Models of care for the delivery of secondary fracture prevention after hip fracture: a health service cost, clinical outcomes and cost-effectiveness study within a region of England

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Declared competing interests from authors:

J.Le., A.M.G., J.Li., S.S., S.D., A.D., S.H., A.F., M.G., R.G.H., report no conflict of interest.

D.P.A. has received unrestricted research and educational grants from AMGEN and Bioiberics S.A.

N.A. reports personal fees from Merck, grants and personal fees from Roche, personal fees from Smith and Nephew, personal fees from Q-Med, personal fees from Nicox, personal fees from Flexion, personal fees from Bioiberica, personal fees from Servier.

C.C. has received consultancy, lecture fees and honoraria from AMGEN, GSK, Alliance for Better Bone Health, MSD, Eli Lilly, Pfizer, Novartis, Merck, Servier, Medtronic and Roche.

M.K.J. has received in the last 5 years honoraria for travel expenses, speaker fees and/or advisory committees from Lilly UK, Amgen, Servier, Merck, Medtronic, Internis, Consilient Health and Jarrow Formulas. He also serves on the Scientific Committee of the National Osteoporosis Society and International Osteoporosis Foundation.

A.J. has received consultancy, lecture fees and honoraria from Servier, UK Renal Registry, Oxford Craniofacial Unit, IDIAP Jordi Gol, Freshfields Bruckhaus Deringer, is a member of the Data Safety and Monitoring Board (which involved receipt of fees) from Anthera Pharmaceuticals, INC., and received consortium research grants from ROCHE.

This report should be referenced as follows:

Judge A, Javaid MK, Leal J, Hawley S, Drew S, Prieto-Alhambra D, Cooper C, *et al.* Models of care for the delivery of secondary fracture prevention after hip fracture: a health service cost, clinical outcomes and cost-effectiveness study within a region of England. *Health Serv Deliv Res*

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A final version (which has undergone a rigorous copy-edit and proofreading) will publish as part of a fuller account of the research in a forthcoming issue of the *Health Services and Delivery Research* journal.

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The research reported in this ‘first look’ scientific summary was funded by the HS&DR programme or one of its predecessor programmes (NIHR Service Delivery and Organisation programme, or Health Services Research programme) as project number 11/1023/01. For more information visit http://www.nets.nihr.ac.uk/projects/hsdr/11102301.

The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HS&DR editors have tried to ensure the accuracy of the authors’ work and would like to thank the reviewers for their constructive comments however; they do not accept liability for damages or losses arising from material published in this scientific summary.

This ‘first look’ scientific summary presents independent research funded by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health. If there are verbatim quotations included in this publication the views and opinions expressed by the interviewees are those of the interviewees and do not necessarily reflect those of the authors, those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health.

Scientific summary

Background

Osteoporosis is a common bone disease affecting three million patients in the UK. Of all the types of osteoporotic fracture, hip fractures are the most costly and a major public health problem due to an ageing population. Hip fractures usually occur as a result of a low-impact fall in individuals with underlying bone fragility due to osteoporosis. About 87,000 hip fractures occur annually in the UK, with a cost (including medical and social care) amounting to about £2.3 billion a year.

There are two principal stages of health care following hip fracture: state of the art care to ensure patients achieve optimal recovery and then effective secondary fracture prevention to ensure health is maintained. This second stage is needed as patients are at considerable risk for subsequent falls, osteoporotic fractures and premature death. Mortality during the first year after fracture ranges from 8.4% to 36% and the risk of second hip fracture ranges from 2.3% to 10.6%. Responding to the first fracture presents a golden opportunity to prevent further fractures. The risk of further fracture can be reduced by up to half with bone protection therapy. Effective management for these patients can significantly reduce this risk, which is why professional bodies have produced comprehensive guidance about the management of hip fracture and these recommend two types of complimentary services: 1) orthogeriatric services focusing on achieving optimal recovery, and 2) fracture liaison services (FLS) focusing on secondary fracture prevention.

Orthogeriatric services are designed to provide specialist geriatric care to the frail older trauma patient and are integral to multidisciplinary management following admission both pre-, peri- and post- operatively. The components include rapid optimisation of fitness for surgery, early identification of rehabilitation goals to facilitate return to pre-fracture residence and long-term wellbeing as appropriate and integrating with related services within the secondary care and community including secondary fracture prevention. A number of models of orthogeriatric care exist, including reactive consultations, regular liaison visits, post-operative transfer to the geriatric ward for rehabilitation and joint care on a dedicated orthogeriatric ward.

Fracture prevention services should have four main components: case finding those at risk of further fractures; undertaking an evidence-based osteoporosis assessment; treatment initiation in accordance with guidelines for both bone health and falls risk reduction; and then strategies to monitor and improve adherence to recommended therapies. Since the provision of these services is multi-disciplinary, guidance recommends structuring services around a dedicated coordinator who provides a link between all the multi-disciplinary teams involved in fracture prevention, an approach known as a Fracture Liaison Service. Despite such guidelines being in place, there still exists significant variation in how fracture prevention services are structured between hospitals.

This report describes variation in the delivery of secondary fracture prevention services across hospitals in one region of England and how these have changed over the past decade. It assesses in detail the clinical and cost-effectiveness of these models of care, and describes the views of health professionals on what aspects of the service are most important to them and how to successfully implement a fracture prevention service.

Objectives

1) To characterise the way hospitals in the region have provided models of care for the delivery of secondary fracture prevention services for hip fracture patients over the past decade

2) To identify the reasons why hospitals chose their specific model of service delivery and assess barriers to change

3) To evaluate the impact that changes to the delivery of secondary fracture prevention have had on health outcomes by altering trends in hip re-fracture rates, NHS costs and life expectancy

4) To establish the NHS costs and cost-effectiveness of different hospital models for delivery of secondary fracture prevention

Methods

Objective 1:

A service evaluation was conducted with the use of a questionnaire developed to capture information on changes to service delivery over the past decade. A health professional at each hospital included in the study was identified through a local network of health professionals involved in fracture prevention services. If they were not able to answer all of the questions, they recommended further health professionals to contact.

Objective 2:

One-to-one semi-structured interviews were conducted with a range of healthcare professionals from all 11 hospitals who met the criteria of working in secondary care and with experience and knowledge of secondary fracture prevention after hip fracture. 43 health professionals were recruited. A qualitative researcher conducted face-to-face interviews using a topic guide to inform questions which was based on the four core elements of a fracture prevention service identified above and extended Normalisation Process Theory (NPT). Interviews were audio-recorded, transcribed, anonymised and imported into the qualitative data analysis software NVivo. An abductive analysis was conducted that involved assigning codes to the transcripts using an inductive approach along with codes that reflected the four main constructs of extended NPT. Data was then displayed on charts using the framework approach to data organisation.

Objective 3:

Data were obtained from the Hospital Episode Statistics (HES) database linked to Office for National Statistics (ONS) mortality records on 33,152 patients admitted for a primary hip fracture from 2003 to 2013 at 11 acute hospitals in a region of England. The interventions of interest were dates on which a hospital appointed an orthogeriatrician or setup/increased a FLS. Each hospital was analysed separately and acted as its own control in a before-after time series design. Confounding variables included age, gender, Charlson co-morbidity index, and area deprivation. The outcomes were all cause mortality at 30-days and 1-year and second hip fracture within 2-years. Cox regression modelling was used to describe the association between the intervention and time to death. For the outcome of second hip fracture, a competing risks survival model was used to account for the competing risk of death. Meta-analyses were used to pool estimates on each health outcome under study for similar interventions across hospitals in the region.

Data from the Clinical Practice Research Database (CPRD) linked to ONS mortality records were obtained on 11,243 primary hip fracture cases aged over 50 from 1999 to 2013. Five guidelines were evaluated: NICE clinical guideline 21 (Nov 2004), NICE technological appraisal 87 (Jan 2005), BOA blue book (Sep 2007), NICE technological appraisal 161 (Oct 2008) and Best Practice Tariff for inpatient hip fracture care (Apr 2010). Guidelines were evaluated using an interrupted time series analysis to assess the effect they have had on altering trends in re-fracture rates, life expectancy (30-day and 1-year) and proportion of patients taking bone strengthening drugs within 1-year after fracture. A segmented linear regression model was specified for each outcome.

Objective 4:

For hospital costs, we used HES data and for primary costs we used the clinical practice research datalink (CPRD GOLD). We adopted the same incidence-based approach to identify hip fracture patients in both sets of data and estimate the costs of hip fracture. A Markov model was developed to simulate the costs and health-related quality of life (QoL) associated with the different OG and FLS models of secondary fracture prevention. A cost-effectiveness analysis was performed using outcome measures such as prevention of hip fractures, life expectancy and Quality-Adjusted Life Years (QALYs) gained. The Markov health states reflect the natural history of hip fractures (e.g. primary hip fracture, secondary hip fracture, death) and the impact of the different models of care (e.g. bone protection therapy, discharge method (home or care home)). Transition probabilities were informed by HES and mortality linked data and relate to a particular model of care. Relative effectiveness measures were applied to the transition probabilities to model the impact of the different models of care. NHS resource use associated with the treatment pathway of hip fracture patients was identified and valued using appropriate data sources. QoL data was derived from a literature search. Incremental cost-effectiveness ratios (ICERs) are estimated for the different models of care and depicted on the cost-effectiveness plane. Probabilistic sensitivity analysis is used to propagate parameter uncertainty and capture decision

uncertainty by using cost-effectiveness acceptability curves and reporting credible intervals around the ICERs.

Results

Service evaluation – There was significant variation in the organisation and structure of secondary fracture prevention services, including staffing levels, the type of service model (consultant versus nurse led service), and the processes used to case find, assess for osteoporosis, initiate treatment and monitor adherence.

Qualitative (Implementation) – Dedicated fracture prevention co-ordinators gave multi-disciplinary health professionals capacity to work together and promoted a shared commitment to the service, but communication with GPs was challenging. The intervention was highly workable and easily integrated into practice. Nevertheless, some participants felt successful implementation was undermined by a lack of resources and capacity to administer scans. There were also concerns about understaffing and poor patient access for some demographic groups.

Qualitative (Business case) – Challenges included collecting all relevant data and negotiating compartmentalised budgets. Participants felt financial considerations were the most important factor in funding decisions, while improved quality of care was less influential. Effective strategies included ways of providing support, demonstrating potential cost effectiveness, and improved quality of care.

Natural experiment (Models of care) – One-year mortality rates declined from 33.1 to 26.0% from 2003/4 - 2011/12. In contrast, the proportion of second hip fractures remained stable throughout the study period. The impact of introducing an orthogeriatrician on 30-day and 1-year mortality was hazard ratio (HR)=0.73 (95% CI: 0.65-0.82) and HR=0.81 (95% CI: 0.75-0.87) respectively. 30-day and 1-year mortality were likewise reduced following the introduction or expansion of a FLS: HR 0.80 (95% CI: 0.71-0.91) and HR 0.84 (95% CI: 0.77-0.93) respectively. There was no significant impact on time to secondary hip fracture.

Natural experiment (Guidelines) – Publication of the BOA blue book (Oct 2007) and NICE technological appraisal 161 (Sept 2007) was associated with a reduction in: subsequent hip fracture of -0.95% (95% CI: -1.67 to -0.23); 30-day mortality of -2.81% (95% CI: -3.73 to -1.85). Introduction of the Best Practice Tariff in 2010 saw a reduction in 1-year mortality of -5.56% (95% CI: -7.59 to -3.52). Publication of the NICE clinical guideline 21 (Nov 2004) and the NICE technological appraisal 87 (Jan 2005) saw an increase in the proportion of patients receiving: a bone strengthening drug of 14.5% (95% CI: 11.1-17.8); and prescribed at least one bisphosphonate at 10-14 months of 8.71% (95% CI: 5.04-12.4).

Health economics (costs) - The annual cost in the year of the hip fracture was estimated to be £10,964 (95% CI: £10,797to £11,161) higher compared to the previous year. The primary care costs associated with primary hip fracture were £1,065 (median £660, SD 1798), of which medications and non-pharmaceuticals accounted for £614 (median £248, SD 1586) of the costs and GP contacts accounted for £358 (median £246, SD 409). The total annual

costs associated with all incident hip fractures in the UK amongst those aged 50 (n=79,243) were estimated at £1,215 million.

Health economics (cost-effectiveness) - After combining costs and outcomes in an incremental cost-effectiveness analysis, and at a £30,000 per QALY threshold, the most cost-effective model of care was introducing an orthogeriatrician. The population EVPI over 5 years was estimated to be between £23 million and £73 million at the £30,000 per QALY gained threshold. This suggests that undertaking additional major commissioned research work to further reduce decision uncertainty is likely to be of significant benefit.

Conclusion

The finding in relation to the beneficial effects of OG and FLS models of care on reducing 30-day and 1-year mortality is a very positive one. The health economics analysis shows that these models of care are cost-effective. Evidence of significant temporal associations with a number of national guidelines suggests a positive impact on clinical decision-making and patient outcomes.

We found that in hip fracture patients an FLS was not effective at reducing the risk of second hip fracture. Whilst this was initially a surprising finding, combining the data from both qualitative and quantitative components of the study, helped us to understand the reasons behind the lack of effect. The primary deficiencies in the models of FLS used by hospitals in this region lie in the component of monitoring and adherence to bisphosphonate therapy.

This study is in hip-fracture patients only. The effectiveness of a FLS for non-hip fracture patients remains unanswered. We were only able to look at second hip re-fracture as an outcome, as other non-hip fractures are not captured by the routine data used. So effectiveness of an FLS for hip fracture patients on non-hip fracture outcomes also remains unanswered.

To inform a decision on the value of undertaking further research in order to eliminate the uncertainty surrounding the decision of cost-effectiveness of FLS models of care, the Expected Value of Perfect Information (EVPI) over 5-years was estimated at £20 million at the £30,000 per QALY gained threshold. This suggests that undertaking additional major commissioned research work to further reduce decision uncertainty is likely to be of significant benefit.

Recommendations for research

1. Further research is urgently needed to assess the clinical and cost-effectiveness of FLS models for non-hip fracture patients. This question cannot be answered using the natural experimental design of this study, as the routine data are not available. This question can only be answered through conducting a randomised controlled trial.

2. For hip fracture patients, the clinical and cost-effectiveness of an FLS on non-hip re-fracture outcomes remains unanswered.

3. For the cost-effectiveness analysis, although a great proportion of the data used was derived from healthcare records of patients with hip fracture; we had to obtain health state utility values from a review of the published literature. It was not possible to reliably estimate utility values for non-hip fractures or the additional impact these may have on the quality of life of individuals with a history of hip fracture. To remove uncertainty in the decision model, high quality data on utility values is required.

4. The qualitative study was focused solely on the perspectives of professionals working in secondary care. Further work could explore their experiences of engagement with fracture prevention services and service provision in primary care. This would offer a comprehensive, 'system-wide' perspective that would over arch the division between primary and secondary care.

5. Further qualitative research should explore the experiences of hip fracture patients and their significant others of accessing these services to add a 'patient centred' context to the implementation of these services.

6. The study focused on fracture prevention rather than falls prevention services. We acknowledge these are interrelated and this represents an area of further qualitative and quantitative study.

Word count: 2,395