■ TRAUMA

Developing a minimum common dataset for hip fracture audit to help countries set up national audits that can support international comparisons

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Aims

The aim of this study was to explore current use of the Global Fragility Fracture Network (FFN) Minimum Common Dataset (MCD) within established national hip fracture registries, and to propose a revised MCD to enable international benchmarking for hip fracture care.

Methods

We compared all ten established national hip fracture registries: England, Wales, and Northern Ireland; Scotland; Australia and New Zealand; Republic of Ireland; Germany; the Netherlands; Sweden; Norway; Denmark; and Spain. We tabulated all questions included in each registry, and cross-referenced them against the 32 questions of the MCD dataset. Having identified those questions consistently used in the majority of national audits, and which additional fields were used less commonly, we then used consensus methods to establish a revised MCD.

Results

A total of 215 unique questions were used across the ten registries. Only 72 (34%) were used in more than one national audit, and only 32 (15%) by more than half of audits. Only one registry used all 32 questions from the 2014 MCD, and five questions were only collected by a single registry. Only 21 of the 32 questions in the MCD were used in the majority of national audits. Only three fields (anaesthetic grade, operation, and date/time of surgery) were used by all ten established audits. We presented these findings at the Asia-Pacific FFN meeting, and used an online questionnaire to capture feedback from expert clinicians from different countries. A draft revision of the MCD was then presented to all 95 nations represented at the Global FFN conference in September 2021, with online feedback again used to finalize the revised MCD.

Conclusion

The revised MCD will help aspirant nations establish new registry programmes, facilitate the integration of novel analytic techniques and greater multinational collaboration, and serve as an internationally-accepted standard for monitoring and improving hip fracture services.

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Introduction

Hip fracture is a rapidly growing challenge; it has been predicted that by 2050 six million people will break their hip each year, with the greatest increases anticipated in Asia and Latin America.[1] Mortality in the first few weeks after the injury is of the order of 10%, and less than half of patients regain their previous abilities and independence.[2]

A series of recent papers used hip fracture as a model of a 'high need, high cost' patient for health services in different countries,[3–9] and examined how mortality, length of stay, readmissions, and costs vary between nations. However, such use

of administrative datasets is of limited use to clinicians, as it does not profile the details of the care provided to individual patients, or consider how different approaches to management might impact outcome.

Outcome is largely determined by patients' pre-existing frailty,[10] but evidence is accumulating that national audit programmes contribute significant improvements to outcomes, including mortality and quality of life.[11,12] Comparison of compatible hip fracture registries from different countries will furnish information from a greater breadth of clinical, demographic, and health economic contexts. This wider variety of sources will not only increase the volume of available data, but also their diversity, generalizability, and global relevance. Larger datasets provide greater power for analysis through the interrogation of phenomena across contexts, verification of observed effects in different populations, and the application of modern data science techniques.

The existing national hip fracture registries share a common heritage in the pioneering work of Rikshöft in Sweden,[13] and subsequent developments such as the Standardized Audit of Hip Fracture in Europe (SAHFE),[14] and the definition of a minimum common dataset (MCD) by the Fragility Fracture Network (FFN) in 2014.[15]

The audits of England, Wales, and Northern Ireland,[16] and of New Zealand and Australia,[17] routinely report data from more than one country, which allows direct comparison of these patient populations, their care, and their outcome. But as these and other national audits evolve to address the specific needs of their patients, populations, and health services, there is divergence in the data fields they collect. This inter-audit variability diminishes the relevance and generalizability of information beyond the parent audit, which in turn restricts the potential to extrapolate findings, apply lessons learned, and drive improvement work across different healthcare contexts.[18,19]

The need for hip fracture audits to establish the needs of vulnerable patients across a range of geopolitical and health settings was thrown into sharp relief by the COVID-19 pandemic.[20] A global survey of disruption to hip fracture services during the pandemic revealed not just varying degrees of disruption to hip fracture care, but underlying differences in the structure of services, clinical reporting processes, and strategic feedback mechanisms.[21] Progressive demographic change in the age and frailty of populations will compound this acute challenge, and it is imperative that our registry capabilities transcend national boundaries.

A recent review of European national hip fracture audits concluded that hip fracture registries were a good tool with which to compare hospitals within one country,[22] but that they need to make the data they collect and present more uniform if international comparisons are to become feasible.

The FFN is a global organization, founded to create a multidisciplinary network to improve the treatment and secondary prevention of fragility fracture and act as a global template for national alliances. The FFN is ideally placed to develop international consensus on the care offered to patients with fragility fracture.[23]

International agreement over a MCD that all audits will collect will greatly improve the compatibility and generalizability of observations, increase the relevance of audit findings beyond their country of origin, and support shared learning between health systems. Although ten hip fracture audits are already active, most countries are yet to establish such programmes despite an urgent clinical and strategic need.

In mid-2020, the FFN Hip Fracture Audit Special Interest Group, representing clinical experts from around the world, reviewed the practice of national audit programmes and found evidence of inter-audit variability and poor adherence to the 2014 MCD. The Group reached consensus that the original MCD required updating in order to encourage adherence, facilitate international cooperation, and reflect iterative changes made to the data collection process as a result of real-world testing. The aim of this multinational collaborative study was to: identify key variables that are common to existing audits, and develop a revised MCD to serve as a global standard for monitoring and improving hip fracture services.

Methods

We performed a detailed comparison of the existing datasets for all ten established national hip fracture audits or registries: England, Wales, and Northern Ireland;[16] Scotland;[24] Australia and New Zealand;[17] Republic of Ireland;[25] Germany;[26] the Netherlands;[27] Sweden;[13] Norway;[28] Denmark;[29] and Spain.[30]

The dataset for each audit was compared to the 32 fields of the 2014 MCD, and adherence to this standard was assessed. Fields that were collected in accordance with the 2014 MCD were identified, as were additional fields that were collected most frequently but did not appear in the original standard. Redundant data fields were discarded. A draft MCD was produced through this process of consensus-filtering.

In order to consider the specific needs and perspectives of clinicians working in an appropriate breadth of environments (high-, middle-, and lower-income nations, and those with existing audits or aspirations to establish programmes), the draft MCD was presented at the FFN Asia Pacific, hosted virtually by the FFN Philippines in July 2021.[31] Feedback from participants was captured in meeting records and through the distribution of an online questionnaire that was circulated to all participants.

Revisions were made to the draft MCD, which was then presented at the Global FFN Congress, hosted virtually from Toronto in September 2021.[32] Further feedback was collected from participants of this congress, and iterative changes were made in order to produce the Final 2022 MCD presented in this study.

Results

We identified a total of 215 potential questions/data fields which were included in one or more of the ten established national audit datasets. All of the fields of the original MCD were being used by at least one audit.

Only 21/32 (65.6%) of the original 2014 MCD fields were being used in the majority of national audits, and only three fields (anaesthetic grade, operation performed, and date/time of primary surgery) were still being used by all ten established audits (Figure 1).

We reviewed other fields that had consistently been adopted by established national audits and found that all audits were

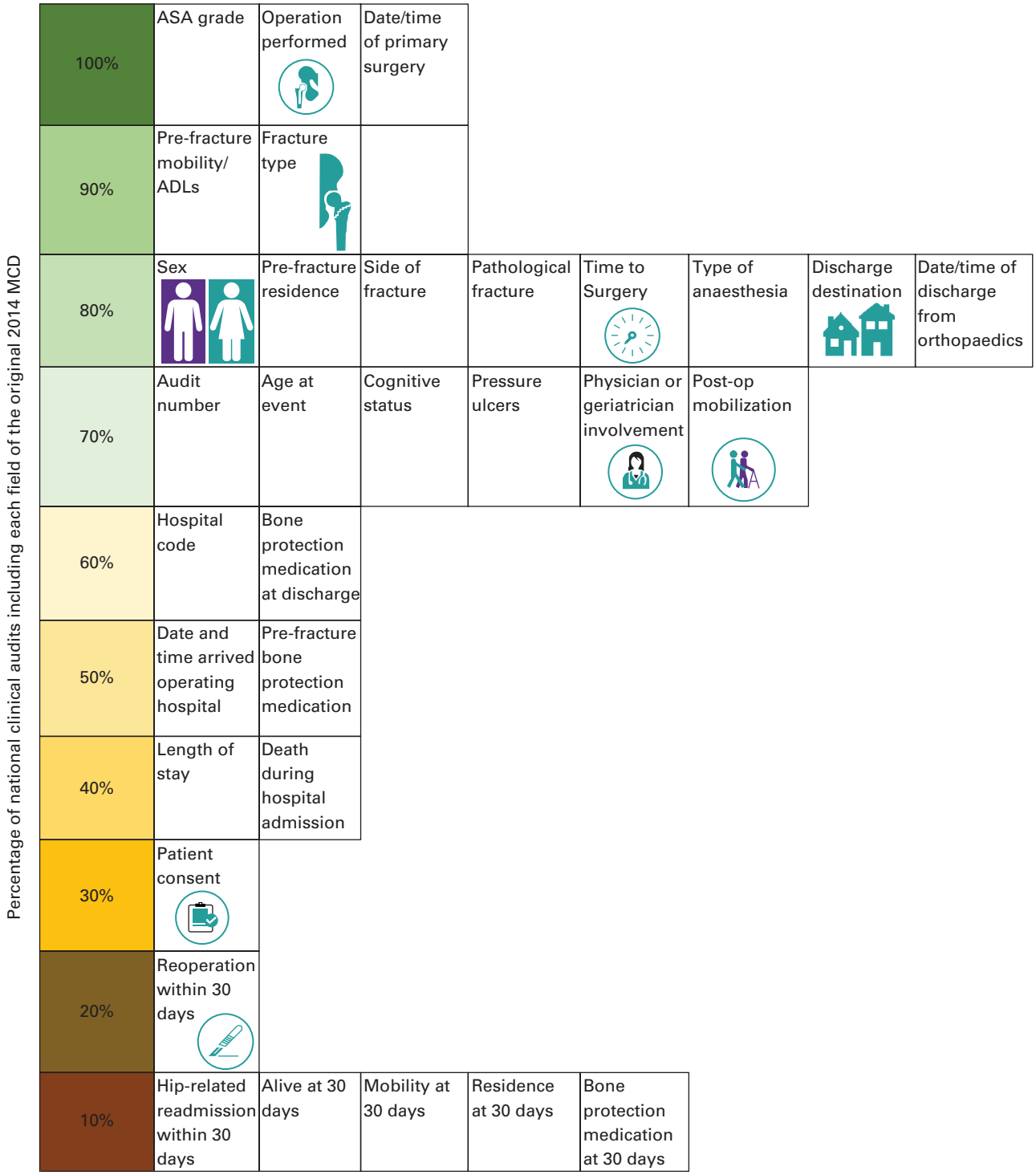

Fig. 1

Inclusion of individual 2014 Minimum Common Dataset (MCD) fields in ten established national clinical audits. ADL, activities of daily living; ASA, American Society of Anesthesiologists.

routinely recording additional fields that had not formed part of the original MCD. Seven audits were also recording 'Date or time of admission to hip fracture ward'; six were also recording 'Admission nutritional risk assessment' and 'Reoperation within 120 days of presentation'; five were also recording 'Date/time of arrival at operating hospital', 'Date/time of assessment by geriatric service', 'Specialist falls assessment', and 'Post-fracture mobility'.

Table I. 22 key fields of the Fragility Fracture Network's 'Core 2022 Minimum Common Dataset'.

Field	Value
Audit number	Patient identifier
Hospital code	Hospital identifier
Sex	1. Male 2. Female
Age at event	Age (years)
Pre-fracture residence	1. Home 2. Institution 3. Acute Care 4. Rehabilitation 5. Unknown
Date and time patient first presented with hip fracture at operating hospital	dd/mm/yyyyy hh:mm (24 hr clock)
Pre-fracture mobility/ ADLs	1. Freely mobile without aids 2. Mobile outdoors with one aid 3. Mobile outdoors with two aids or frame 4. Some indoor mobility but never goes outside without help 5. No functional mobility (using lower limbs) 6. Unknown
Cognitive status	1. Normal 2. Known dementia 3. Not known dementia but positive screen for cognitive impairment (using a specified tool appropriate to the country)
ASA grade	1, 2, 3, 4, 5, or Unknown
Side of fracture	1. Left 2. Right
Pathological fracture	1. No 2. Malignancy 3. Atypical 4. Unknown
Fracture type	1. Intracapsular non-displaced 2. Intracapsular displaced 3. Trochanteric 4. Subtrochanteric 5. Other
Operation performed	1. No operation performed 2. Cannulated screws 3. Sliding hip screw 4. Intra-medullary nail 5. Hemiarthroplasty 6. Total hip arthroplasty 7. Other
Date/time of primary surgery	dd/mm/yyyyy hh:mm (24 hr clock)
Type of anaesthesia	1. General 2. Spinal 3. Other regional e.g. nerve block
Pressure ulcer developed during this admission	1. Yes 2. No
Physician/geriatrician involvement	1. Physician 2. Geriatrician 3. Not seen
Out of bed postoperatively	Got out of bed by day 1 postoperatively. 1. Yes 2. No 3. No operation performed
Death during acute hospital admission	1. No 2. Died pre-surgery 3. Died post-surgery
Date/time of discharge from acute care	dd/mm/yyyyy hh:mm (24 hr clock)
Acute discharge destination	1. Home 2. Institution 3. Acute Care 4. Rehabilitation 5. Unknown 6. Dead
Bone protection medication at discharge	1. Commenced 2. Continued 3. Changed 4. Discontinued 5. No action taken

ADLs, activities of daily living; ASA, American Society of Anesthesiologists.

These findings were reviewed in a meeting of the FFN's Hip Fracture Audit Special Interest Group, and a two-part structure for a revised MCD was proposed. The number of proposed data fields was reduced to a set of 22 variables (the revised 'Core 2022 minimum common dataset'), without which a national clinical audit would either not be effective, or would not be able to support meaningful international comparisons.

The ten fields removed from the 2014 MCD formed the basis of 12 'optional' fields which are recommended (the 'Extended 2022 MCD') but ought not to be considered essential to any national audit programme. These fields increase the breadth and granularity of collected data, and might be adopted by individual audits according to their needs (Tables I and II).

During the FFN Asia-Pacific meeting, eight questions were used to address points of contention, and to ensure that the MCD was feasible within the resource confinements of lower-income countries. Each question was validated individually by respondents from a number of less economically developed (n = 21) and more economically developed counties (n = 6), with a total of 224 responses collected. Overall agreement was reassuring, with 204 of 224 respondents (94.1% (95% confidence interval (CI) 90.3 to 97.7)) agreeing with the inclusion of the reviewed data fields within our guidance – encouraging evidence of support from these countries. Consensus was less strong when comparing the inclusion of data fields in the minimum as opposed to the extended dataset, but still supportive, with agreement of 157/224 respondents (70.0% (95% CI 59.8 to 80.2)).

Discussion

This study aimed to review and revise the Global Fragility Fracture Network's 2014 MCD for Hip Fracture Audit through analysis of the existing ten national audit programmes, and a robust process of expert consensus with stakeholders representing the global hip fracture community. The resulting 2022 MCD sets out an abbreviated set of 22 data fields (the 'Core 2022 MCD') that should be considered necessary for effective clinical audit, and an additional 12 data fields (the 'Extended 2022 MCD') that may add value to national audits according to local need. This 2022 MCD has been ratified by the FFN Hip Fracture Audit Special Interest Group, representing clinical experts and registry leads from around the world, and should serve an international standard for monitoring and improving hip fracture services.

This updated and abbreviated MCD includes: patient and hospital information; basic casemix data; injury descriptors; care process measures; and outcome measures. It requires the collection of 25% fewer variables than the original 2014 MCD, and should provide a more accessible framework upon which aspirant nations can establish new hip fracture audit programmes.

Numerous instruments have been validated to measure patient factors such as comorbidity, cognitive status, and mobility, but complexity of administration and interpretation, and the need to reduce the data collection burden to a minimum practicable level, justify the inclusion of simple measures in the revised MCD. Furthermore, regional factors such as languages and cultural differences present barriers to universal adoption of specific tools. The data fields recommended in the current study are intended to maximize the generalizability, comparability, and utility of these complex variables. The care process measures included in the 2022 MCD reflect those that are considered most informative by existing audit programmes and include: timing of presentation, admission to a definitive inpatient ward, and interventions (including medical and orthogeriatric review, surgical management, and postoperative mobilization); treatment details (including type of surgery, mode of anaesthesia, and secondary fracture prevention), and outcome measures (including discharge timing and destination, post-injury level of mobility, and survival).

It will be for individual countries to decide on specific definitions of some data fields according to how those data are collected, interpreted, and coded using local systems. For example, the timing of initial presentation might be considered to refer to the timing of reported precipitant event (e.g. fall), timing of presentation to the emergency department (ED), or the timing of confirmed hip fracture diagnosis following clinical and radiological assessment. Complexity of this example increases further when considering patients who suffer their fracture while they are an inpatient in hospital, and therefore follow a separate referral pathway that typically bypasses the ED. Although inter-audit variations in definitions pose a challenge to the compilation and comparison of data fields from different audits, this effect can be mitigated by the provision of accurate data dictionaries to accompany each audit.

Many countries have not yet developed the speciality of geriatric medicine, but the role of the orthogeriatrician has been well defined in the literature and endorsed in national guidelines, and it is important to reflect this in the capture of data pertaining to 'Physician/geriatrician involvement' in the revised MCD. The primary drivers of this inclusion are to examine the role of multispecialty medical care, and to encourage a shared-care approach with collaboration between the surgical/anaesthetic clinicians, internal medicine/specialist geriatric clinicians, nurses, and therapists in order to improve perioperative optimization, the management of clinical frailty conditions, and secondary fragility fracture prevention. The importance of pharmacological interventions for 'bone protection' is well-recognized, and programmes should audit the use and utility of this secondary fracture prevention activity.

Established audit programmes have, through a process of iterative design and real-world testing, modified existing MCD data fields and developed novel variables in order to better reflect their services. A portion of these fields have been incorporated into the 2022 Core MCD, and the remainder were used to define optional fields that formed the basis of the 2022 Extended MCD. For example, one optional field is 'Date and time of trauma causing hip fracture', which aims to record any significant period of delay between injury and initial presentation. Although such delays are uncommon in most developed

Table II. 12 optional fields for the Fragility Fracture Network's 'Extended 2022 Minimum Common Dataset'.

Field	Value
Patient consent	1. Yes 2. No
Date and time of trauma causing hip fracture	dd/mm/yyyy
Date and time of admission to orthopaedic/ orthogeriatric ward	dd/mm/yyyyy hh:mm (24 hr clock) *or* Patient was never admitted to an specialist orthopaedic or orthogeriatric ward
Nutritional assessment performed on admission	1. Normal (screeened using a specified tool appropriate to the country) 2. Malnourished 3. Not assessed
Pre-fracture bone protection medication	1. Yes 2. No
Date/time of discharge from post-acute care	dd/mm/yyyyy hh:mm (24 hr clock)
Post-acute discharge destination	1. Home 2. Institution 3. Acute Care 4. Rehabilitation 5. Unknown 6. Dead
Definition of follow-up timepoint: depending on local service structure each audit/registry should select either 30 days after presentation, or 120 days after presentation	
Alive at end of this follow-up period	1. No 2. Yes
Reoperation within this follow-up period	1. None 2. Reduction of dislocated prosthesis 3. Washout or debridement 4. Implant removal 5. Revision of internal fixation 6. Conversion to hemiarthroplasty 7. Conversion to total hip arthroplasty 8. Girdlestone/excision arthroplasty 9. Periprosthetic fracture management 10. Other 11. Unknown
Mobility at end of this follow-up period	1. Freely mobile without aids 2. Mobile outdoors with one aid 3. Mobile outdoors with two aids or frame 4. Some indoor mobility but never goes outside without help 5. No functional mobility (using lower limbs) 6. Unknown
Residence at end of this follow-up period	1. Home 2. Institution 3. Acute Care 4. Rehabilitation 5. Unknown 6. Dead
Bone protection medication at end of this follow-up period	1. Yes 2. No

countries, practice can be very different in lower- and middle-income countries, where hospital referral is not automatic and is frequently associated with delays. This optional field will allow systems to monitor delays to presentation and assess their consequences on outcomes.

The well-recognized importance of nutrition as a modifiable predictor of improved outcomes in hip fracture patients is reflected in nutrition assessment data being collected by six of the ten established audits.[33] For this reason, it would be appropriate to add the option to record patients as 'normal' or 'malnourished' following a 'Nutritional assessment performed on admission'. Many screening tools include an 'at risk of malnutrition' category, but all patients presenting with hip fracture are at risk of becoming malnourished so this category was not included, as it might provide inappropriate reassurance. Patients identified as 'at risk' by a screening tool should be included in the 'malnourished' category.

The revised MCD captures 'Date/time of discharge from acute care', but the degree to which extended care (beyond surgical management and the immediate postoperative period) is delivered in the acute hospital varies enormously around the world.[3-9] The introduction of a new optional field of 'Date/time of discharge from post-acute care' would allow subsequent recovery and rehabilitation to be captured. Different countries may need to adapt the precise definition to ensure that they most accurately profile the key elements of the pathway, which should be considered as 'Total time in orthopaedic/geriatric ward(s) on an acute hospital site' and 'Subsequent recovery and rehabilitation in a healthcare setting other than the patient's pre-fracture residence'. Similarly, the 2022 MCD captures 'Acute discharge destination', but the Extended MCD includes an optional field of 'Post-acute discharge destination' to record the levels of care into which patients are discharged following the acute hospital stay.

The collection of outcome measures is important to ensure that any given hip fracture service is providing effective care. The recorded variables should include those most pertinent to patients with hip fracture, namely: length of hospital stay and discharge destination; inpatient and post-discharge death; and complications including reoperation and pressure ulcer development. When considering mortality, in-hospital death is frequently recorded by the existing audits, but variation in length of stay between health systems means that mortality at a pre-determined timepoint provides a more generalizable and comparable field. Measuring these outcomes at 120 days after fracture may provide the most complete measure of overall recovery, but many healthcare systems are unable to capture data at this timepoint. Where 120-day follow-up data would be impractical, data collected 30 days after initial presentation may be a valid alternative.

The revision of the MCD is timely, given increasing appreciation of the need for a global perspective on hip fracture with the COVID-19 pandemic's disproportional impact on frail and older patients. Continuous evolution of mechanisms for collecting, analyzing, and using clinical health data is vital as we cope with such acute pressures, and with the more gradual challenge of demographic change. A broad field of data-driven improvement work that combines clinical audit with health data science and medical informatics techniques has been described as 'meta-audit'.[34] This goes beyond classical clinical audit and expands the utility of data that are collected routinely (as a product of clinical encounters) or specifically (as part of a deliberate audit process).

The use of clinical audit mechanisms to provide data for observational and experimental studies will increase the efficiency and agility of research by reducing the resource outlay and the lead times typically associated with establishing bespoke research or study cohorts. Large datasets are required to identify significant effects, given the complexity of hip fracture care and the heterogeneity of patients with this injury. The compilation of data from multiple audit sources increases sample breadth, and provides opportunities to establish observational studies (such as ecological studies at population level) and experimental studies (such as randomized controlled trials embedded into audits, or quasi-randomized trials in which different geographical areas act as different treatment arms).

Data safeguarding and information governance can pose a major barrier to the sharing of clinical audit data between agencies and nations. Meta-audit describes how discrete clinical audit datasets might be compiled and analyzed concurrently while protecting sensitive information through two distinct approaches: the findings of multiple audits collecting the same MCD could be compared, and observed effects pooled centrally, to allow meaningful interpretation through a process analogous with meta-analysis; and the coordinated analysis of audit datasets at multiple local levels using a common process, prior to the pooling of anonymized compatible results and further analysis using the same analytic key.

In this sense, 'meta-audit' is referring to the compilation and examination of data from different but fundamentally compatible sources, and the coordination of hip fracture audits through widespread adoption of an updated MCD will facilitate this process. The uptake and maintenance of an international MCD will provide evidence for the utility of continual clinical audit in hip fracture, and will make this a recognized standard of practice to which all health systems might be expected to adhere.

In conclusion, hip fracture is an increasing global health challenge but, by improving the coordination and standardization of registry programmes, the potential to learn from collaboration and modern health data analytic techniques can be harnessed. This study describes a ratified MCD, based on global consensus and extensive real-world testing, that has the potential to be relevant, feasible, and sustainable across all nations and serves as a template for new and existing national hip fracture registries. By adopting this shared language of clinical audit, programmes will be able to compile and compare observations and drive improvement of hip fracture services across the world.

Take home message

- This study describes a Minimum Common Dataset for hip fracture registries, based on global consensus and extensive real-world testing.
- This shared language of clinical audit will allow clinicians and policy-makers to compare observations and drive improvement of hip fracture services across the world.

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