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ORIGINAL ARTICLE

Hospitalisations for fracture and associated costs between 2000 and 2009 in Ireland: a trend analysis

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Abstract
Summary In Ireland, the absolute numbers of hospitalisations for all osteoporotic-type fractures including hip fractures increased between 2000 and 2009 along with the mean length of stay. The cost of hospitalisations for these fractures also increased between 2003 and 2008.
Introduction The purposes of the study were to carry out a trend analyses of the total number of osteoporotic-type fractures in males and females aged 50 years and over in Ireland between 2000 and 2009 and to project the number of osteoporotic-type fractures in the Republic of Ireland expected by 2025.
Methods Age- and gender-specific trends in the absolute numbers and direct age-standardised rates of hospitalisations for all osteoporotic-type fractures in men and women ≥50 years were analysed, along with the associated hospitalisation costs and length of stay using the Hospital In-Patient Enquiry system database. Future projections of absolute numbers of osteoporotic-type fractures in years 2015, 2020 and 2025 were computed based on the 2009 incidence rates applied to the projected populations.
Results Between 2000 and 2009, the absolute numbers of all osteoporotic-type fractures increased by 12 % in females and by 15 % in males while the absolute numbers of hip fractures increased by 7 % in women and by 20 % in men. The age-specific rates for hip fractures decreased in all age groups with the exception of the 55–59-year age group which showed an increase of 4.1 % (p=0.023) within the study period. The associated hospitalisation costs and length of stay increased. Assuming stable age-standardised incidence rates from 2009 over the next 20 years, the number of all types of osteoporotic-type fractures is projected to increase by 79 % and the number of hip fractures is expected to increase by 88 % by 2025.
Conclusions Hospitalisations for osteoporotic-type fractures continued to increase in Ireland. Hip fractures increased by 7 % in women and 20 % in men.

Keywords Bed days · Costs · Fractures · Osteoporosis · Projections · Trends

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Introduction

Osteoporosis is defined as 'a systematic skeletal disease characterised by low bone mineral density and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture' [1]. Hip fractures are regarded as the most severe of the osteoporotic fractures with an associated mortality rate of between 20 and 30 % during the first year after fracture. In general, the lifetime risk of any osteoporotic fracture is very high and is estimated to be between 40 and 50 % in women and 13 and 22 % for men [2]. There are significant variations in the incidence and trends of fragility fractures across the world with more recent studies indicating a possible

reversal of the secular trend of fractures in the USA [3–5], Canada [6, 7], Japan [8], Finland [9], Denmark [10], France [11], Switzerland [12, 13] but not in Austria [14], Spain [15] or Germany [16, 17]. Many of these epidemiological studies have focused on the classical osteoporotic sites (hip, distal forearm, proximal humerus and vertebra). However, it is now well recognised that decreased bone mineral density levels predispose a person's susceptibility to a fracture at several other sites including clavicle, scapula, sternum, rib, pelvis tibia and fibula and other parts of the humerus. While studies have been published on the incidence rates of hip fractures in Ireland [18, 19], there have been no published data on the longitudinal trends of all osteoporotic-type fractures in Ireland over a given time period. This is predominantly due to the fact that only a proportion of patients who sustain a fracture at other sites such as the vertebra and wrist are actually hospitalised; therefore, it is difficult to identify true incidence rates for these fractures. In light of the increasing pressure on health care resources and budgetary constraints, evidence on current and projected incidence of fractures are essential for health policy and planning.

The aims of this study were to conduct a trend analysis of the total number of osteoporotic-type fractures in males and females aged 50 years and over in Ireland between 2000 and 2009 and to project the number of osteoporotic-type fractures in the Republic of Ireland by 2025. In addition, the length of stay (LOS) and cost of hospitalisation associated with admission was examined.

Materials and methods

Source of hospital statistics

The Hospital In-Patient Enquiry system

The Economic and Social Research Institute, in collaboration with the Department of Health and Children, is involved in the collection, processing and analysis of data for the Hospital In-Patient Enquiry system (HIPE) which operates in all acute hospitals nationally. It is the only source of morbidity data available nationally for acute hospital services in Ireland. More than 60 acute-care public hospitals participate in HIPE, reporting on close to one million records annually. Data cover approximately 96 % of all admissions to a hospital. HIPE is a computer-based discharge abstracting system designed to collect demographic, clinical and administrative data on discharges and inhospital deaths from acute general hospitals nationally. The most important aspect of this process is the coding of the diagnoses and procedures performed using the International Classification of Diseases, Ninth Revision (ICD-9-CM) from 2000 to 2004 and the Tenth Revision, Clinical Modification (ICD-10-CM) from 2005 to 2009. Each HIPE discharge record represents details of one admission, and there may be more than one admission for any patient, in any given year. There were no risk factor data available in the database.

By identifying the specific codes for fractures, hospitalisation data on all patients who were admitted to hospital for treatment of all osteoporotic-type fractures between 2000 and 2009 were examined. A list of all fracture types included in the analyses can be found in the "Appendix". Patients who had sustained a fracture as a direct result of severe trauma, such as a road traffic accident, were excluded from the study. Only fractures sustained as a result of minimal trauma (defined as a fall from standing height or less, or a similar degree of injury) were included. The fracture data were extracted from the HIPE database through Health Atlas Ireland (www.healthatlasireland.ie).

Population data and calculation of gender- and age-specific incidence rates

The population projections used were based on the Irish Central Statistics Office (CSO) Regional Population Projections 2011–2026, published December 2008 [20]. The projections by the CSO are based on a number of assumptions concerning mortality, fertility and migration. The more conservative estimate (M2F1—moderate migration, low fertility) was used to identify future projections of absolute numbers of osteoporotic-type fractures in years 2015, 2020 and 2025. Projected figures were computed based on the 2009 incidence rates applied to the projected populations. Stability of individual fracture rates was assumed, based on the majority of past trends being non-significant using regression analyses (data not presented).

Diagnosis-Related Group

Diagnosis-Related Groups (DRGs) are classification systems that group patients according to the consumption of resources required for their treatment and their clinical characteristics. Originally they were developed for inpatients, but they are now also used for ambulatory and long-term care. Physicians are responsible for classifying patients and assigning a DRG to each admission. Early DRGs were developed initially as a tool to administrate costs and to help hospitals and clinics to monitor utilisation and quality of services provided. DRGs are now utilised as the base of a Prospective Payment System that pays a fixed amount for each patient that receives care [21]. The DRG costs for the present study were obtained from an analysis of the Health Atlas Ireland database (www.healthatlasireland.ie). LOS was calculated as the time from arrival to hospital to either discharge from hospital or death in hospital.

Statistical methods

The absolute numbers and direct age-standardised incidences of hospitalisations were calculated by gender and in 5-year age bands in those aged 50 years or over for the different osteoporotic-type fracture groups. Linear regression analysis was used to calculate the yearly percent change in numbers of discharges for males and females and to examine the linear trends. Analysis of LOS data was performed separately for males and females using Poisson regression and patient days as the dependent variable with an offset of number of hospital episodes. The mean hospitalisation costs (2003 to 2008) are presented over time. DRG costs were only available from 2003 to 2008 at the time of the study. The DRG costs were examined by gender per hospital day. Year and fracture site were included as predictor variables in the regression analysis, with year considered as a continuous variable to test for any linear trend. Rate ratios and 95 % confidence intervals are presented. All analyses were performed using SAS v9.1 PROC GENMOD (SAS Institute Inc, USA). Significance at $p<0.05$ is assumed.

Results

Hospitalisations for major osteoporotic-type fractures

Between the years 2000 and 2009, the absolute numbers of all osteoporotic-type fractures in patients aged 50 years or over increased by 12 % in females and by 15 % in males (Table 1). Overall the absolute numbers of hip fractures increased by 7 % in women within the 10-year study period and by 20 % in men. The largest increase in the absolute number of fractures in women was in hospitalisations for vertebral fractures (37 %) and other osteoporotic-type fractures (28 %). In men, the largest increase was in hospitalisations for other osteoporotic-type fractures (27 %), fractures of the tibia and fibula (30 %) and hip fractures (20 %). The numbers of hospitalisations for vertebral and rib fractures decreased by 47 and 11 % respectively in men. The number of hospitalisations for all osteoporotic-type fractures increased by 1.1 % in women per year and by 0.01 % in men (Table 1).

Table 1 Absolute number of hospitalised major osteoporotic fractures in women and men from 2000 to 2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Change 2009 vs 2000 (%)	Change per year (%)
Women												
Hip	2,819	2,882	2,813	2,850	2,876	2,800	2,729	3,039	2,987	3,029	7	0.7
Vertebra	200	268	228	210	242	204	245	246	299	316	37	−0.3
Distal radius	1,639	1,752	1,842	1,698	1,620	1,576	1,596	1,553	1,692	1,798	9	−0.3
Tibia and fibula	272	271	269	265	213	252	256	330	243	274	1	0.3
Ribs	150	116	128	117	129	155	145	149	197	167	10	2.3
Pelvis	359	367	387	376	416	328	398	389	481	421	15	3.7
Clavicle, scapula, sternum, proximal humerus	656	651	626	614	634	618	666	725	803	731	10	2.2
All other osteoporotic-type fractures	946	987	938	1,001	873	1,096	1,159	1,224	1,233	1,309	28	6.7
Total	7,041	7,294	7,231	7,131	7,003	7,029	7,194	7,655	7,935	8,045	12	1.1
Men												
Hip	837	958	848	915	975	936	947	1,081	1,144	1,052	20	3.20
Vertebra	201	232	216	206	231	132	159	155	184	137	−47	−0.03
Distal radius	242	299	296	285	260	177	198	213	219	263	8	−0.04
Tibia and fibula	154	235	187	205	149	187	173	191	176	219	30	0.01
Ribs	276	276	279	282	290	231	192	227	218	249	−11	0.00
Pelvis	125	121	115	130	119	68	117	115	130	133	6	0.03
Clavicle, scapula, sternum, proximal humerus	278	302	304	301	285	245	256	344	309	336	17	0.01
All other osteoporotic-type fractures	502	626	528	612	496	625	590	670	633	686	27	0.05
Total	2,615	3,049	2,773	2,936	2,805	2,601	2,632	2,996	3,013	3,075	15	0.01

[a] Based on assuming a linear trend over time

[b] All other osteoporotic-type fractures (fracture of other part of bony thorax, fracture of bony thorax part unspecified, fracture of scapula, fracture at wrist and hand level, fracture of foot, except ankle, fracture of skull and facial bones, fracture of neck)

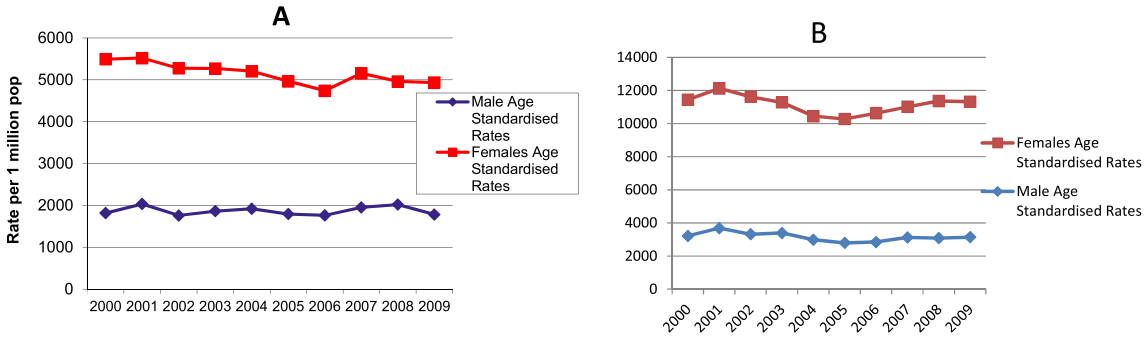

Fig. 1 Age-standardised incidence of hospitalisations in Ireland between 2000 and 2009 for: **a** hip fractures by gender and **b** all other osteoporotic-type fractures by gender

Age-standardised rates

As illustrated in Fig. 1, the age-standardised rates for hip fractures has decreased for all age groups with the exception of the 55–59-year age group which showed an increase of 4.1 % (p=0.023) within the 10-year study period. There was no significant change in the rate of hip fractures in men and a significant decrease of 1.25 % (p=0.003) in women. Similarly there was a decrease in the age-standardised rates for non-hip fractures in all age groups up to 75 years after which there was a slight increase in the age-standardised rates within the study period The change in the overall rates of non-hip fracture admissions was −0.81 % (p=0.136) in women and −2.28 % (p=0.029) in men.

Patient days in hospital and mean length of stay

The number of patient-days per year spent in hospital for all osteoporotic-type fractures in the over 50-year age group increased from 97,753 days in 2000 to 132,786 in 2009 in women (an increase of 36 %) and from 33,131 days in 2000 to 56,380 days in men (an increase of 70 %) (Table 2). The annual percentage change per year was +4 % in women and +7 % in men. The main increase in bed days for women was for fractures of the vertebra (143 %), ribs (89 %) and pelvis (65 %). The main increase in the patient bed days for men was for fractures of the distal radius and ulna (231 %), other osteoporotic-type fractures (168 %) and clavicle, scapula, sternum and proximal humerus (106 %). The mean LOS for hospitalisation of osteoporotic-type fractures increased over the 10-year study period by 17 % in females and 30 % in males. For hip fractures, the LOS increased by 27 % in women and 40 % in men.

Cost of hospitalisations for major osteoporotic fractures

Similarly in line with increases in the absolute numbers of hospitalisations for fractures and increases in number of bed days, the annual DRG costs of hospitalisation increased by 30 % in women and by 31 % in men (Table 3). The increases in DRG costs were evident for all fracture types with the largest percentage increases in hospitalisations due to rib fractures, other osteoporotic-type fractures and vertebral fractures which showed a 146, 111 and 56 % increase in DRG costs, respectively, in women. For men increases in DRG, costs were 152, 41 and 34 % in other osteoporotic-type fractures, hip fractures and vertebral fractures, respectively. The DRG costs of hospitalisations for hip fractures increased by 4 % in women per year and by 8 % in men (Table 3).

The corresponding percentage increase per year for DRG costs of hospitalisation for all osteoporotic-type fractures was 6 % in women and 7 % in men. The mean DRG cost per day for hip fracture admissions in women increased by 8 % from 593.4€ in 2003 to 642.2€ in 2008 but decreased in men by 10 % from 651.5€ to 589.3€. For all other osteoporotic-type fractures, the mean DRG cost per day for women increased by 7 % from 460.5€ to 492.5€ but decreased for men by 4 % from 531.7€ to 512.5€.

The regression analysis found that the trend in LOS was significantly increasing over time in both males and females (p<0.001). Similarly, the analysis of costs per hospital day showed a significant increase over time (p<0.001). The LOS increases year on year by 2.4 %, and the LOS for hip fractures was 1.55 times higher than ‘other fractures’ in both men and women.

Population projections of fractures

Based on current population demographics and the more conservative M1F2 fertility and migration projections described earlier, it is estimated that the population over the age of 50 years will increase from 1,169.9 million in 2008 to 1,432.5 million in 2015 and 1,882.4 million in 2025 an overall increase of 61 % in the over 50 age group by 2025. Assuming stable age-standardised incidence rates from 2009 over the next 20 years, the number of all types of osteoporotic-type fractures is projected to increase by 79 % (Fig. 2), and the number of hip fractures is expected

Table 2 Patient days spent in acute-care hospitals for major osteoporotic fractures in Ireland

Patient days	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Change 2009 vs 2000 (%)	Change per year (%)
Women												
Hip	45,468	47,231	49,150	55,717	54,150	58,019	56,406	59,431	61,238	61,940	36	4
Radius and ulna	9,009	8,803	9,166	9,954	9,954	10,851	8,865	8,598	10,680	10,432	16	1
Vertebra	2,298	4,226	4,054	2,505	2,835	2,856	3,609	3,421	4,077	5,576	143	8
Tibia and fibula	2,995	2,902	3,068	2,415	2,306	3,702	3,218	5,110	3,357	3,854	29	5
Ribs	1,750	1,900	2,084	1,767	1,834	1,888	2,659	2,250	3,552	3,307	89	7
Pelvis	5,457	6,259	6,550	6,957	8,456	6,853	7,709	7,013	10,215	9,031	65	10
Clavicle, scapula, sternum, proximal humerus	7,494	7,986	7,335	8,187	8,699	8,180	9,469	9,182	12,554	11,103	48	6
Other osteoporotic-type fractures	14,599	12,113	10,970	12,621	10,630	16,874	15,486	15,752	17,062	17,551	20	4
Total days women	97,753	100,852	100,551	109,571	106,883	121,224	117,766	121,643	133,519	132,786	36	4
Men												
Hip	14,392	16,581	18,024	16,986	20,478	23,032	21,423	23,990	26,404	25,285	76	9
Radius and ulna	1,020	1,188	1,511	1,706	1,699	1,016	997	1,532	1,787	3,375	231	14
Vertebra	2,288	2,828	2,899	2,296	2,576	1,830	2,629	2,609	3,132	2,177	−5	0
Tibia and fibula	1,314	2,010	1,621	1,680	1,169	2,603	1,616	2,285	2,244	2,294	75	7
Ribs	2,682	2,701	2,995	2,977	3,349	3,222	2,910	3,669	2,839	3,372	26	2
Pelvis	2,736	2,459	1,904	2,489	2,461	1,627	2,847	2,122	2,937	3,278	20	2
Clavicle, scapula, sternum, proximal humerus	2,991	3,504	4,049	3,588	4,080	3,549	3,403	5,794	4,203	6,150	106	8
Other osteoporotic-type fractures	5,708	6,025	5,379	5,533	4,465	8,093	7,787	9,748	8,462	10,449	83	10
Total days men	33,131	37,296	38,382	37,255	40,277	44,972	43,612	51,749	52,008	56,380	70	7

[a] All other osteoporotic-type fractures (fracture of other part of bony thorax, fracture of bony thorax part unspecified, fracture of scapula, fracture at wrist and hand level, fracture of foot, except ankle, fracture of skull and facial bones, fracture of neck)

Table 3 Annual costs of hospitalisation cost (€, millions) for osteoporotic-type fractures in Ireland

Women	2003	2004	2005	2006	2007	2008	Change 2008 vs 2003 (%)	Change per year (%)
Hip	33.1	33.2	31.6	31.8	39.4	39.3	19	4
Radius and ulna	6.4	6.4	6.4	6.7	7.5	8.3	30	6
Vertebra	1.2	1.4	1.0	1.2	1.5	1.8	56	10
Tibia and fibula	1.5	1.3	1.7	1.6	2.1	1.6	6	5
Ribs	0.7	0.8	0.9	1.2	1.2	1.7	146	8
Pelvis	2.6	2.8	2.2	2.7	2.9	3.9	48	27
Clavicle, scapula, sternum, proximal humerus	4.4	4.3	4.2	4.7	5.2	6.5	47	9
Other osteoporotic-type fractures	5.9	5.6	8.8	7.6	9.0	9.3	58	13
Total	55.8	55.8	56.8	57.4	68.9	72.5	30	6
Men								
Hip	11.1	11.8	10.9	11.2	14.0	15.6	41	8
Radius and ulna	1.2	1.2	0.7	0.9	1.1	1.1	−5	−1
Vertebra	1.1	1.5	0.8	1.0	1.3	1.5	34	4
Tibia and fibula	1.2	0.9	1.2	1.1	1.4	1.3	9	5
Ribs	2.1	1.8	1.8	1.6	2.4	2.0	−5	−5
Pelvis	1.0	1.0	0.6	1.0	1.2	1.1	16	1
Clavicle, scapula, sternum, proximal humerus	2.2	2.1	1.5	1.9	3.2	2.5	13	7
Other osteoporotic-type fractures	3.3	2.7	4.6	4.4	6.2	5.2	58	17
Total	23.1	23.1	22.0	23.1	30.7	30.3	31	7

[a] All other osteoporotic-type fractures (fracture of other part of bony thorax, fracture of bony thorax part unspecified, fracture of scapula, fracture at wrist and hand level, fracture of foot, except ankle, fracture of skull and facial bones, fracture of neck)

to increase by 88 % by 2025 with the highest rate of increase in the over 85-year age group where incidence of fractures are projected to increase by 112 %.

Discussion

This is the first population-based study of all osteoporotic-type fracture incidence rates conducted in the Republic of Ireland. The results found a continuous increase in the national fracture trends over the 10-year study period between 2000 and 2009 in both men and women. Our results are similar to the findings of other European countries such as Austria [14], Spain [15] and Germany [16, 17] which showed that there has been and continues to be an increase in the absolute number of hospitalised hip fractures in women and men. Lippuner et al. found that hospitalisations for major osteoporotic-type fractures continued to increase in Switzerland between 2000 and 2007, driven by an increase in the absolute numbers of hospitalisations for non-hip fractures [22]. While Lippuner et al. found a decrease of 1.8 % in the absolute numbers of hospitalisations for hip fractures in women and a 3.3 % increase in men, our study identified a 7 % increase in hip fracture hospitalisations for women in Ireland and a 20 % increase for men.

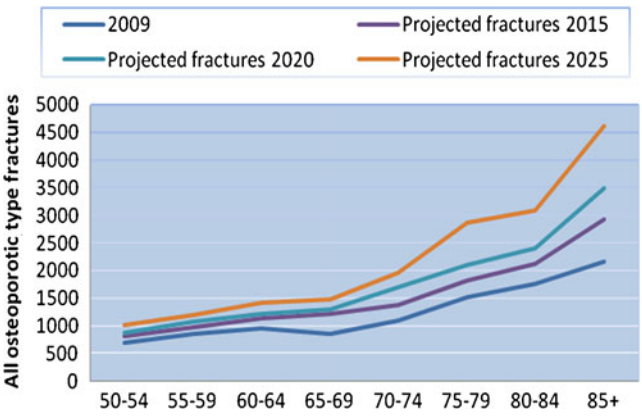

Fig. 2 Projection of future numbers of all osteoporotic-type fractures in Ireland from 2009 to 2025

Overall, however, the results of this study identified a decrease in the age-standardised rate for hip fracture in females with a slight increase in the age-standardised rate for hip fracture in males. Similarly we found a decrease in the age-standardised rates for non-hip fractures in females and males within the same 10-year period. These findings are in keeping with other studies which have suggested that the age-adjusted hip fracture rates may have reached a plateau or may be in fact decreasing [9, 23, 24]. Factors that may be contributing to this levelling of age-standardised rates are possibly increased awareness and screening for osteoporosis, improvements in the pharmacological

management of osteoporosis particularly since 2004 with the increased availability of products which have less frequent dosing regimes and are therefore better tolerated along with a healthier ageing population [25–30]. It was not possible from this study to make inferences about the study cohort and the period effects that may influence the changing epidemiology of in particular hip fractures which were addressed by Langley et al. [31]. Abrahamsen et al. [10] concluded that osteoporosis treatments had been prescribed to too few subjects to account for the decreasing fracture rates identified in their study. An analysis of the national HSE-PCRS scheme database identified that between 2005 and 2009, there were approximately 100,000 people (85,584 females, 15,265 males) prescribed medicines for the treatment of osteoporosis in Ireland [32]. This would account for approximately 33 % of the total number of people estimated to have osteoporosis in Ireland based on WHO figures.

There was an increase in the annual costs of hospitalisation for osteoporotic-type fractures for women and men between 2003 and 2008 in line with the increase in the absolute numbers of fractures. The increase in LOS in our study was again in contrast with Lippuner et al. who identified a reduction in the mean LOS in their trend analyses. The greatest increase in the number of bed days was found in hospitalisations for vertebral fractures in women. This may be explained by the increasing number of vertebroplasties and kyphoplasties that are now being performed in patients with fractures of the vertebral column [33]. The increased length of stay in the 10-year study period was evident in hospitalisations for all fracture types. A study by Nikkel et al. [34] identified that the cost and length of stay for patients admitted for hip fractures are significantly related to days spent awaiting surgery, preoperative sepsis, operative complications and cerebrovascular accidents. In their study, they did not find that age has a statistically significant effect on the cost of hospitalisation. Weight loss and malnutrition comorbidity was found to be a major factor driving increased cost of hospitalisation and increased length of stay due to higher complication rates associated with these patients. More expensive implants was also a factor increasing the costs of hospitalisation.

The total population of Ireland is projected to rise to between a low of 4.57 million and a high of 4.91 million by 2021 [35]. The absolute numbers of older males (i.e. aged 65 years and over) is expected to increase by between 70 and 79 % on existing numbers while the absolute numbers of older females is expected to rise to between 52.3 and 57.6 % of present figures. It is projected that a large proportion of these increases will be in the 'young' older people category (i.e. people aged 65–74 years) Mortality rates are assumed to decrease in Ireland which will result in an increase in life expectancy at birth from 76.7 years in 2005 to 86.5 years in 2041 for Irish males and from 81.5 years in 2005 to 88.2 years in 2041 for Irish females [36]. Therefore, the current trends which show an increase in absolute numbers of both hip and non-hip fractures are very likely to continue. The projected results based on absolute numbers of fractures for 2009 suggest that there will be an increase in the number of hip fractures by 88 % and an increase in the number of all types of fractures of 79 % by 2025. The greatest increase in the numbers of fractures will be in the over 85-year age group where it is projected that the numbers of all types of fractures could increase by 115 %. Our projected figures for hip fractures are similar to the findings of Dodds et al. [19] who based their projections on the average number of absolute hip fractures between 2000 and 2004. Dodds et al. projected that there would be an increase of up to 100 % in the absolute figures for hip fractures by 2026.

Approximately 90 % of fractures in the over 60-year age group can be attributed to osteoporosis, and the risk of future fracture increases 1.5- to 9.5-fold following any type of fragility fracture particularly in the first year after sustaining a fracture [37]. Direct access for general practitioners to DEXA scans to facilitate early diagnosis and treatment of osteoporosis in patients after fracture is imperative. Presently there are a vast number of pharmacological treatments available for the management of osteoporosis, many of which offer a variety of newer and more infrequent dosing regimes which help to reduce the adverse effects of the drugs and improve compliance [37–42]. However, despite the proven efficacy of these products and their availability with different dosing regimes and routes of administration, services to provide the necessary evaluation, treatment and follow-up assessments for patients with osteoporosis remain scarce in Ireland and in most other European countries.

The present study has some limitations. This was a retrospective study; therefore, it is subject to inaccuracies in the dataset. The International Classification of Diseases, Ninth Revision, Clinical Modification was changed to the tenth Revision ICD-10-CM in 2005, and it was not possible to convert ICD-9 data sets directly into ICD-10 data sets or vice versa. ICD-9 has 6,969 codes while there are 12,420 codes in ICD-10 [43]. There is the potential also to duplicate patient numbers because of recurrent admissions as each HIPE discharge record represents details of one admission. Furthermore, the HIPE database accounts for inpatient hospitalisations; therefore, any clinical vertebral fractures or other fractures treated conservatively that did not require hospital admission would not be recorded on the dataset thereby possibly underestimating the absolute numbers for such fractures. We assumed stable age-standardised incidence rates over the next 20 years in making projections of the incidence of all osteoporotic-type fractures to 2025. Obviously it is difficult to predict the future population. Oeppen and Vaupel [44] have demonstrated that experts have predicted that life expectancy is approaching a ceiling, but these experts have been repeatedly proven wrong. Therefore,

our future incidence estimates based on population projections are more likely to be a conservative estimate.

The report by the National Council on Ageing and Older People published in January 2008 highlighted the need for the development of multidisciplinary Integrated Fall and Fracture Prevention Programmes in each of the acute hospitals in Ireland and the importance of including the general practitioners and primary care teams in the overall management of these patients [45]. The report highlighted the fact that services presently available are not provided on a comprehensive population basis. They are not standardised or integrated as part of a national or regional cohesive service and differed greatly in their approach. Outcomes from present services are therefore difficult to measure or determine. A UK-wide audit launched in 2007 to improve the care of patients with hip fracture shows wide variation in standards of care [46]. A similar type of audit for both hip and other fractures in the Irish setting would provide a greater insight into the present care of this patient group and help to prevent the debilitating and costly consequences of the disease. With a rapidly ageing Irish population, the increase in trends in hospitalisations for all types of osteoporotic fractures identified between 2000 and 2009 are projected to almost double over the next 20 years. While many countries have identified a decrease in the secular trend for hip and non-hip fractures, our findings were in contrast with these studies. Therefore, in an already financially constrained healthcare system, it is imperative that adequate cost-effective infrastructures are in place nationally to incorporate a multidisciplinary approach to tackle this costly and largely preventable problem.

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Conflicts of interest None.

Appendix

Table 4 Distribution of the ICD-10 codes used to identify typical and other atypical osteoporotic-type fractures

Fracture type	ICD-10	ICD-9
Typical osteoporotic-type fractures of the hip	S72.0, S72.1, S72.2, S72.9	820
Typical osteoporotic-type fractures of the distal radius and ulna	S52.5, S52.6, S52.7, S52.8	8132, 8134
Typical osteoporotic-type fractures of the tibia and fibula	S82.2, S82.4, S82.5, S82.6	8230,8232, 8234, 8242, 8232
Typical osteoporotic-type fractures of the pelvis	S32.1, S32.4, S32.5	8056, 8066, 8080, 8082
Typical osteoporotic-type fractures of the thoracic and lumbar vertebrae	S22.0, S32.0	8056, 8066, 8080, 8082
Typical osteoporotic-type fractures of the clavicle, scapula, sternum and humerus	S22.2, S42.0, S42.2, S42.3, S42.4, S42.9	8072, 8100, 8120, 8122, 8124, 8110
Typical osteoporotic-type fractures of the ribs	S22.3, S22.4	8070
Other osteoporotic-type fractures of the hip	S72.3, S72.4, S72.7, S72.8	8212
Other osteoporotic-type fractures of the distal radius and ulna	S52.0, S52.2, S52.3	8130
Other osteoporotic-type fractures of the tibia and fibula	S82.8, S82.9	8244, 8246, 8238
Other osteoporotic-type fractures	S22.8, S22.9, S42.1, S62, S92, S02, S12	8140, 8250, 8252, 8000, 8010, 8020, 8022, 8024,8050

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