conclusion, AF presents a significant and increasing burden on hospital care in Scotland. At 25% of the total cardiovascular burden, AF costs are increasing relatively faster.

Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia found in clinical practice with increased prevalence in the ageing population.[1] It affects 5% of those aged over 65 years and 10% of those aged over 80 years.[2] Its prevalence is increasing primarily for two reasons; an increase in the ageing population and advances in medical care leading to survival from underlying conditions closely associated with AF, such as hypertension, coronary heart disease, and cardiac failure.[3] It has been described as epidemic in proportion since some researchers have predicted its prevalence will triple by 2050.[4]

AF can cause significant morbidity, and worsen pre-existing cardiac conditions.[5] It has significant adverse effects on the patient's overall quality of life with worse quality of life measures compared to post-myocardial patients.[6,7]

However, a major complication of AF is thromboembolic stroke, which is one of the most disabling and costly cardiovascular conditions,[5] accounting for about 15% of all strokes in the USA.[8] Furthermore, AF-related strokes are more severe and have worse outcomes compared with non-AF related strokes.[8] The mortality rate of patients with AF is approximately double that of patients with normal sinus rhythm, and AF alone increases the risk of ischaemic stroke up to five-fold.[9] Whether silent or symptomatic it is a progressive condition that worsens with time,[4] usually progressing from a paroxysmal to a permanent state.[6] Furthermore, AF is known to be a contributing factor to increase in number of hospitalisations, as well as long-term morbidity and mortality from thromboembolic events.[1] It carries a 1.3–2.8-fold increase in cardiovascular mortality with an annual death rate of about 1.4–4%.[10] The Framingham Heart study estimated that one in four people above the age of 40 will have AF at some point in their lives.[11] The economic burden of treating AF patients, including treatment of related complications, is both costly and complex, often requiring specialist medical care, hospitalisation and interventional procedures.[3] Consequently, taking into account the increasing prevalence, it is likely to impose a substantially increased economic burden on healthcare systems compared with 10 years ago when a similar study was conducted.

In view of this, the primary objective of our study was to evaluate the burden of this disease on secondary

care and the consequent economic impact on the National Health Service (NHS) in Scotland, with a population of 5.2 million.

Materials and methods

A prevalence-based approach was used to estimate the economic burden of AF in Scotland (population 5.2 million), which has a well-described system for recording hospitalisation data. Collection and collation of data on all hospital discharges are done by Scotland's NHS Information and Statistics Division (ISD) using the Scottish Morbidity Record Scheme (SMR). We used the contemporary data obtained to estimate both healthcare resource utilisation and costs. These data were then applied on an age- and sex-specific basis to official mid-year population estimates in Scotland.

Beginning with the year 2004 and up to the year 2008, necessary anonymised data from patient case records was used to code up to the diagnosis of AF at the time of hospital discharge according to the Tenth Revision of the World Health Organisation International Classification of Diseases (ICD-10). The meaning of the term 'discharge' included both live discharges and deaths. Every patient had a unique identifier assigned to him/her, which was done at his/her first hospital visit. These data were then analysed to determine the number of individual patients who contributed to these hospitalisations on an annual basis. To be consistent with the previous study, we only selected patients 55 years and older.[1]

Also, Scotland's hospital data are linked to information held by the General Register Office for Scotland relating to all deaths within the UK. These data permit analysis of trends in hospitalisation on both an 'episode' basis and a 'patient' basis. We analysed data on a patient basis. All data extractions were performed using SPSS for Windows version 16.0 and the data analyses were conducted using MS Excel.

Results

Total episodes of AF hospitalisation

During the study period from 2004 to 2008, a total of 162,449 hospital episodes (inpatient episodes) in Scotland were coded with a primary or a secondary diagnosis of AF. There were 28,613 hospital episodes (20.0 per 1,000 population) in 2004, which increased to 36,204 by 2008 (24.2 per 1,000 population); representing a 26.5% increase over the five-year study period (**table 1**). Throughout this period, cumulatively, men accounted for more hospital episodes than women (120.1/1,000 compared with 99.5/1,000). The number of AF-related hospital episodes increased from 14,284 in 2004 to 18,072 in 2008 in men and from 14,329 in 2004 to 18,132 in women.

Table 1. Burden of atrial fibrillation (AF) in comparison with the total burden of cardiovascular (CV) conditions in Scotland

Year	Hospital inpatient episodes		Hospital treated patients		Hospital discharges*		Inpatient bed days	
	AF patients	CV patients	AF patients	CV patients	AF patients	CV patients	AF patients	CV patients
2004	28,613	147,566	21,907	102,552	41,085	208,602	344,164	1,458,203
2005	30,410	158,959	22,942	109,124	44,573	224,971	364,419	1,508,261
2006	32,551	167,995	24,264	114,540	47,205	235,637	390,256	1,561,310
2007	34,671	173,636	25,472	117,431	51,631	246,630	402,229	1,549,716
2008	36,204	173,704	26,510	117,343	54,686	251,052	394,128	1,515,705

*includes inpatient and outpatient discharges and deaths

There were 147,566 hospitalisations related to cardiovascular conditions in 2004 (103.2 per 1,000 population) increasing to 173,704 (116.3 per 1,000 population) in 2008, which represents a 17.7% increase in five years, in contrast to the 26.5% increase for AF hospitalisation during the same period. Of the total cardiovascular hospitalisations, those related to AF increased from 19.4% in 2004 to 20.8% in 2008, indicating a rising contribution of AF to total cardiovascular hospitalisation as displayed in **table 1**.

When compared with the previous published work by Stewart *et al.* assessing trends in hospitalisations related to AF in Scotland between 1986 and 1996, our study shows that hospitalisations due to AF have shown a six-fold increase from 1986 to 2006.[1] In addition, compared to the 10-year study period from 1986 to 1996,[1] total AF hospitalisations during the current five-year study period have increased to 162,449 from 103,085.

AF population

During the study period from 2004 to 2008, a total of 121,095 AF patients with primary or secondary diagnoses of AF were hospitalised. This included 21,907 (15.3 per 1,000 population) patients in 2004, which increased to 26,510 (17.7 per 1,000 population) in 2008, representing a 21.0% increase in hospital-treated AF patients. The cumulative number of patients hospitalised for their AF was higher among women than men; numbering 11,214 women and 10,693 men in 2004, and increasing to 13,481 and 13,029, respectively, in 2008. However, when standardised for the Scottish population, there were 88 men per 1,000 Scottish men hospitalised for their AF compared with 75 women per 1,000 Scottish women. A similar trend was observed among patients treated for their cardiovascular disease as displayed in **table 1**. Hospital-treated AF patients, as a proportion of cardiovascular patients, increased from 21.4% in 2004 to 22.6% in 2008, suggesting an increased burden of AF among hospital-treated cardiovascular conditions. The number of AF patients requiring hospitalisations increased progressively with age. Throughout the study period, 5,769 (17.7 per 1,000) patients aged 55–59 years were hospitalised compared with 26,583 (264.5 per 1,000) patients in the age group of 85 and above.

AF-related hospital discharges

Total AF-related discharges, which included inpatient and day-case discharges, as well as deaths, increased by 33.1% during the study period from 2004 to 2008 compared with an overall increase of 20.4% in cardiovascular patients, as displayed in **table 1**. The population standardised estimates indicated 28.7 discharges per 1,000 in 2004

increasing to 36.6 discharges per 1,000 in 2008. AF accounted for approximately 19.7% of cardiovascular discharges in 2004, which increased to approximately 21.8% in 2008, suggesting an overall increase in AF-related hospitalisations in Scotland during this period. The five-year cumulative hospital discharges were higher among men (172.8/1,000 population) compared with women (149.6/1,000 population). The total discharges attributable to AF increased steadily with age such that patients aged 55–59 years had 6.8 discharges per 1,000, increasing to 129.5 discharges per 1,000 among patients 85 years and over in 2008. The overall AF-related activity by age of patients in 2008 is displayed in **figure 1**.

Average inpatient stay

The average inpatient stay for AF patients decreased from 2004 to 2008 (**figure 2**), with a similar trend observed for all patients admitted with cardiovascular conditions. Among AF patients, the average inpatient stay progressively increased with age with patients in the age group 85+ years experiencing the longest stay in hospital. Similarly, throughout the study period, women experienced longer hospital stays compared with men.

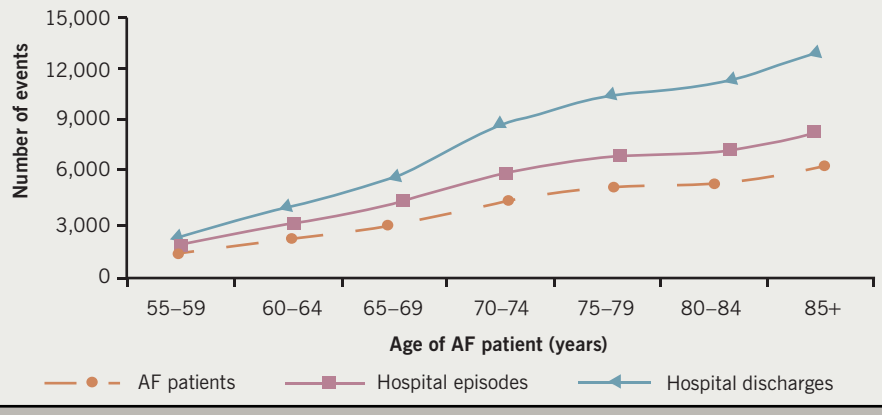
Inpatient bed days

The total number of inpatient bed days for AF patients increased from 344,164 (240.7 per 1,000 population) in 2004 to 394,128 (263.8 per 1,000) in 2008, a 14.5% increase over the study period. The cumulative bed days over the five-year study period were 15.8% higher in women than men (1,351.6 per 1,000 in women compared with 1,166.7 per 1,000 in men). In the same period, the total inpatient bed days for cardiovascular patients increased by 3.9% as displayed in **table 1**. AF-related inpatient bed days, as a proportion of total cardiovascular bed days, increased from 23.6% in 2004 to 26.0% in 2008, further suggesting an increased trend towards AF-related hospital burden. When compared with the study by Stewart and colleagues, the total inpatient bed days in our study in 2006 were 1.6-fold more than in 1996, and 2.4-fold more thawn in 1986 (**figure 3**).

Inpatient cost

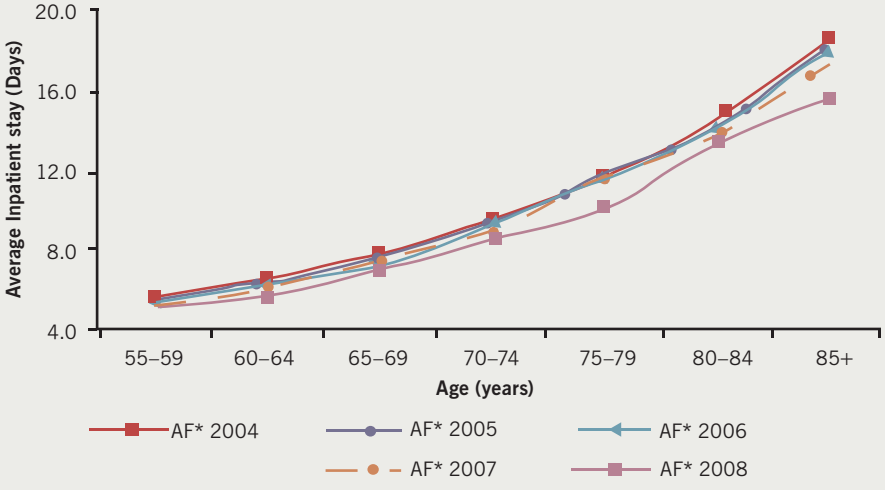
The total cost for cardiovascular inpatients in Scotland increased from £622.9 million in 2004 to £655.5 million in 2008 (**table 2**). The total inpatient cost of AF also increased from £136.4 million in 2004 to £159.3 million in 2008. The inpatient cost per patient, however, decreased for both cardiovascular (£6,074.0 per cardiovascular patient in 2004 to £5,586.2 per cardiovascular patient in 2008) and AF patients (£6,226.3 per AF patient in 2004 to £6,009.0

Figure 1. AF-related hospital activity by age of patient in 2008



*All AF patients

Figure 2. Average inpatient stay for AF (2004–2008)



*All AF patients

Table 2. Total hospital costs of AF compared with CV conditions in Scotland (in million units)

Year	Inpatient costs		Day case costs		Total costs	
	AF patients	CV patients	AF patients	CV patients	AF patients	CV patients
2004	£136.5	£622.9	£2.4	£18.1	£138.9	£641.1
2005	£146.4	£647.9	£2.5	£21.3	£148.9	£669.2
2006	£153.5	£665.8	£2.7	£24.5	£156.3	£690.3
2007	£160.9	£664.6	£3.1	£26.4	£164.0	£691.0
2008	£159.3	£655.5	£3.2	£26.9	£162.5	£682.4

per AF patient in 2008). The average inpatient costs for AF were 16.7% more in women (£6,719.5 per patient) than men (£5,756.4 per patient) over the five-year study period.

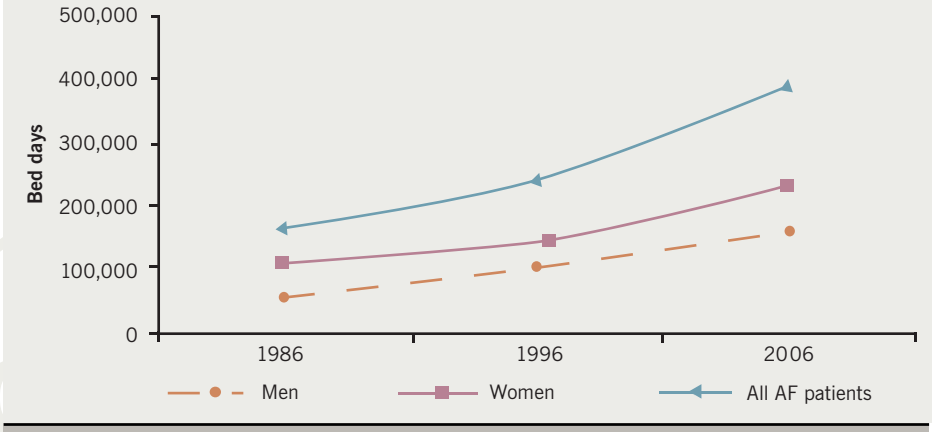
Day-case cost

The total day-case cost for AF patients was £2.4 million in 2004, which increased to £3.2 million by 2008. Although this cost increase was observed for both genders, the increase was higher for men than women. Among all cardiovascular patients, the total day-case cost increased from £18.1 million in 2004 to £26.9 million in 2008. The day-case cost per AF patient, however, decreased from £913.4 in 2004 to £861.2 in 2008. The corresponding costs for cardiovascular patients were £904.5 and £858.9, respectively.

Total AF-related cost (inpatient + day cases)

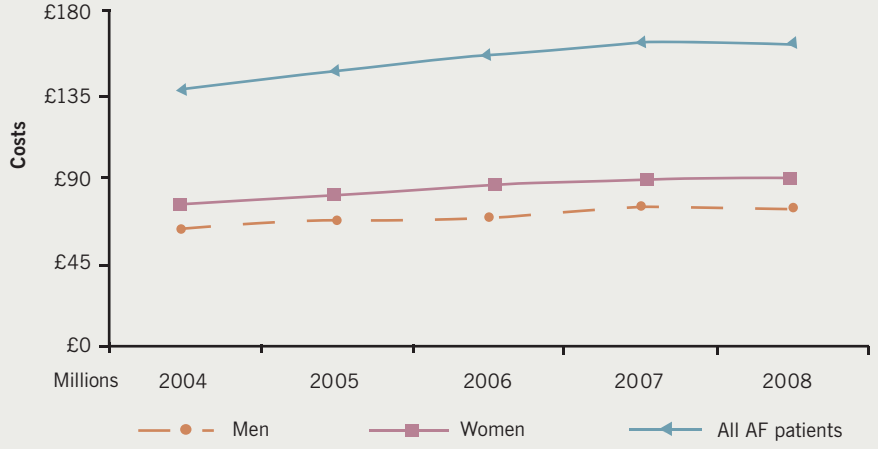
The cumulative hospital costs associated with AF amounted to £770.6 million in the five-year study period and increased from £138.9 million in 2004 to £162.5 million in 2008. During the same period, the total NHS Scotland spend on hospital costs attributable to cardiovascular conditions was £3.4 billion. Total expenditure on AF patients was 21.7% of total cardiovascular expenditure in 2004, which increased to 23.8% in 2008. Throughout the study period, females accounted for higher total costs (54.6% *vs.* 45.4%) than men (**figure 4**).

Figure 3. Trends in AF-related inpatient bed days (1986–2006)



*All AF patients

Figure 4. Total AF-related hospital costs (2004–2008)



*All AF patients

Discussion

Although AF is not considered an acutely life-threatening condition, our study shows that its increasing prevalence and associated morbidity and mortality results in frequent hospitalisations and utilisation of healthcare resources. Our study provides follow-up data from a previous similar study reported more than a decade ago, allowing unique comparisons and study of the increasing economic burden of this condition to the healthcare system in Scotland, with a comparatively stable population of 5.2 million.

In our five-year study period, we found a 33% increase in hospital activity related to AF, amounting to nearly 25% of total cardiovascular hospital costs. Although the actual patient cost per admission has decreased since 2004, this has not offset the increased cost from increased numbers of AF patients and more frequent hospitalisations. Between 1996 and 2006, the number of hospitalisations with AF approximately doubled in both men and women. Average inpatient stay days were highest in the elderly population, in particular patients above 85 years and females, who had three-times longer hospital stays compared with patients younger than 60 years. Women patients accounted for 41% more hospital bed days and 20% higher total costs than men. The age, gender and population standardised estimates suggest that this may be attributable to women living longer than men, thus experiencing AF longer than men. One speculation is that these findings may also reflect that AF presenting in elderly women is more difficult to manage, or that they experience more AF complications, thus requiring more hospitalisations and longer stays. The increase in number of patients hospitalised may also truly indicate a greater prevalence of AF, however it is also possible that improved diagnosis and reduced threshold for hospital admissions are contributing to this trend in Scotland. Our study does not reveal the basis for these trends, and these finding are exploratory.

Our results are in line with Stewart and colleagues earlier study assessing AF hospitalisation trends in Scotland from 1986 to 1996.[1] Our study found that the direct cost of AF to the NHS in Scotland was £770.6 million in the five-year study period from 2004 to 2008, and the cost increased greatly by 17.0% from 2004 to 2008. When we combined our

data with data from Stewart *et al.*, we found that the number of hospitalisations for AF almost doubled in the period between 1996 and 2006, and accounted for 26.0% of total cardiovascular inpatient bed days in 2008. In addition, we found a trend of shorter inpatient length of stay over the years, similar to that reported by Stewart *et al*. The reasons for this are likely to be multi-factorial, including improved access to in-hospital specialist care, development of treatment guidelines and pathways, as well as initiatives for increased primary care patient management. This has led to cost saving as reflected in the trend of reduced overall per patient cost for AF hospitalisation over the study period. Nevertheless, the cost per patient for AF-related hospitalisations still remains greater than for cardiovascular-related admissions. The combined results of our analyses and the Stewart study demonstrate the increasing burden of AF on hospitalisations and consequently healthcare costs. Our study not only shows an overall increase in AF costs in the last three decades, but also demonstrates a broadly linear trend in cost escalation. This information, we hope, will help decision makers plan their healthcare expenditure in the future and focus on cost-saving AF treatments.

Like any other study, our study has several limitations. Our analysis included patients hospitalised with AF as their primary or secondary diagnosis. The available data did not distinguish between these two groups. Therefore, although our results demonstrate an increasing trend towards AF-related hospitalisations and costs, we are unable to quantify the impact of AF as a primary or secondary cause of hospitalisation. The burden in a significant proportion of cases where AF is a secondary diagnosis cannot be solely attributed to AF. Therefore, our analysis may have resulted in an overestimation of the true burden of AF in Scotland. The estimated economic burden only includes the direct tariff costs of hospital treatment in Scotland. Importantly, in this era of increasing intervention for AF, invasive intervention costs were not included, neither were medications, and other indirect costs, as this was beyond the scope of the data available. The results, therefore, may underestimate the true total economic impact of AF in Scotland. We hypothesise that this increasing burden of AF is a result of increasing prevalence of AF in Scotland and the increasing cost of hospital treatment. However, in the absence of any conclusive evidence, we are unable to confirm this. In addition, our data do not include hospital activity in those aged below 55 years, however, the numbers in this age group are comparatively small and would not impact on the final analysis. Although these data derive from the Scottish population, a relatively homogenous white population, nevertheless, it is reflective of secondary care management of AF in a developed western European healthcare system.

Overall, our study demonstrates that there is an increasing trend in the number of patients requiring hospitalisation with AF, associated with a parallel increase in AF-related hospital activities (inpatient and outpatient). Reflective of these trends, the total number and proportion of AF-related bed days compared with cardiovascular bed days has grown enormously, and hospital-related AF costs appear to be increasing relatively faster than those for all cardiovascular conditions. Despite cost savings from decreasing average length of hospital stay and cost per admission, the overall costs continue to increase, placing considerable burden on healthcare resources. Early diagnosis of AF, optimal treatment strategies, including newer therapies and implementation of guidelines for patient-focused management of AF, should be considered in the effort to reduce AF hospitalisations and achieve better outcomes and cost savings ●

Conflict of interest

MK has served as a consultant to Sanofi, UK. YP is employed by Sanofi, UK. A-M C has served as a speaker, a consultant and an advisory board member for Sanofi, UK. This study was funded in full by Sanofi, UK, and the writing of this paper was funded by Sanofi, UK. Writing support was provided by Market Access International, India.

Key messages

- Our study reports the increasing trends of atrial fibrillation (AF)-related hospital activity and costs in Scotland from 2004 to 2008
- AF-related hospital discharges increased by 33%, compared with 20% for all cardiovascular conditions, accounting for £163 million in 2008, and 24% of all cardiovascular hospital costs
- AF-related hospital episodes increased consistently with age; 17.7 per 1,000 patients aged 55–59 years were hospitalised compared with 264.5 per 1,000 patients in the age group of 85 and above
- The total inpatient bed days in our study in 2006 were 1.6-fold more than 1996 and 2.4-fold more than 1986

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