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Using national hip fracture registries and audit databases to develop an international perspective

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ABSTRACT

Hip fracture is the commonest reason for older people to need emergency anaesthesia and surgery, and leads to prolonged dependence for many of those who survive. People with this injury are usually identified very early in their hospital care, so hip fracture is an ideal marker condition with which to audit the care offered to older people by health services around the world.

We have reviewed the reports of eight national audit programmes, to examine the approach used in each, and highlight differences in case mix, management and outcomes in different countries.

The national audits provide a consistent picture of typical patients – an average age of 80 years, with less than a third being men, and a third of all patients having cognitive impairment – but there was surprising variation in the type of fracture, of operation and of anaesthesia and hospital length of stay in different countries.

These national audits provide a unique opportunity to compare how health care systems of different countries are responding to the same clinical challenge. This review will encourage the development and reporting of a standardised dataset to support international collaboration in healthcare audit.

Introduction

Each year about 2 million people sustain a hip fracture; a global figure that may exceed 6 million by 2050, with the greatest increases anticipated in Asia and Latin America [1]. Mortality in the first few weeks after the fracture is of the order of 10%, and less than half of survivors regain their previous level of function [2]. The outcome of hip fracture is often determined by patients' pre-existing frailty, but recent trends suggest that implementation of national audit programmes can significantly improve outcomes, including mortality [3].

Rikshöft, the Swedish national registry of hip fracture care was set up in 1988 as the first national database championing the care of patients with hip fracture [4]. Its success led to European Commission support for development of the Standardised Audit of Hip Fracture in Europe (SAHFE) as a model [5]. The Fragility Fracture Network (FFN) has extended the SAHFE model; developing a minimum common dataset (MCD) that has been used in a pioneering international collaboration between five European centres – Barcelona, Spain; Celje, Slovenia; Lübeck, Germany; Msida, Malta; Stuttgart, Germany [6].

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Denmark has run a nationwide population-based clinical quality database since 2003 [7]. Reporting is mandatory, with all orthopaedic departments providing data to the Danish Hip Fracture Database (DHFD). The Norwegian Hip Fracture Register developed alongside the Norwegian Arthroplasty Register, and since 2005 its reports have provided a detailed picture of trends in care, particularly in respect of changes in surgical and anaesthetic techniques [8].

The Scottish Hip Fracture Audit (SHFA) produced a series of annual reports between 1993 and 2010. More recently 'snap shot' data collected over a four month period was used in intermittent audit against standards directly relating to a specific hip fracture pathway [9]. However, from 2016 the SHFA will again be collecting and reporting data on all patients, having observed that some aspects of performance deteriorated with the move away from continuous audit.

Around the UK a number of individual hospitals routinely collected data using datasets modelled on that of the Standardised Audit of Hip Fracture in Europe. In 2005 collaboration between the British Orthopaedic Association and the British Geriatrics Society led to a series of innovations, including a joint 'Blue Book' which proposed standards for the care of patients with fragility fracture [10], and the establishment of the National Hip Fracture Database (NHFD) [11].

Since its inauguration in 2007 the NHFD has collected data on half a million people presenting with hip fracture in England, Wales and Northern Ireland. Its model initially focused on annual comparison of practice between participating hospitals, but in the last few years its emphasis has moved from an annual reporting cycle towards a continuous quality improvement programme; reporting live data to support clinical governance and innovation in individual hospitals, on a website open to the public.

The impact of the NHFD [3] has encouraged the development of similar national audits; Ireland have been reporting since 2013 [12], New Zealand and Australia released their first report in 2016 [13], and the year of data collection has just finished in the Netherlands.

New Zealand and Australia's approach of presenting two national reports in a single document allows direct comparison of their patient populations, of their care, and of its outcome. In this paper we extend this to an examination of all eight of these national audits, considering how each has developed from their common origin, and what they might tell us about hip fracture, and about healthcare more generally in these different countries.

Methodology

We present a summary of the results of the most recent annual reports for eight national audits: Sweden [4], Denmark [7], Norway [8], Ireland [12], Australia and New Zealand [13] and the United Kingdom (where Scotland [9] reports separately from England, Wales and Northern Ireland [11]).

Each audit is underpinned by an enormous resource of data. However, information governance makes it difficult to access these directly or to combine them across national borders, so in this paper we have confined our analysis to the data that are publically available, including those not routinely published in English [4,7,8].

We constructed a detailed cross-tabulation of all demographic, casemix, care or outcome data that had been presented in the most recent annual reports from these countries. Annual reports do not repeatedly publish figures that are expected to be stable from year to year, so where necessary we supplemented these recent data with figures from the previous annual reports.

Our cross-tabulation identified 260 different aspects of case-mix, care or outcome that were described in one or more of the national reports. The three tables of this paper are focused on the 50 topics for which directly comparable data were available from at least three of the national reports.

Table 1
Structure and casemix of the eight national audits.

	Sweden	Denmark	Norway	England, Wales, Northern Ireland	Scotland	Ireland	New Zealand	Australia
AUDIT STRUCTURE								
Publication	Nov. 2016	April 2016	June 2016	Sept. 2016	July 2016	Nov. 2016	Sept. 2016	Sept. 2016
Audit period	2015 cases	Dec 2014–Nov 2015	2015 cases	2015 cases	Oct 2015–Jan 2016	2015 discharges	2015 cases	2015 cases
Total number of cases	15,062	6789	8400	64,864	1041	2962	594	2925
Age range (years)	50+	65+	All ages	60+	50+	60+	50+	50+
Hospitals included	52/54	26/26	46/46	177/177	21/21	16/16	4/23	21/99
Cases captured (%)	88	100	93	91	–	81	–	–
Data completeness (%)	100	100	89	(94)	–	96	97	98
CASEMIX								
Female (%)	68	70	70	72	73	70	65	70
Average age (years)	82	83	80	(83)	82	–	82	82
Aged 80–89 years (%)	44	45	–	46	–	42	44	45
Admitted from home (%)	70	73	–	78	75	83	75	71
From care home (%)	26	19	–	19	18	8	24	28
Already an inpatient (%)	4	1	–	4	6	9	–	–
Pre-existing cognitive impairment (%)	21	–	24	37	26	26	27	40
Normal cognition (%) [a]	64	–	68	63	–	74	73	60
ASA grade 1–2 (%) [b]	39	–	37	27	(26)	44	27	18
ASA grade 3 (%)	53	–	54	54	(53)	51	55	58
ASA grade 4–5 (%)	8	–	7	14	(15)	5	17	23
Mobile outdoors, no aids (%)	43	–	–	36	–	48	49	44

(Bracketed figures are derived from the previous annual report, where none were given in the most recent report).
[a] Normal cognition defined by Abbreviated Mental Test (AMT) score >6/10 in IHFD, and >7/10 in NHFD.
[b] ASA = American Society of Anesthesiologists.

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We examine the approaches taken by the different audit programmes, identify common elements, and highlight areas in which differences in methodology might hinder those wishing to use their reports as a basis for international comparisons, or as a stimulus for development of comparable quality improvement initiatives in other hospitals or countries.

Results

Comparison of the eight reports demonstrates obvious parallels, with between 65% and 73% of cases being women (Table 1).

The average age of 80 years reported by the Norwegian audit is perhaps the most meaningful, since this register includes patients of all ages. This figure would be entirely consistent with the average age of 82 years reported by all four audits which were limited to over 50 years olds, and the 83 years which has been described in the audits which only included people over the ages of 60 or 65 years.

Ethnicity has only been reported in the combined audit from Australia and New Zealand

All of the audits reported over half of patients as having 'severe systemic disease'; Grade 3 using the American Society of Anesthesiologists' (ASA) grading of physical status [14]. In Denmark the Charlson Comorbidity Index (CCI) [15] is used instead of ASA. While this complicates direct comparison of casemix between audits, the distribution of CCI scores reported in Denmark (38% of patients score 0, 40% score 1–2, and 22% score 3 or more) is informative for those counties which do not specifically record comorbidities.

Different audits focused on very different approaches to description of pre-fracture mobility, so comparison were not possible beyond noting that the majority of patients were unable to walk outdoors without aid; figures for this varying between 51 and 64% across different audits.

There was a fairly consistent picture in that three quarters (70–83%) of people were admitted from home. The audits from Sweden, Denmark, the UK and Ireland record the proportion of hip fractures that were sustained by hospital inpatients. However, the configuration of hospital services varies considerably between countries and the definition of an inpatient hip fracture also differs between these audits, so figures ranging from 1% to 9% do not necessarily reflect differences in patient safety.

Dementia has a crucial impact on patient care and outcome after hip fracture [11], but the audits all tended to take different approaches to definition of cognitive function. Some simply reporting clinicians' opinion as to whether patients have 'cognitive impairment' or 'normal cognition' at presentation (with 7.6% in an intermediate 'uncertain' category in the Norwegian register). In Denmark dementia is just one element captured within the Charlson Comorbidity Index.

All but one of the national audits report rates of cognitive impairment. Table 1 presents these figures after correction for missing data (which ranged up to 36% of cases in one report). Rates of cognitive impairment ranged from 21 to 40% in different countries.

This might argue that a more objective approach to definition of cognitive impairment should be considered. Adoption of the Abbreviated Mental Test (AMT) score [16] identified 37% of patients as 'cognitively impaired' using a threshold of >7/10 for normal cognition in the NHFD, compared to 26% when a threshold of >6/10 was used in Ireland.

Such figures perhaps provide a sense of proportion for the less formally defined cognitive impairment in other reports. However, the very high incidence of delirium among hip fracture patients [17] limits the usefulness of simple mental test scores. The results of the NHFD's recent introduction of routine screening for post-operative delirium using the 4AT tool [18] are awaited with interest by other counties.

We found considerable variation in the proportions of different fracture types in different countries. The Swedish and Norwegian audit have a more detailed approach to coding fracture type, the 'Other' category in Table 2 including 3% of cases which they code as basocervical fracture, but which other audits include along with inter-trochanteric fractures. In Norway the 'Other' category also includes a further 4% of displaced or undisplaced intracapsular fractures managed by total arthroplasty.

Displaced intracapsular fracture is the commonest coded fracture type, but the proportion of patients with this injury varied from 29% to 49% in different countries.

Precise coding of fracture type is often difficult, and we might anticipate that surgical procedures will be recorded more reliably. With displaced intracapsular fracture as the commonest injury, it is not surprising that hemiarthroplasty was the most common operation. However, there was considerable variation in this with a

Table 2
Surgical and anaesthetic practice.

	Sweden	Denmark	Norway	England, Wales, Northern Ireland	Scotland	Ireland	New Zealand	Australia
FRACTURE TYPE								
Inter-trochanteric (%)	38	37	34	34	(38)	35	43	46
Sub-trochanteric (%)	8	7	5	6	(4)	7	5	8
Displaced intracapsular (%)	39	45	40	49	(36)	37	37	29
Undisplaced intracapsular (%)	12	10	14	10	(17)	11	15	17
Other (%)	3	–	8	0	(5)	1	0	0
Unknown (%)	0	1	0	0	(0)	9	0	0
ANAESTHESIA								
Spinal anaesthesia (%)	95	–	87	41	50	73	41	27
General anaesthesia (%)	5	–	9	50	44	19	56	70
Both, other or unknown (%)	–	–	4	9	6	7	3	3
OPERATION								
Sliding hip screw (%)	22	22	26	29	36	25	22	19
Intramedullary nail (%)	27	31	15	12	7	21	30	36
Internal fixation with screws (%)	17	10	15	–	2	2	13	4
Hemiarthroplasty (%)	25	25	38	–	44	49	26	33
Total arthroplasty (%)	9	10	4	–	6	3	9	8
Cementing of arthroplasties (%)	97	–	79	82	83	70	95	81

(Bracketed figures are derived from the previous annual report, where none were gived in the most recent report).

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25–26% of all cases being treated with hemiarthroplasty in Sweden, Denmark and New Zealand, 33% in Australia, but 38–49% of patients in other countries.

In New Zealand and Australia inter-trochanteric fracture was reported as the commonest injury, and as a result over half of people received intra-medullary nails or sliding hip screws. Similar rates of these procedures were recorded in Sweden and Denmark, where these operations were recorded for significant numbers of patients with intracapsular fracture.

Rates of intra-medullary nailing ranged from 7% in Scotland, to 36% in Australia. Sliding hip screws are used in 19–29% of all cases, except in Scotland where a figure of 36% reflects very limited use of nails. The majority of arthroplasties were recorded as having been cemented, with figures ranging between 70% and 97% in different countries. None of the audits recorded more than 10% of patients as having received total hip arthroplasty.

International variation in practice was also evident for anaesthesia. Rates of spinal anaesthesia ranged enormously – between 27% in Australia and 95% in Sweden. Rates of general anaesthesia varied correspondingly – from 5% to 70%. Up to 9% of cases were classified as 'other' (including patients who received both spinal and general anaesthesia) or 'unknown'.

The audits all recognised the importance of prompt admission to an appropriate bed (Table 3), but different perspectives on this were reported; reflecting different local and national priorities. A political focus on minimising time in the emergency unit or speed of admission does not necessarily translate into patients reaching the most appropriate bed, the Scottish audit reports time to a receiving ward, while audits in the rest of the UK and in Ireland specify time to an orthopaedic ward.

Across all the audits, about 70% of people received their operation by the day following presentation. This is broadly equivalent to surgery within 36 h [19]. The figure for surgery within 48 h ranged from 74%, up to the figure of 95% reported in Sweden.

There was also widespread recognition that the purpose of surgery is to control pain and to permit prompt mobilisation. The audits were broadly consistent in their reporting of successful mobilisation by the first post-operative day – describing rates which ranged from 55% to 90%.

The importance of pressure ulcer prevention was consistently recognised, with some form of surveillance data included in most of the audits, and 2–4% of patients recorded as developing ulcers.

Secondary prevention was commonly addressed, with different audits recording 47% to 72% of patients taking bone protection at point of discharge. Rates of falls assessment were more variable, and less easy to define in a way that permits direct comparison between different national audits.

Each national audit took a different approach in its description of how long patients remained in hospital, and of their final outcome in terms of survival and return home. Variation in these models within individual countries made it impossible to draw comparisons of length of stay across the national audits.

Discussion

The frail, elderly, often cognitively impaired patients who suffer hip fracture used to be viewed as a burden on orthopaedic and hospital services. The development of national registries and audits has changed attitudes, and their national reports describe how care and outcomes have improved.

Use of quality indicators has focused attention on the treatment of these patients, allowing hip fracture to serve as a marker condition for the hospital care of older people generally. High quality process and outcome data allows us to demonstrate the benefit of investment in the multidisciplinary care of these patients, and so encourages such innovation.

This comparison of national audits may be helpful in identifying weaknesses in methodology. For instance the different approaches to definition of pre-existing cognitive impairment make direct comparisons difficult. On the other hand, the figures reported by the NHFD and Ireland using the Abbreviated Mental Test score at different thresholds provide a sense of proportion for the audits in which cognitive impairment is not objectively defined, as does Denmark's reporting of Charlson Comorbidity Index in respect of levels of physiological impairment in the hip fracture population.

A number of the audits use external sources to check and validate the completeness and quality of data. But audit data are often collected by clinical staff as part of patient care so their quality may exceed that of existing administrative systems. Hip

Table 3
Process and outcome of care.

	Sweden	Denmark	Norway	England, Wales, Northern Ireland	Scotland	Ireland	New Zealand	Australia
ACUTE CARE								
Average time in EU (hours)	0	–	–	–	–	–	7	7
Orthopaedic ward <4 h (%)	–	–	–	44	93	10	–	–
Geriatrician review <72 h (%)	–	–	–	88	59	–	–	–
Geriatrician review at any time (%)	–	–	–	–	–	54	76	95
Operation day 0 or day 1 (%)	71	–	–	72	70		–	–
Operation <48 h (%)	95	–	83	–	–	74	80	75
Non-operative mangement (%)	1	–	–	2	2	4	2	4
REHABILITATION								
Mobilised by day 1 post-op. (%)	–	90	–	76	66	73	55	85
Developed a pressure ulcer (%)	–	–	–	3	–	4	2	3
Pressure ulcer 'unknown' (%)	–	–	–	3	–	3	32	3
Discharged on bone protection (%)	–	–	–	(67)	(50)	47	65	72
Received falls assessment (%)	–	84	–	97	88	47	46	76
Mean acute length of stay (days)	8	9	–	16	–	–	10	10
Median acute length of stay (days)	7	8	–	–	11	13	7	7
Mean hospital 'super-spell' (days)	–	–	–	23	32	20	–	–
Known discharged to own home (%)	53	–	–	(43)	34	30	16	13
Died as an inpatient (%)	4	3	–	7	5	5	4	5
30 day mortality (%)	–	10	–	7	(9)	–	–	–

(Bracketed figures are derived from the previous annual report, where none were gived in the most recent report).

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fracture data increasingly serve as a gold standard against which generic processes of performance and outcome monitoring should be checked.

Data quality is crucial, especially in respect of surgical and anaesthetic approach [20]. Classification of hip fractures can be challenging, even if surgeons and radiologists collaborate in multidisciplinary x-ray meetings. An additional level of difficulty arises if audit data is collected by non-surgical staff who have to rely on admission notes made by junior surgeons.

This international review identified huge international variation in anaesthetic and surgical practice.

There are many potential approaches to anaesthesia for hip fracture, with individual patients receiving different combinations of general, regional anaesthesia, nerve blocks and sedation. The Anaesthesia Sprint Audit of Practice [21] showed that non-anaesthetists may struggle to classify these techniques appropriately when entering details into a national audit database. Clarity in recording technique is crucial if anaesthetists are to contribute to, and learn from these national audits.

If audits are to challenge which procedures are performed for different fracture types, as the Norwegian audit does, or to challenge compliance with national guidelines, as the NHFD does in England, Wales and Northern Ireland [22,23], then surgeons must develop and maintain rigorous structures to ensure data quality.

Factors such as individual clinicians' preference, surgeons' remuneration in a fee-for-service setting or implant costs may contribute to the international variation we describe, such as in use of sliding hip screws and nails. Some variability in practice is understandable if the evidence doesn't support one approach over another. However, where the evidence is clearer then variation in approach within countries, or between countries, serves to highlight unwarranted clinical practice which may directly impact on outcome for individual patients [23,24].

Descriptions of patients' progress varied considerably – from the Norwegian focus on acute care and operation to the Scottish audit which maps and challenges a carefully defined clinical pathway. Each country will have different priorities driving the effectiveness and efficiency of care. Approaches to definition of time spent in the emergency unit, or to time waiting for surgery reflect these. As a result direct comparisons are difficult, and perhaps not helpful.

Length of stay (LOS) following hip fracture is also complex. Some audits used median figures as these are more appropriate for description of the skewed distribution of LOS. Others reported mean figures as these are more helpful in modelling bed occupation and resulting costs. The usefulness of either approach will be limited by the enormous range of potential models for rehabilitation in acute and rehabilitation wards, specialist units, community hospitals, care homes and community settings. None of the audits were confident in their ability to capture the whole of a patient's 'super-spell' – the time spent in all hospital and subsequent rehabilitation placements before a patient either returns home or moves to live permanently in a new care setting.

It is not possible to draw useful conclusions from reported differences in rates of patients returning directly to their own home, or of inpatient mortality. Both of these outcome measures will be affected by how long patients remain in the care settings upon which their national audit is focused. This can be avoided if mortality is examined at a fixed time point after hip fracture, but follow-up at 30 or 120 days depends on strict attention to avoidance of missing data, and is so far only reported by three national audits. At present longer term functional outcomes, patient reported outcomes and experience measures are notably absent from these national datasets. Such approaches would be hugely challenging within such large audit programmes, but they have been shown to be viable [25], and will be increasingly important as cost-effectiveness becomes a key driver of resource allocation.

Hip fracture audit is clearly a powerful driver for change, and discussion in every one of these reports identified how the process of auditing care rapidly improved clinical practice. One new audit recorded nearly a third of patients' pressure ulcer status as 'unknown' this year, but experience from other longstanding national audits suggests that this will very rapidly improve in the face of ongoing audit.

Despite their common origin and their basis in a similar minimum core dataset, each of these national audits has developed differently, reflecting different pressures and priorities in each country. To some extent this means that each report highlights different and important aspects of care, so they complement each other; each providing insights that will help the development of others.

However, as the national reports each take a different format it is surprisingly difficult to draw direct comparisons between patient casemix, models of care, markers of quality and outcomes between these countries. The independence with which national models are developing could limit our ability to use them to develop a common language in which to discuss approaches to this patient population, and so compromise the extent to which hip fracture can be used as a marker condition with which to compare the health care systems in different countries.

Conclusions

This paper seeks to encourage cooperation between national hip fracture registries, to improve and coordinate data definition, and maintain their focus on comparability. This has been successful for hip and knee arthroplasty registries in the Nordic Arthroplasty Registry Association, and could facilitate large-scale international hip fracture research, in the form of prospective observational studies or even randomised controlled trials [26].

The pilot phase of the FFN Hip Fracture Audit Database has shown how a shared minimum common dataset supports mutual learning from comparisons between hospitals in different countries [6]. This review is a first step in sharing data at a national level; comparing elements of the FFN minimum common dataset to provide an overview that complements the innovative descriptive and analytical work that each national audit provides. Different national audits may develop different models for feeding their findings back to participating hospitals, but we would suggest that in preparing their annual reports they should attempt to maintain the comparability of their findings.

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