Cost-effectiveness of a community-based screening programme for chronic atrial fibrillation in Japan

Maeda K, Shimbo T, Fukui T

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
An annual electrocardiogram (ECG) community-based screening programme and an annual pulse palpation community-based screening programme for chronic atrial fibrillation (AF) were compared with no screening. Different screening intervals and starting ages (65 or 75 years) were also evaluated.

Type of intervention
Screening.

Economic study type
Cost-utility analysis.

Study population
The target population for the model were 65-year-old males or females residing in Japan, who were followed up to 85 years of age.

Setting
The setting was the community and primary care. The economic study was carried out in Japan.

Dates to which data relate
The studies providing the epidemiological, effectiveness and utilities evidence dated from 1985 to 2000. The resource use data related to 1998 to 2001. The prices used were from 2001.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of completed studies and assumptions.

Modelling
A Markov model was developed, using DATA 3.5 software (TreeAge Software Inc., to compare the quality-adjusted life expectancy and costs of the three strategies. The health states considered in the model were healthy with sinus rhythm, healthy with AF, ischaemic stroke without disability, ischaemic stroke with disability, repeated disabling ischaemic stroke, intracranial haemorrhage (ICH) without disability, ICH with disability, disabling ischaemic stroke and disabling ICH, and death. Residents with AF, which was detected while they were visiting health care facilities for other reasons (case-finding), did not participate in the screening programmes. ECG was assumed to be a ‘gold’ standard of diagnosis for AF. The model was run until the population was 85 years of age.

Outcomes assessed in the review
The model parameters included:

AF prevalence and incidence by age and gender;

the proportion of detected AF by gender and method (case-finding and screening);

the operating characteristics of the screening tests;

the incidence and type of ischaemic stroke and ICH in AF patients without anticoagulation;

the relative risk reduction of ischaemic stroke with anticoagulant therapy; and

the utilities for the different health states.

**Study designs and other criteria for inclusion in the review**

Most of the outcomes were derived from a population-based cohort study. The mortality rate of ischaemic stroke and the proportion of disabling ischaemic stroke were derived from a cost-effectiveness study. The risk reduction in ischaemic stroke with anticoagulation therapy and the incidence of ICH were derived from a meta-analysis of randomised controlled trials of anticoagulants prophylaxis. The sensitivity and specificity of palpation of the pulse for detecting AF were derived from a cross-sectional study. The authors did not report any inclusion criteria.

**Sources searched to identify primary studies**

Not stated.

**Criteria used to ensure the validity of primary studies**

Not stated.

**Methods used to judge relevance and validity, and for extracting data**

Not stated.

**Number of primary studies included**

Eight studies provided the epidemiological, effectiveness and utilities evidence.

**Methods of combining primary studies**

The results of the primary studies were combined in a narrative.

**Investigation of differences between primary studies**

The authors reported that US data for the incidence of AF in individuals aged 65 to 74 years old were judged to be compatible with that of a Japanese cohort study for individuals aged 60 to 69 years old.

**Results of the review**

A selection of the results is outlined here (further details were provided in the paper).

The prevalence of AF at 65 years was 1.8%.

The annual incidence of AF ranged from 0.50% in 65- to 74-year-old women, to 1.75 for 75- to 84-year-old men.

The proportion of detected AF was about 60% by case-finding and about 40% by screening.
The sensitivity of palpatory examination was 97.4% and the specificity was 78.8%.

The annual incidence of ischaemic stroke in AF patients without anticoagulation was 2.45% (25% fatal, 44% disabling).

The annual incidence of ICH in AF patients with anticoagulation was 0.2% (27% fatal, 8% disabling).

The relative risk reduction of ischaemic stroke with anticoagulation was 62%.

The utilities for unhealthy states were 0.39 for ischaemic stroke with disability and 0.11 for repeated disabling stroke.

**Methods used to derive estimates of effectiveness**
The authors also made assumptions to derive the estimates of effectiveness.

**Estimates of effectiveness and key assumptions**
The authors assumed ECG was perfect for detecting AF. Compliance with attendance and prescriptions was assumed to be 100% in the base-case.

The annual rate of gastrointestinal haemorrhage in AF patients receiving anticoagulation was assumed to be 0.3%.

The authors assumed that the utility after ICH with disability was 0.39, and that the utility after disabling ischaemic stroke and disabling ICH was 0.11. The utility was assumed to be 1 for healthy in AF, ischaemic stroke without disability, and ICH without disability.

**Measure of benefits used in the economic analysis**
The measure of benefit used was the number of quality-adjusted life-years (QALYs) gained from adopting each of the strategies examined. The utilities were derived from a study by Gage who examined preferences after stroke using the time trade-off method (see Other Publications of Related Interest). Other reported outcomes included the number of prevented ischaemic strokes per 1,000 residents, and number of increased ICH per 1,000 residents. The health benefits were discounted at an annual rate of 3%.

**Direct costs**
The costs considered included those of the screening methods, office visits after the detection of AF, echocardiography, monitoring of INR levels, warfarin use, and disability care. The quantities and the costs were not reported separately. Owing to the long-term horizon of the study, discounting was appropriately carried out at a rate of 3%. Estimates of the quantities and costs were derived by modelling. The sources ranged from Japanese official publications to expert opinion. The price year was 2001.

**Statistical analysis of costs**
The costs were treated deterministically and no statistical tests were performed.

**Indirect Costs**
Time during which the residents attended the screening programme was estimated by expert opinion and valued at a Japanese salary survey. The quantities and costs were not reported separately. The price year was 2001. Owing to the long-term horizon of the study, discounting was appropriately carried out at a rate of 3%.

**Currency**
US dollars ($).
Sensitivity analysis
Several one-way sensitivity analyses and scenario analyses were performed. The ranges for epidemiological data and costs were varied from half to double the base-case values. The sensitivity and specificity of palpatory examination, compliance, and utilities were varied within clinically significant ranges. Different scenarios, where starting age was changed from 65 to 75 years old and screening intervals were varied from every year to every 5 years, were evaluated.

Estimated benefits used in the economic analysis
The QALYs obtained in men were 11.87 with no screening, 11.88 (5.83 incremental quality-adjusted life-days, QALDs) with annual palpation, and 11.88 (5.86 incremental QALDs) with annual ECG.

The corresponding figures for women were 13.46 QALYs with no screening, 13.47 QALYs (5.35 incremental QALDs) with annual palpation, and 13.47 (5.37 incremental QALDs) with annual ECG.

Compared with no screening, the incremental life-days of the palpation screening strategy ranged from 2.44 in females to 2.65 in males.

Compared with no screening, the incremental life-days of the ECG screening strategy ranged from 2.45 in females to 2.67 in males.

The number of prevented ischaemic strokes per 1,000 residents ranged from 7.90 in females to 8.24 in males. The number of increased ICH per 1,000 residents ranged from 1.057 in females to 1.120 in males.

Cost results
In men, no screening cost $1,329, annual palpation cost $1,451 (incremental cost $120.0), and annual ECG cost $1,455 (incremental cost $125.7).

The corresponding figures for women were $1,210 for no screening, $1,356 for annual palpation (incremental cost $146.1), and $1,361 for annual ECG (incremental cost $150.5).

Synthesis of costs and benefits
Both screening strategies were compared with no screening for each gender. Incremental cost-effectiveness ratios (ICERs) expressed as $ per QALY gained were 7,637 for annual palpation in males (9,968 in females) and 7,830 for annual ECG in males (10,220 in females).

The results were sensitive to the incidence of ischaemic stroke and the anticoagulant prescription rate. The ICER approached $40,000/QALY gained when the incidence was halved or the prescription rate was 30%.

Other sensitive parameters were relative risk reduction of anticoagulants and age of the target population (ICERs increased slightly in 75-year-old population).

Longer screening intervals reduced the base-case ICERS significantly. ECG every 5 years had an ICER of $1,785/QALY gained in comparison with no screening in males, while annual ECG compared with ECG every 2 years had an ICER of $59,860/QALY gained).

Other parameters did not influence the results significantly. Palpation screening, when performed on 1,000 hypothetical residents with a 1% prevalence of AF, would avoid 780 applications of ECG, thus saving $361.

Authors' conclusions
Screening strategies using either annual pulse palpation or annual electrocardiogram (ECG) were a simple and cost-effective way to manage atrial fibrillation (AF) among community residents. The two screening strategies were similar in terms of their effectiveness and costs.
CRD COMMENTARY - Selection of comparators
The authors explicitly justified their choice of the comparators by incorporating a do nothing strategy, justified by international recommendations, and the two most commonly used diagnostic tests for AF into the model, which was probably applicable to most settings.

Validity of estimate of measure of effectiveness
The authors did not state that a systematic review of the literature was performed, nor did they report the review methodology. Nevertheless, the study designs appear to have been adequate for the parameters incorporated in the model, and drug risk reduction and side effects were taken from a meta-analysis. The authors assumed ECG was a perfect test and no sensitivity analysis was conducted around this assumption. Although compliance was also assumed to be 100%, it was analysed in the sensitivity analysis. The sensitivity analysis used reasonable ranges for this parameter and all the other parameters analysed.

Validity of estimate of measure of benefit
The estimation of benefits was modelled. The Markov model used for this purpose was appropriate since it enabled an estimation of the long-term benefits obtained by adopting each of the strategies examined. All the future benefits were discounted at a rate of 3% per annum. The QALYs were derived using utilities from a published study (Gage et al., see Other Publications of Related Interest), which examined preferences after stroke using the time trade-off method. An appropriate sensitivity analysis, using clinically significant ranges, was conducted on this parameter.

Validity of estimate of costs
Categories of costs relevant to the perspective adopted were included in the analysis. However, the omission of fixed costs (i.e. ECG devices) might have resulted in the underestimation of ECG screening strategy costs. The costs and the quantities were not reported separately, thus limiting the extrapolation of the results to other settings. The resources used were modelled using authors’ assumptions and expert’ opinion, but no sensitivity analysis was performed. The unit costs were taken from published sources and a sensitivity analysis was performed. The date to which the prices referred was reported, and this increases the reproducibility of the results. Discounting was appropriately not undertaken, as the costs were incurred during less than one year.

Other issues
ICERs were calculated comparing both screening strategies with no screening. If calculated in the usual way of increasing benefits and costs, ECG strategies would have been much less cost-effective in comparison with pulse palpation. The authors appropriately compared their study results with other economic evaluations of screening programmes currently performed in Japan. The issue of generalisability to other settings was partially addressed in the sensitivity analysis. The authors’ conclusion reflected the scope of the study. The authors reported several limitations of their study. First, the limited availability of AF incidence and anticoagulation effectiveness data in Japan. Second, the simplification of AF natural history dictated by the Markov model. Third, contraindications to anticoagulants, which some patients have, were not considered and nor were patient preferences. Finally, the fixed costs were omitted.

Implications of the study
Both annual ECG screening and annual palpation screening were simple and satisfied conventional cost-effectiveness criteria to prevent ischaemic stroke associated with AF in community residents in Japan. This should be judged in the context that screening programmes to detect AF are not recommended, and only in 2002 did the American Heart Association endorse periodic office-based screening (case-finding). Some modifications in AF screening can be made to reduce the cost, such as nurses rather than physicians performing palpation, or technicians rather than physicians reading the ECG. Also, as the effectiveness is very similar at lower costs, policy makers may prefer lower-intensity screening programmes because of the more favourable cost-effectiveness result. The authors strongly recommended that epidemiological data on the incidence of AF in Japan should be gathered.
Source of funding
None stated.

Bibliographic details

PubMedID
15153326

DOI
10.1258/096914104774061092

Other publications of related interest

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aged, 80 and over; Atrial Fibrillation /diagnosis /epidemiology; Cost-Benefit Analysis; Female; Humans; Japan; Male; Markov Chains; Mass Screening /economics /methods; Quality-Adjusted Life Years; Sensitivity and Specificity; Sex Factors

AccessionNumber
22004001030

Date bibliographic record published
31/07/2005

Date abstract record published
31/07/2005