



How accurate is the data provided to the Irish hip fracture database?

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Abstract

National databases, such as the Irish Hip Fracture Database (IHFD), are known to contain inaccuracies. The coordination of services, national funding and future research rely on the integrity of the IHFD so as to avoid policy and budget planning being based on misrepresentative data. An audit was performed to assess the accuracy of the 2016 IHFD data collected in our trauma unit. The Hospital In-Patient Enquiry (HIPE)-recorded fracture classification, IHFD-recorded fracture classification and IHFD-recorded operation performed for each hip fracture patient was identified. Each variable was compared with the classifications and procedures derived by the authors. Two hundred fifty-two cases were identified. The HIPE-recorded fracture classification was accurate in 29% of cases, and the IHFD-recorded fracture classification in 61% ($p < 0.001$). The IHFD-recorded operation performed was accurate in 76% of cases. Thirty-six cases (14%) were omitted by HIPE, and eight (3%) from the local IHFD ($p < 0.001$). Errors resulted from poor documentation, in determining the presence of fracture displacement, prosthesis coating and intramedullary nail length. Diagnoses and procedures were identified from ward and theatre logbooks that the data coordinator was unable to record. The data coordinator in our unit doubled the accuracy of the data, and reduced the rate of omitted cases by a factor of 4.5. Accuracy levels would be significantly improved with clear, thorough documentation by the medical team following education of junior surgical trainees on hip fracture classification and procedural coding. Inaccurate data has a negative effect on hospital reimbursement and compromises the integrity of the IHFD.

Keywords Hip fracture · Irish Hip Fracture Database · National Database · Documentation · Accuracy · Audit

Introduction

The Irish Hip Fracture Database (IHFD) is a clinically led, web-based national audit, which measures the care and outcomes of patients with hip fractures. It is a collaborative venture, supported by the Irish Gerontological Society (IGS) and the Irish Institute of Trauma and Orthopaedic Surgery (IITOS), whilst the National Office of Clinical Audit (NOCA) provides operational governance [1]. The Model of Care for Trauma and Orthopaedic Surgery declared the IHFD an integral part of

driving clinical and organisational improvements in the quality and effectiveness of the care that is provided to hip fracture patients on a national basis [2, 3]. Since its creation in 2012, the IHFD has contributed to improved patient care, by benchmarking units against the six standards of care set out by the British Orthopaedic Association and British Geriatric Society, in the “Blue Book” [2, 4].

In Ireland, there are approximately 3500 people with hip fractures managed on an annual basis [2], and these injuries make up 79% of the total cost of managing all fragility fractures. Fall-related injuries cost the economy over €500 million. This cost is estimated to rise to over €900 million by the year 2020, and to over €1500 million by 2030 [5]. The IHFD records 90% of all hip fractures in Ireland, with 2962 featured in the 2015 dataset [2]. The numbers of all fragility fractures are expected to rise by 79% in the next 20 years and the numbers of hip fractures are expected to raise by over 85%, to over 5500 per annum, by 2025 [6]. The IHFD will become increasingly important as a source of epidemiological data to understand the magnitude of hip fractures in Ireland and to monitor subtle differences in outcome that require a large

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sample size in order to be quantified accurately [7, 8]. The coordination of services, as well as national funding and future research, will rely on the integrity of the database [9]. National databases continue to contain inaccuracies, however, resulting in policy and budget planning being based on misrepresentative data [8–10].

In this study, the accuracy of the data collected on all hip fractures in a tertiary trauma and orthopaedic surgery unit was audited prior to submission to the IHFD. The aim was to validate the dataset and identify the sources of error.

Methods

An audit was performed of the 2016 data prior to submission to the IHFD from our trauma unit. Data for the IHFD is collected by individual data coordinators in all contributing hospitals nationwide, through the Hospital In-Patient Enquiry (HIPE) portal in collaboration with the Healthcare Pricing Office (HPO). HIPE is a discharge based data collection system, so data points were collected on a discharge basis. The IHFD for 2016 included all patients that were discharged from 1st January 2016 to 31st December 2016 inclusive, diagnosed with a hip fracture due to injury diagnosis on HIPE, aged 60 years or older and from hospitals contributing data with at least 25 such cases per year [2].

Within the trauma unit, the local IHFD coordinator collected data from the theatre and ward lists on a daily basis. Each patient had their hip fracture and surgery categorised by the IHFD coordinator after reviewing the medical notes and imaging performed. The categories available to the IHFD coordinator were derived from the HIPE Portal Data entry / Hip Fracture Admission (V4.0.2*) as used by the IHFD and referenced in each annual report [11]. The authors scrutinised the HIPE portal, the theatre logbook and the ward admission book to identify any patients who sustained hip fractures that may not have been captured in the local database. All hip fractures and operations performed were classified via preoperative and postoperative plain film radiographs by the authors in line with the HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*). Cases where the HIPE Portal was unable to code for a specific fracture type were highlighted and brought to the attention of the local HIPE Project Manager. In cases where the fracture classification or operation performed did not align with the IHFD classification categories, a new category was proposed to the National IHFD Audit Coordinator for inclusion in future reports.

The HIPE-recorded fracture classification, IHFD-recorded fracture classification and IHFD-recorded operation performed were compared with the classifications derived and procedures recorded as identified by the authors, and the accuracy of each variable was analysed. The data was categorised as “correct”, “minor error”, “incorrect”, or

“severe error”. A minor error pertained only to the HIPE-recorded hip fracture classification. Such an error was recorded when a hip fracture was coded within the correct classification category, but the specific sub-classification was incorrect whilst still being correct as per the HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*). An example of this was a HIPE code of “S7204 Fracture of midcervical section of femur” as opposed to “S7203 Fracture of subcapital section of femur”, when both were correctly identified by the local IHFD as being “intracapsular–displaced” fractures. Minor errors highlighted inaccuracies within the coding performed via the HIPE portal, but did not affect the accuracy of the output for the attention of the IHFD. Incorrect data was that whereby the classification or the operation performed that was recorded by HIPE or for submission to the IHFD differed from what was validated by the authors. Severe errors were recorded when hip fracture episodes were omitted by HIPE or the local IHFD, when “not documented” was recorded as the hip fracture classification or operation performed, and when a patient was included in the local IHFD without having sustained a hip fracture. Where an error was detected, an endeavour was made to identify the aetiology.

Descriptive statistical analyses were performed to explore the collected data. The accuracy of each variable was converted to a binary data set (accurate/inaccurate), where “accurate” included all correct data entries, and “inaccurate” included all minor errors, severe errors and incorrect data entries. McNemar’s test was used to assess the significance of the difference between the HIPE database and the local IHFD. The data was analysed using IBM SPSS Statistics Version 23. Statistical significance was determined when $p < 0.05$.

Results

There were 252 patients over the age of 60 years discharged from the trauma unit in 2016 having sustained a hip fracture. Table 1 shows the frequencies of each fracture type encountered using the terms available via the IHFD classification criteria. Intracapsular fractures were recorded in 131 cases (52%). Two slipped capital femoral epiphysis (SCFE) and two distal femoral cases were included in the local IHFD in error. Isolated greater and lesser trochanteric fractures were highlighted and proposed as a new category that could be included in future versions of the HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*) and the 2016 IHFD report. Table 2 shows the frequencies of operations performed using the terms available via the IHFD classification criteria. Bipolar uncemented coated hemiarthroplasty was the most common procedure and was performed in eighty-seven cases (34.5%). Revision arthroplasty was performed in seven cases of periprosthetic fractures. Open reduction internal fixation (ORIF) was performed in four periprosthetic fracture cases.

Table 1 Frequencies of fracture classifications using the terms available via the IHFD classification criteria

Fracture classification	Total	(% of 252)
Intracapsular	131	52%
Undisplaced	(10)	(4%)
Displaced	(121)	(48%)
Intertrochanteric	74	29.4%
Periprosthetic	20	7.9%
Subtrochanteric	18	7.1%
Greater trochanteric*	4	1.6%
SCFE ^e	2	0.8%
Distal femoral ^e	2	0.8%
No fracture	1	0.4%

Undisplaced and displaced are subdivisions of intracapsular fractures - 121 and 10 both add together to make up the 131 intracapsular fractures, as do 4% and 48% to make up the entire 52%

*Denotes fracture not included in IHFD categories

^e Denotes fracture included in local IHFD in error

Both of the latter two operations were highlighted as operative categories that the IHFD does not account for, and a recommendation was made for their inclusion in future data collection protocols.

Shown in Table 3 are the frequencies of correct entries, incorrect entries and errors in the data extracted from HIPE and local IHFD. The IHFD-recorded fracture classification was correct in 61.1% of cases, compared to the HIPE-recorded fracture classification in 29% of cases. McNemar testing proved this to be of statistical significance ($p < 0.001$) as shown in Table 4. The authors identified thirty-six cases (14.3%) of hip fractures that were omitted from the HIPE-recorded fracture classifications. Eight cases (3.2%) of hip fractures were located in the operative logbook that were

Table 2 Frequencies of operations performed using the terms available via the IHFD classification criteria

Operation performed	Total	(% of 252)
Art bi-p hemi uncem coated	87	34.5
Int fix DHS	74	29.4
Int fix IM nail long	27	10.7
Non operative	14	5.6
Art bi-p hemi cem.	13	5.2
ORIF*	10	4
Int fix IM nail short	9	3.6
Art THR uncem coated	7	2.8
Revision arthroplasty*	7	2.8
Art bi-p hemi uncem uncoated	2	0
In situ pinning ^e	2	0.8

*Denotes operation not included in IHFD categories

^e Denotes operation included in local IHFD in error

omitted from the local IHFD-recorded fracture classifications. McNemar testing proved this difference in omission rates between the HIPE and IHFD-recorded fracture classifications to be of statistical significance ($p < 0.001$).

The aetiologies of error for the IHFD-recorded fracture classification, where identifiable, are shown in Table 5. Seventy errors out of a total of ninety-eight (27.8% of the total database) were identified as having attributable causes which could be rectified prior to future data collection. Poor documentation by the medical team in the patients’ notes accounted for forty-eight errors (19.0% of the total database). Ten cases of intracapsular fractures included errors related to being “undisplaced” or “displaced”, eight cases of hip fractures were omitted from inclusion as described above and two cases of SCFE were included in the local IHFD in error. As per the HIPE Portal Data entry/ Hip Fracture Admission (V4.0.2*), two cases of isolated greater trochanteric fractures did not fit any of the predetermined fracture types, and were coded as “Other”. Twenty-eight errors within the IHFD-recorded fracture classification (11.1% of the total database) did not have an attributable cause identified.

The aetiologies of error for the IHFD-recorded operation performed, where identifiable, are shown in Table 6. Fifty out of a total of sixty one errors (19.8% of the total database) had attributable causes. Thirty errors (12.3% of the total number of operations performed) arose from the inaccurate descriptions of the coating of uncemented hip hemiarthroplasty prostheses. There were seventeen cases in which the HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*) did not include a category that described the surgical procedure performed—open reduction internal fixation for periprosthetic fracture and revision arthroplasty for periprosthetic fracture. The length of an intramedullary nail was coded incorrectly in two cases. Eleven errors within the IHFD-recorded operation performed (4.4% of the total database) did not have an attributable cause identified.

Discussion

This paper is the first to describe the validation of local data prior to submission to the IHFD. “Correct” data was identified in 29% of the HIPE-recorded fracture classification, 61.1% of the IHFD-recorded fracture classification and 75.8% of the IHFD-recorded operation performed. The IHFD coordinator in our trauma unit more than doubled the accuracy of the data collected, and reduced the rate of omissions by a factor of over 4.5, by thoroughly reviewing and “translating” each patient’s HIPE data, medical notes and imaging into the numerous data points required by the IHFD. Case omissions, incorrect fracture classifications and inaccurate descriptions of procedures performed have been previously reported in national databases [8, 9, 12, 13]. The individual effectiveness of data coordinators is vital to maintaining and subsequently improving the integrity of the IHFD. Dedicated, trained data coordinators cross

Table 3 Frequencies of correct entries and errors

Variable	Correct (% of total)	Minor error (% of total)	Incorrect (% of total)	Severe error (% of total)
HIPE-recorded fracture classification	73 (29.0)	52 (20.6)	97 (38.5)	30 (11.9)
IHFD-recorded fracture classification	154 (61.1)	–	40 (15.9)	58 (23.0)
IHFD-recorded operation performed	191 (75.8)	–	57 (22.6)	4 (1.6)

referencing hip fracture data from multiple sources reduces the likelihood of poor quality data being submitted to hip fracture databases, but depend on the accuracy of the primary documentation to avoid errors [9, 14]. Trauma centres without IHFD data coordinators need to be aware of how inaccurate their raw data is likely to be without adequate clinical oversight. The value of each hospital investing in a data coordinator looks set to increase, as NOCA and IHFD guidelines have, as of Jan 2018, offered a best practice tariff to hospitals who are able to achieve the six Blue Book Standards per hip fracture patient on condition that the data entry per quarter exceeds that of 90%. Without skilled data coordinators translating HIPE data and clinical notes on a regular basis, misrepresentative hip fracture data in Ireland will have negative effects on funding, as well as audit and research.

Within the IHFD-recorded fracture classification, seventy errors out of a total of ninety-eight were found to have an attributable cause. Forty-eight of such errors resulted from inadequate documentation by the surgical team in the medical notes. Educational sessions with the non-consultant hospital doctors who admit hip fracture patients on arrival to the ED could significantly improve deficiencies in the local database. The classification of the displacement of intracapsular hip fractures was a source of error in 4% of cases. The National Hip Fracture Database (NHFD) in the UK describes inaccuracies in assessing the degree of intracapsular fracture displacement in 5–15% of cases [15]. Difficulties in accurately classifying such injuries arise from the use of the historical Garden system, using only one radiographic view of the pelvis [16]. The Integrated Care Pathway for Hip Fracture was rolled out nationwide in 2015 [17] and introduced into individual emergency departments on a hospital basis. National uptake is improving year on year and improvements are expected in documentation and compliance with Blue Book Standards [18]. The admission hip fracture classification has been simplified to “box ticking” within the care pathway filed in the patient’s medical notes. This admission pro forma makes up part of the “Hip Fracture

Admission Pathway” that was introduced in our trauma unit in the second half of 2016. Compliance with the pathway’s documentation should show a rise in the proportion of correct hip fracture classifications within the local IHFD. The HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*), however, does not account for all potential hip fracture classifications as identified by this study. Isolated greater trochanteric fractures and lesser trochanteric fractures need to be included in future revised versions. The number of inaccurate data entries within the IHFD fracture classifications could be as low as 28 (11.1% of the total database) if these avoidable sources of error could be appropriately dealt with. Further education and training for NCHDs, as well as improved note keeping, could result in accuracy levels exceeding 90% within the IHFD, which would be an improvement on the NHFD in the UK, which describes accurate hip fracture classification in 89.8% of cases [9]. Accuracy levels of 96% have been described in the Finnish Hospital Discharge Register [19], which thus can be used as a valuable, reliable resource in assessing the epidemiology and trends in musculoskeletal injuries and their treatment.

The recorded operation performed was accurate in 75.8% of cases, which was similar to the error rate of 23.5% (or 76.5% accuracy) submitted by to the NHFD by a major trauma centre [9]. 12.3% of submitted operative data contained inaccuracies in describing whether an uncemented prosthesis was ‘coated or uncoated’. This terminology seems unnecessarily complicated, but the use of such sub-classifications stems from the adoption of the NHFD coding terms in order to facilitate comparisons between the databases. The length of an intramedullary nail was interpreted in error in two cases. The IHFD was unable to code 6.7% of the operations performed, which related to open reduction internal fixation or revision arthroplasty for periprosthetic fractures. Such procedures are omitted from the HIPE Portal Data entry/Hip Fracture Admission (V4.0.2*), as are their descriptions from

Table 4 Proportions of “Correct” recordings

Variable	Correct (%)	McNemar test
HIPE-recorded fracture classification	29.0	$P < 0.001$
IHFD-recorded fracture classification	61.1	
IHFD-recorded operation performed	75.8	N/a

Table 5 Error aetiology for the IHFD-recorded fracture classification

Error aetiology	Total	(% of 252)
Documentation	48	19.0
Displacement	10	4.0
Omissions	8	3.2
SCFE	2	0.8
Unable to code	2	0.8
Total	70	27.8

Table 6 Error aetiology for the IHFD-recorded operation performed

Error aetiology	Total	(% of 252)
Coating	31	12.3
Unable to code	17	6.7
Length of IM nail	2	0.8
Total	50	19.8

the Integrated Care Pathway for Hip Fractures. Their inclusion would greatly improve the quality of the IHFD with regard to the operations performed nationally due to the rising incidence of periprosthetic hip fractures [20]. Eradication of these known sources of error in operation recording could improve this data point's accuracy to over 95%. In Finland, procedural coding was found to be of an excellent standard, with an accuracy level of 88% [19].

The IHFD for 2016 included all patients that were diagnosed with a hip fracture due to injury diagnosis on HIPE, or a specified type of fracture, other than periprosthetic, on IHFD add-on screens [2]. The database receives periprosthetic fracture data from the contributing hospitals, but excludes them from comparisons with the Blue Book Standards. "Other" or "Not Known" fractures, which may include those of the periprosthetic variety, accounted for 10% of the national hip fracture workload in 2015 [2]. Periprosthetic fractures accounted for 7.9% of the annual hip fracture workload in our trauma unit in 2016. The HIPE-recorded fracture classification was inaccurate for all 20 periprosthetic fractures, which were coded as "Mechanical complication of an internal joint prosthesis". Such miscoding has financial implications for the hospital. A revised definition of a periprosthetic fracture is required of HIPE so as to avoid continued underreporting. The treatment of such injuries is complex, given the elderly cohort with medical comorbidities. Surgical management is significantly lengthened compared to that of a hip fracture, with prolonged postoperative recovery times, in-patient stays and rehabilitative requirements [20]. If periprosthetic fractures were included in the IHFD's Blue Book Standard comparisons, the time to surgery and length of stay results would be skewed in order to account for the availability of subspecialised revision arthroplasty surgeons and postoperative rehabilitation facilities. The true incidence of periprosthetic fractures in Ireland is unknown as hip fractures are only coded up to 5 cm distal to the lesser trochanter. Future work is scheduled in order to explore this topic, given the challenges that they generate for our trauma units.

Managing a patient who has sustained a hip fracture, the most common trauma presentation requiring surgery in Ireland [3], costs on average £12,163 (approximately €14,000) [21]. The cost in managing a periprosthetic hip fracture is in excess of £23,469 on average (approximately €26,000) [20]. Misdiagnosing a patient's hip fracture, omitting a hip fracture from the medical notes and miscoding an operation have reimbursement implications for the hospital in

question. This is comparable to failing to document medical comorbidities, adverse events and subsequent investigations performed. Admission documentation, theatre listings and operation notes, from where coding is derived, are often completed by the most junior member of the surgical team. Further documentation throughout a patient's admission, emulating that which was recorded on presentation to the emergency department, carries diagnostic and procedural errors through the medical notes, thus multiplying the chances of coding errors on discharge [22]. It is the responsibility of the senior team members to ensure that the correct classification and procedure are recorded [23]. All operative modifications, updates or complications should be highlighted in the patient's notes [9]. Resources should be invested in the education of surgical trainees in the accurate classification of hip fractures and proper procedural coding to minimise discrepancies. In the current environment, where "money follows the patient", and with the introduction of activity based funding, accurate coding is vital to ensure adequate reimbursement is obtained [9, 20, 21].

Annual hip fracture audits have been shown to improve and maintain high standards of care for this vulnerable patient cohort [24–26]. The IHFD will continue to play a key part in Ireland's hip fracture care as benchmarking incentivises trauma units to comply with the Blue Book Standards [4, 18]. Future audit and research will depend on the validity of the database [8, 9]. Submission of data to the IHFD requires investment from the medical team and clinical oversight in order to preserve its integrity.

Conclusion

Hip fracture data from our trauma unit contained inaccuracies that were identified and corrected prior to submission to the IHFD. The value of the local data coordinator 'translating' data from HIPE into the IHFD is evident. The data coordinator in our unit doubled the accuracy of the data that was due to be submitted to the database, and reduced the rate of omitted cases by a factor of 4.5. However, accuracy levels would be most significantly improved with clear, thorough documentation by the medical team following education of junior surgical trainees on hip fracture classification and procedural coding. Inaccurate data has a negative effect on hospital reimbursement post hip fracture management, compromises the integrity of the IHFD, and has the potential to invalidate future research and audit without adequate clinical oversight from senior team members.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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