



Cost of hospitalisation for hip fracture—findings from the Irish hip fracture database

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Abstract

Summary The authors utilised the Irish Hip Fracture Database (IHFD) to quantify the impact of hip fracture on the health service in terms of incidence, bed days and financial costs. The absolute number of hip fracture cases recorded by the IHFD has increased, as has the associated costs of hospitalisation.

Introduction Hip fracture places a considerable clinical and financial burden on the healthcare system, with acute hospitalisation accounting for a substantial proportion of the costs incurred. This paper aimed to quantify the cost of hospitalisation for hip fracture in Ireland in terms of bed days and direct hospital costs.

Methods The authors analysed 23,494 cases in the Irish Hip Fracture Database (IHFD) from 2014 to 2020. Case numbers and length of stay were analysed annually. Hospital costs for hip fracture were described using the 2020 Activity-Based Funding Price List, which outlines the fees paid to public hospitals for inpatient activity.

Results For the time period 2014–2020, the total cost of hospitalisation for hip fracture was approximately €296 million, equating to approximately €11,700 per episode of care. The annual cost of hospitalisation increased from approximately €34 million in 2014 to €44 million in 2020. In 2020, the mean length of stay for hip fracture was 17 days accounting for > 62,600 acute hospital bed days.

Conclusion The absolute number of hip fracture cases recorded by the IHFD has increased, as has the cost of hospitalisation. Given the current capacity issues and economic constraints, there is a growing need to prioritise time spent in the most expensive acute hospital setting to the immediate perioperative period and maximise the use of community services and early supportive discharge for the rehabilitation phase.

Keywords Bed days · Costs · Economic burden · Financial costs · Hip fracture · Length of stay

Introduction

Hip fracture places a considerable burden on society in terms of morbidity, mortality and healthcare utilisation. Ireland has one of the highest age standardised incidence rates of hip fracture in the world at a rate of 406/100,000 for females [1]. In real terms, this equates to > 3,600 cases per annum, with this figure set to increase in parallel with the

aging population [2]. The direct costs associated with the acute management of hip fracture are substantial as surgical fixation and hospitalisation are key components of the care pathway for the majority of hip fracture patients.

The absolute number of all fragility fracture admissions increased by 30% between 2000 and 2014, with hip fracture accounting for a third of all admissions and almost half of all bed days [3]. Previous research has shown that healthcare costs for hip fracture patients are three times higher than age matched counterparts [4]. This has considerable implications for the health service as the total direct and indirect cost of falls and fractures for people aged ≥ 65 years is estimated at €404 million per annum, accounting for 4.2% of all public health expenditure in Ireland [5]. As life expectancy continues to increase, so will the incidence of hip fracture with the associated need for hospitalisation, rehabilitation and community care. Robust data on the impact of hip fracture

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on healthcare utilisation is essential to facilitate efficient health service planning and the delivery of cost-effective patient care.

Aim

To identify the annual cost of inpatient care for hip fracture in Ireland 2014–2020 in terms of bed days and direct hospital costs.

Methods

Data source

The Irish Hip Fracture Database (IHFD) is a clinically led, web-based system where data are collected through the Hospital In-Patient Enquiry (HIPE) system, in association with the Healthcare Pricing Office (HPO). The audit is clinically supported by the Irish Institute of Trauma and Orthopaedic Surgery (IITOS) and the Irish Gerontological Society (IGS). Operational management is provided by the National Office for Clinical Audit (NOCA). The IHFD is a timely and accurate database with 99% coverage in recent years.

The Irish Hip Fracture Standards (IHFS) are the standards against which the Irish healthcare services are benchmarked. The IHFS are in alignment with the Best Practice Tariff (BPT) for hip fractures, which focuses on 8 core parameters: 6 clinical and 2 for data quality and clinical governance. IHFS 7 for early mobilisation is the latest standard to be introduced to the IHFD and will be included in the BPT from 2022.

Data collection & data entry

The IHFD collects data on hip fracture patients through a specific IHFD portal on the HIPE system. The HIPE system is the principal source of demographic, clinical and administrative information on all discharges and deaths from publicly funded acute hospitals in Ireland [6]. All sixteen trauma units in the Republic of Ireland voluntarily submit data on patients that are discharged following hip fracture. Data from patients' medical records are entered retrospectively in each hospital by audit coordinators, with support from the local IHFD clinical lead and NOCA. A specific data entry form is used to record details of an extensive number of variables ranging from the patients' pre-operative functional status to the type of surgery and clinical outcomes. Data are collected for each hip fracture episode from admission to hospital discharge. Eligibility criteria are as follows:

Inclusion criteria:

- (i) Diagnosis on HIPE of either hip fracture due to injury (ICD-10-AM diagnosis codes S72.00 to S72.2) or with a specified type of fracture (e.g. intracapsular displaced, intracapsular undisplaced, intertrochanteric, subtrochanteric or open) other than periprosthetic.
- (ii) Aged 60 years or over.

Data quality & data validation

Data from HIPE are merged with additional IHFD data and an anonymised extract is sent to NOCA from the HPO. The data is assessed within NOCA using internationally agreed dimensions of data quality [7]. Data Validation Reports (DVR) are distributed to each hospital along with quarterly reports. The NOCA data analytics team verify the data with the contributing hospitals and HPO. Data quality is monitored through monthly meetings with the local audit coordinators and regular two-way feedback. Once data is validated, an annual report is produced and sent to the IHFD governance committee for approval. The IHFD data dictionary is available in the most recent IHFD annual report [2].

Patient population

Within the IHFD, patient demographics and case mix have remained largely unchanged over the time period 2014–2020. However, the most notable change in the patient population over the study period is an increase in the degree of frailty and comorbidity of patients, i.e. ASA Grade III (severe systemic disease) admissions increased from 39% in 2013 to 55% in 2020. A full description of the trends in hip fracture care in the Republic of Ireland has been published elsewhere [8]. The majority of Irish hip fracture patients are females aged 80 years or older who sustain a hip fracture from low energy trauma i.e. fall less than 2 m. Home is the most common source of admission (85%). The most common type of surgical repair is cemented hemi-arthroplasty (36%) followed by internal fixation with a short IM nail (18%) [2]. Spinal anaesthesia continues to be the predominant type of anaesthesia, either on its own (55%) or in combination with a nerve block (21%) [2]. Patient demographics, clinical characteristics and care pathway are outlined in Table 1.

Activity-Based Funding

Since 2016, Public hospitals in Ireland are funded using Activity Based Funding (ABF), as opposed to block funding. With this model of funding, hospitals are paid a fixed amount for inpatient and day case activity based on Diagnosis Related Groupings (DRG). Cases that are clinically similar and that are expected to consume a similar amount

Table 1 Patient characteristics and care pathway for Irish hip fracture patients 2020 [2]

Parameter	Percentage
Gender	
Female	67%
Male	33%
Mean age	81
Over 80 years	43%
Admission source	
Home	85%
Nursing home	11%
Acute hospital transfer	4%
Cognitive status on admission	
Normal cognition	69%
Cognitive impairment (AMT < 7)	31%
Pre-fracture mobility	
Low functional ability	53%
High functional ability (NMS > 6)	47%
Previous fragility fracture	
Yes	35%
No	65%
Bone health	
Bone health medication pre-admission	13%
Bone health medication started during admission	59%
Awaiting dual energy x-ray absorptiometry scan	5%
Assessed – no bone protection needed	6%
Not assessed	9%
Awaiting out-patient assessment	8%
Type of trauma	
Low energy	95%
High energy	2%
Unknown	3%
ASA grade	
I or II	37%
III	55%
IV or V	8%
Fracture type	
Intracapsular displaced	40%
Intracapsular undisplaced	8%
Intertrochanteric	37%
Subtrochanteric	6%
Other	9%
Type of anesthetic	
Spinal only	55%
Spinal and nerve block	21%
GA only	13%
GA and nerve block	8%
GA and spinal	3%
Type of surgery	
Arthroplasty hemi cemented	36%
Internal fixation – IM nail short	18%
Internal fixation – IM nail long	14%

Table 1 (continued)

Parameter	Percentage
Internal fixation – dynamic hip screw	12%
Arthroplasty hemi uncemented	12%
Arthroplasty THR cemented	3%
Arthroplasty THR uncemented	2%
Internal fixation screws	1%
Other	2%
Irish Hip Fracture Standards (IHFS)	
IHFS 1 (Admitted to orthopedic ward < 4 h)	33%
IHFS 2 (Surgery within 48 h)	75%
IHFS 3 (Pressure ulcer)	3%
IHFS 4 (Review by Geriatrician)	82%
IHFS 5 (Bone health assessment)	91%
IHFS 6 (Specialist falls assessment)	85%
IHFS 7 (Early mobilisation by Physiotherapist)	78%
Length of stay	
Mean	17 days
Median	11 days
Discharged home directly	28%
In hospital mortality	5%

of resources are grouped into DRG [9]. Each DRG is represented by a number indicating a medical or surgical procedure, plus a code indicating the level of complexity. The price assigned to each DRG is applicable to the entire episode of care from admission to discharge. Outpatient activity and Emergency Department activity is not included. Ireland is currently using version 8.0 of the Australian Refined DRG system.

Analysis

We analysed 23,494 cases in the IHFD from 2014 to 2020. Data were exported from Microsoft Excel into Stata® (version 17) for analysis. Length of stay was measured as the number of calendar days from admission to discharge from hospital. The annual number of bed days in the acute hospital was calculated by multiplying the mean length of stay by the absolute number of hip fracture cases in the given year. Direct hospital costs were calculated using the 2020 ABF Price List from the HPO. Eight DRG codes were used for hip fracture patients: I03 A/B, I08 A/B, I78 A/B and W02 A/B. The 2020 list price for each specific procedure was multiplied by the number of episodes recorded by the IHFD. A small proportion of cases were coded as ‘other’. In these cases, the case weighted average price of the eight procedure codes used for hip fracture patients was applied. Logistic regression analysis was conducted to investigate the association between ASA Grade and length of stay.

Results

Hip fracture incidence

Since 2014, there has been a 36% increase in the absolute number of hip fractures with data recorded by the IHFD (Fig. 1). However, this is in the context of data completeness in the IHFD increasing from 84% in 2014 to 95% in 2017 and > 99% thereafter. A slight reduction in incidence was seen in 2020 during the COVID 19 pandemic.

Although the absolute number of hip fracture cases has increased in recent years, incidence rates have declined both in Ireland and globally. The age standardised rates for the susceptible population in Ireland have declined over the last decade from 538 to 423 per 100, 000 for females and from 285 to 225 per 100,000 for males [10]. The reasons for this are not fully understood.

Length of stay—international trends

There is considerable variation from country to country in terms of length of stay in an acute hospital following hip fracture. This is most likely due to different patient demographics, case mix, care pathways and healthcare systems. For instance, the mean (median) length of stay in Spain is 11 (9) days, UK 16 (12) days, Australia 9 (8) days and a mean of 8 days for both Sweden and Denmark (Fig. 2) [11]. The USA (Kaiser Permanente) has the shortest reported mean length of stay of 5 days. In contrast, Ireland has a longer mean length of stay of 20 (13) days. However, Germany reports the longest median length of stay at 16 days. As not all of the hip fracture registries report both the mean and median values, mean length of stay only is depicted in Fig. 2.

Length of stay—national trends

There was little fluctuation in length of stay during the time period 2014–2019 (Fig. 3). However, a notable decline was

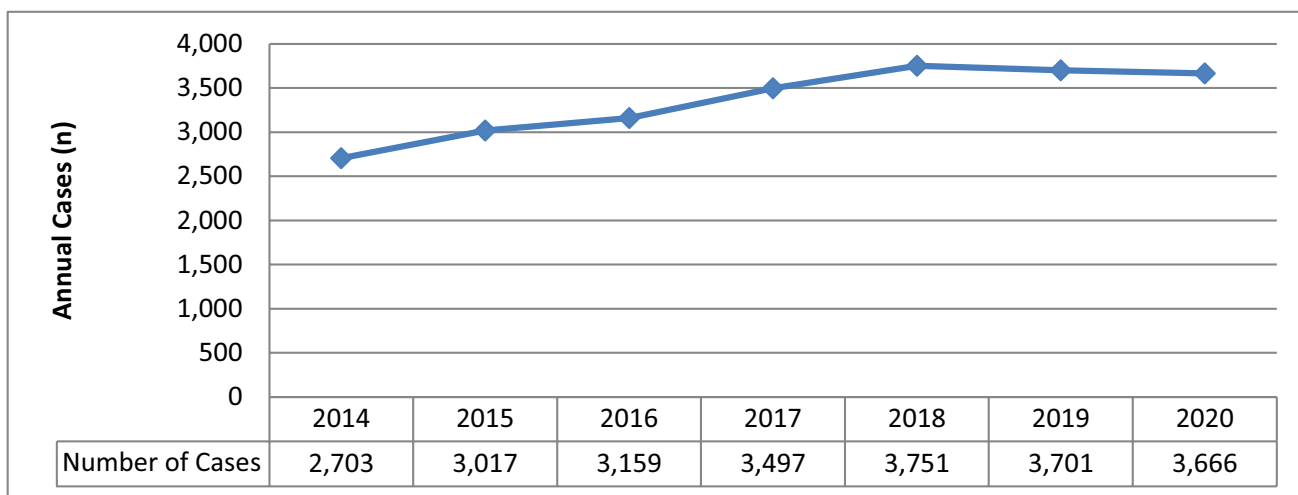


Fig. 1 Hip fracture cases in Ireland 2014–2020

Fig. 2 International overview of mean length of stay (days) 2019 [9]

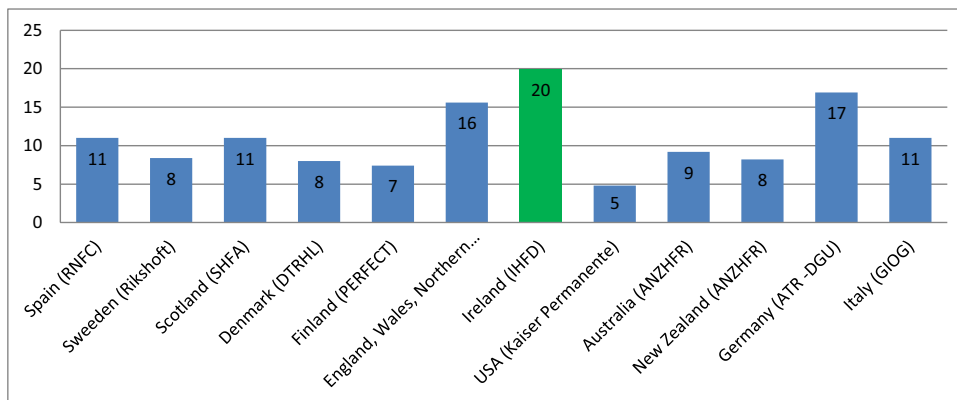
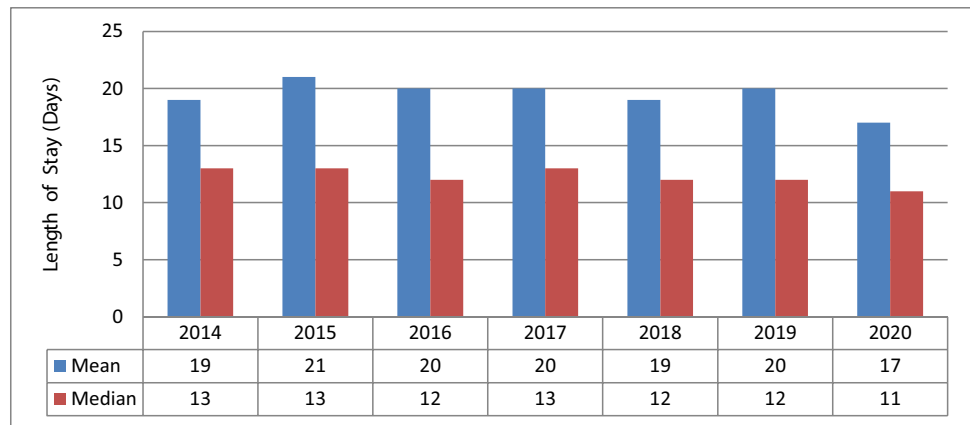


Fig. 3 National trends in length of stay 2014–2020



seen in 2020 with a reduction in the mean (median) length of stay from 20 (12) days in 2019 to 17 (11) days in 2020, which equated to a saving of ~ 10,000 bed days. This substantial reduction is attributed to new internal patient pathways and greater communication between the acute hospitals and the community sector during the COVID 19 pandemic. More specifically, there was an increase in the number of internal rehabilitation beds, greater involvement with community intervention teams and early supported discharge teams, as well as an increase in transfers to off-site facilities such as private hospitals and stand-alone orthopaedic hospitals [12]. This collaborative effort resulted in a shorter length of stay and a greater proportion of patients discharged home directly.

Within the IHFD, patients with higher ASA Grades had longer lengths of stay. Logistic regression analysis showed that patients with severe systemic disease (ASA Grade 3) were 3 times more likely to stay longer than the mean length of stay in hospital (OR 3.01, 95% CI 2.39–3.78, $p < 0.001$) (Supplementary Table 1). Similarly, those with ASA Grade 4 disease were 4.5 times more likely to stay longer than the mean length of stay (OR 4.57, 95% CI 3.56–5.86, $p < 0.001$).

This is important as length of stay impacts on bed days and overall cost of hospitalisation.

Bed days

Hip fracture places a considerable burden on the acute hospital sector. In 2020 alone, the mean length of stay for hip fracture was 17 days accounting for > 62,600 bed days (Fig. 4).

Direct costs of inpatient care

The direct hospital costs of hip fracture care are tabulated using the 2020 ABF Price List from the HPO, which outlines the fee paid to public hospitals for inpatient activity (Table 2). Hip replacement of minor complexity was the most common procedure code used for hip fracture patients. For the time period 2014–2020, hospitalisation for hip fracture cost the Irish health service approximately €296 million, which equates to a cost of approximately €11,700 per episode of care. The cost of hospitalisation increased over the study period from approximately €34 million in 2014 to

Fig. 4 Acute hospital bed days for hip fracture 2014–2020

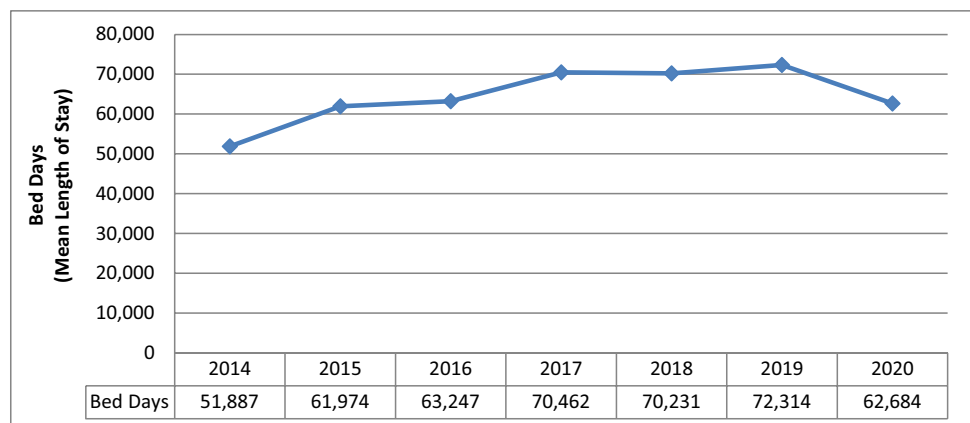


Table 2 Activity-Based Funding by discharge year 2014–2020

DRG	Description	Price*	2014	2015	2016	2017	2018	2019	2020	Total
			No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost
I03 A	Hip Replacement, Major Complexity	€19,680	262/€5,156,160	359/€7,065,120	390/€7,675,200	280/€5,510,400	244/€4,801,920	251/€4,939,680	229/€4,506,720	2015/€39,655,200
I03 B	Hip Replacement, Minor Complexity	€10,967	967/€10,605,089	1053/€11,548,251	1066/€11,690,822	1315/€14,421,605	1503/€16,483,401	1482/€16,253,094	1420/€15,573,140	8806/€96,575,402
I08 A	Other Hip & Femur Procedure, Major Complexity	€21,703	304/€6,597,712	330/€7,161,990	393/€8,529,279	272/€5,903,216	284/€6,163,652	295/€6,402,385	299/€6,489,197	2177/€47,247,431
I08 B	Other Hip & Femur Procedure, Minor Complexity	€10,337	974/€10,068,238	997/€10,305,989	1031/€10,657,447	1250/€12,921,250	1307/€13,510,459	1245/€12,869,565	1323/€13,675,851	8127/€84,008,799
178 A	Fracture Neck of Femur, Major Complexity	€8,905	48/€427,440	49/€436,345	47/€418,535	47/€418,535	43/€439,915	39/€347,295	45/€400,725	318/€2,831,790
178 B	Fracture Neck of Femur, Minor Complexity	€4,148	50/€207,400	63/€261,324	57/€236,436	70/€290,360	106/€439,688	76/€315,248	90/€373,320	512/€2,123,776
W02 A	Hip, Femur & Lower Limb Procedure for MT, Major Complexity	€46,539	13/€605,007	25/€1,163,475	27/€1,256,553	8/€372,312	3/€139,617	8/€418,851	5/€232,695	90/€4,188,510
W02 B	Hip, Femur & Lower Limb Procedure for MT, Minor Complexity	€21,708	11/€238,788	16/€347,328	12/€260,496	55/€1,193,940	62/€1,345,896	61/€1,324,188	48/€1,041,984	265/€5,752,620
X	Other		74/€867,280	74/€867,280	125/€1,465,000	136/€1,593,920	199/€2,344,000	199/€2,847,960	207/€2,426,040	3072/€13,876,480

Table 2 (continued)

DRG	Description	Price*	2014	2015	2016	2017	2018	2019	2020	Total
			No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost	No of Episodes/Cost
			2703/€34,773,114	55/€39,754,822	3159/€42,318,688	3497/€43,375,618	3751/€45,599,828	3701/€45,718,266	3666/€44,719,672	25,382/€296,263,008
Total										

*Price as per 2020 Activity-Based Funding Price list

€44 million in 2020. This 28% increase in costs over a 6 year period is substantial.

Discussion

Hip fracture places a considerable clinical and financial burden on the healthcare system, with acute hospitalisation accounting for a substantial proportion of the costs incurred. Since 2014, there has been a 36% increase in the absolute number of hip fractures recorded by the IHFD. The cost of hospitalisation for hip fracture 2014–2020 was approximately €296 million, equating to approximately €11,700 per episode of care. This finding is in keeping with previous research showing an average cost of €12,687 per admission in Ireland [6]. Similarly, in Italy, the cost of acute hospitalisation for hip fracture is €10,079 [13]. In the UK, hospitalisation costs associated with admission for primary hip fracture are approximately £8,663 [14]. In a systematic review and meta-analysis of over 100 studies looking at the cost of fragility fractures globally, *Williamson et al.* showed a pooled estimated cost of \$10,075 for the index hospital admission [15].

Although, the costs of hospitalisation are similar from country to country, the staggering costs involved in hip fracture care provides a stark incentive to look at more sustainable ways of delivering healthcare at the lowest level of complexity once the patient is medically fit for discharge. Recently, *Ferris et al.* highlighted how not only is Discharging Directly Home (DDH) integral to the quality of life of patients; it is also a key driver of the socioeconomic cost of hip fracture. In terms of the modifiable factors, patients who are mobilised early post operatively are 24% more likely to be DDH (OR 1.24, $p < 0.01$, 95% CI 1.06–1.45) [16]. Conversely, patients who experience surgical delay are less likely to be DDH (OR 0.70, $p < 0.01$, 95% CI 0.56–0.88).

Timely surgery can impact length of stay and reduce the cost of admission. *Castelli et al.* analysed data from > 60,000 hip fracture patients across 152 hospitals in the UK and showed that costs are lower for those who received surgery on the same day of admission and discharged to their own home [17]. Currently, only 75% of Irish hip fracture patients are operated on within 48 h of admission [2]. This is in contrast to countries such as Germany and Sweden where 72% and 66% of patients respectively are operated on within 24 h of admission [18]. An Orthogeriatric model of care has also been shown to reduce time to surgery, improve the overall quality of care and enhance patient outcomes [19].

In Ireland, the IHFS are the quality standards against which services are benchmarked. The IHFS encompass process measures that improve patient outcomes, i.e. prompt admission to an orthopaedic ward, timely surgery and early post-operative mobilisation [20]. Hospitals that

adhere to the IHFS are rewarded with a Best Practice Tariff, which is a financial incentive for providing high quality patient care. A payment of €1000 is paid to the hospital for each case that meets the IHFS. 70% of this payment goes to the trauma service and 30% to hospital management. Since its introduction in 2018, the number of hospitals qualifying for the BPT has increased year on year. Financial payments of €278,000 were made in 2018, which increased to €548,000 in 2019 and to €710,000 in 2020 [2]. The IHFS and BFT serve to improve patient outcomes by optimising the care pathway, reducing the length of stay in the higher acuity hospital setting and enabling patients to return to independent living following hip fracture. Further analysis of the impact of the BPT on costs and bed days will be conducted when more years of data are available.

Length of stay is often used as a surrogate marker of the efficiency of a service. In recent years length of stay has remained relatively stable at a mean (median) of 20 (17) days despite an increase in the degree of frailty of the patient cohort. An improvement was seen in 2020 during the COVID pandemic when there was greater emphasis on early supported discharge and more effective communication between the various teams involved in the care of hip fracture patients. Given that hip fracture accounts for > 62,600 bed days per year at considerable cost to the health service, there is a strong economic incentive to identify cost effective approaches to the management of hip fracture [21]. It is important to note that in addition to differences in the patient population and clinical practice, some of the variation in length of stay internationally may be due to differences in the place of residence pre-fracture. *Ireland et al.* showed that hip fracture patients admitted from residential care have widely different lengths of stay compared to those admitted from the community, with delays in transfer to a rehabilitation facility being the major obstacle [22]. *Salonga-Reyes et al.* also highlighted how the lack of available supported care beds, residential care beds and difficulties in obtaining funding for home care packages compounds the issue of delayed discharge from an acute hospital [23].

Finally, but perhaps most importantly, hip fracture is preventable. Given that the majority of hip fractures occur as a result of a low impact fall in the home, it is imperative that we support older adults to stay safe in their own environment. During the COVID 19 pandemic, many people were spending more time in their homes, which prompted NOCA to devise some practical tips for older adults on how to stay safe at home (Supplementary Fig. 1). Promoting bone health through education on the importance of diet and exercise, as well as early identification and treatment of osteoporosis are key to improving the health outcomes of those at risk of sustaining a fragility fracture.

Limitations

This paper utilises a large national database of older adults to describe the impact of hip fracture on the acute hospital system and associated financial costs. Although the IHFD was established in 2012, data completeness in the earlier years was sub-optimal, therefore the authors analysed the database from 2014 to 2020.

Data pertaining to diagnoses and procedures is coded directly from patients' hospital records by trained HIPE coders. The accuracy of the HIPE system is dependent on the accuracy of the discharge summary, which is completed by a member of the medical team at time of discharge. Although the HIPE system is open to human error, it is the only record of acute hospital admissions in Ireland.

Direct hospital costs for hip fracture were calculated using the ABF Price List from the HPO, which assigns a fixed value to the episode of care from admission to discharge based on DRG. ED attendance and outpatient visits are not included in the DRG system, therefore the costs outlined in this paper do not capture the full patient journey. In addition, costs are not calculated separately for specific individual comorbidities, as this information is not captured by the IHFD. ASA grade is used as an indication of the burden of systemic disease. In the absence of a Unique Health Identifier, it is not possible to take other costs such as ambulance transportation or rehabilitation into consideration.

Conclusion

This paper utilised the IHFD to quantify the impact of hip fracture on the Irish health service in terms of bed days and direct hospital costs. The absolute number of registered hip fracture cases has increased and places a considerable burden on the acute hospital system at a substantial financial cost. There is a strong economic incentive to identify cost effective approaches to the management of hip fracture at the lowest level of complexity such as early supported discharge and discharge directly home when medically fit. This will require strategies at a national and regional level to improve access to lower acuity healthcare settings and multi-disciplinary care in the community.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00198-021-06294-7>.

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Author contribution HF conceptualised and designed the paper, LB provided the data, JS performed the analysis. All authors drafted the manuscript, provided feedback and approved the final draft.

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Data availability Data from the Irish Hip Fracture Database can be requested from the National Office of Clinical Audit, Ireland.

Declarations

Ethics approval Ethical approval was received from the Royal College of Surgeons in Ireland Research Ethics Committee (REC202001017).

Conflict of interest None.

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