



Joint position on quality indicators for fragility hip fracture in Mexico

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Abstract

Summary A standardized framework for quality indicators (QIs) in fragility hip fracture care is lacking in Mexico, leading to variable treatment. This study proposes 33 QIs developed through literature review and expert consensus. These indicators aim to improve multidisciplinary care, reduce complications, and optimize resources, supporting national efforts for standardized management.

Fragility hip fractures present a major public health challenge due to high mortality, complications, and healthcare costs. In Mexico, the absence of a standardized framework for quality indicators (QIs) for the management of fragility hip fractures has led to significant variability in care. This article aims to propose a comprehensive set of QIs tailored to the Mexican healthcare system. The proposal was developed through a three-phase process: a systematic review of international literature, a RAND/UCLA-type consensus approach involving experts from nine national medical societies, and the evaluation of QIs based on the opportunity and necessity criteria. The final consensus led to the identification of 33 QIs, covering preoperative, intraoperative, postoperative, and perioperative phases of care. Key indicators include timely surgery (within 48 h), early mobilization, orthogeriatric co-management, nutritional assessment, fall prevention, delirium detection, and secondary fracture prevention upon discharge. These indicators are designed to promote multidisciplinary care, improve functional outcomes, and reduce complications. The process also included operational definitions and measurement criteria to facilitate implementation in clinical settings, potentially contributing to the creation of national or regional hip fracture registries. This proposal represents the first multidisciplinary initiative in Mexico to address fragility hip fracture care with the goal of standardizing quality, optimizing resource use, and improving patient outcomes. Ongoing evaluation and adaptation of these indicators will be crucial to ensure their continued relevance and effectiveness in the evolving healthcare landscape.

Keywords Quality indicators · Healthcare · Research and development · Hip Fracture · Orthogeriatrics

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Introduction

Hip fracture has become a public health issue due to its high rate of complications, mortality, functional impact, and disability [1–3]. Studies have shown that first-year mortality can reach approximately 30% [4, 5], and 45% do not regain their previous walking ability [6]. Additionally, the cost of hip fracture care can amount to \$250,000 Mexican pesos (around \$14,000 USD) during the acute phase [7] and increases substantially with surgical delays [8].

Significant efforts have been made in many countries to improve the prognosis of patients with hip fracture. One of the most important initiatives has been the development of quality indicators (QIs). A quality indicator is a tool used for objectively quantifying and evaluating the care processes and health outcomes of a specific clinical condition. Additionally, QIs aim to reduce variability in care between centers that treat the same condition, promote equity, and ensure more efficient use of healthcare resources [9].

Several international healthcare organizations and authorities have proposed QIs for the management of fragility hip fractures. Examples include the United Kingdom NICE guideline [10], Quality Services in Ontario-Canada [11], the Italian Orthogeriatric group [12], and the Irish Health Records Office [13].

In Mexico, however, there is still no proposal for QIs tailored to the country's unique context in terms of resources and healthcare systems, which could help standardize care and improve outcomes for patients.

Aim

The aim of this work is to develop a comprehensive proposal for quality indicators (QIs) for the care of patients with hip fractures in Mexican healthcare institutions. These indicators will be designed to serve as a flexible framework, adaptable to the specific needs and circumstances of each institution, enabling effective implementation tailored to the realities of each multidisciplinary context.

Methodology

To propose QIs for the care of patients with hip fractures, three phases were carried out. In the first phase, a systematic review of the literature was performed. Subsequently, a RAND/UCLA [14] type consensus process was applied (*Research and Development*) to obtain significant agreements between different medical societies. The RAND/UCLA method is a consensus process that combines the best

available scientific evidence with expert clinical judgment to assess the appropriateness of medical interventions. It involves a structured, multi-round rating and discussion process among a panel of experts. Finally, the results obtained in the consensus process were analyzed and discussed.

The systematic review of the literature was registered on PROSPERO (ID CRD42022339800) and was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Searches were conducted by experts in methodology with experience in hip fracture QIs. The search strategy included three databases (Pubmed, Google Scholar and Cochrane Library), English language, covering the period from 2012 to 2022, the use of MeSH terms (*hip fractures, healthcare quality indicators, osteoporosis, quality standards, and key performance indicators*) and search phrases with Boolean operators (Table 1). Eligible studies included systematic reviews, meta-analyses, clinical practice guidelines, and consensus involving QIs. In parallel, a search was carried out on the websites of international societies that have proposed QIs in hip fracture. On the other hand, the coordinators of this project identified the international scientific associations and societies that have published QIs in hip fragility fractures with the support of the *Fragility Fracture Network*.

Two reviewers analyzed abstracts and retrieved full text. Subsequently, the published literature was reviewed, and relevant publications were selected (including hip fracture QIs, where they clearly described the way to measure them). The QIs of the selected articles were extracted, and the repeated ones were eliminated (see Fig. 1 for a visual representation of our search process). Bias risk was minimized through predefined inclusion and exclusion criteria, using medical subject headings (MeSH) terms in specific pre-established databases. There was no communication between reviewers during the paper evaluation process to maintain objectivity.

The Donabedian quality model [15] was used to categorize QIs as structure, process, or result. The level of evidence and strength of recommendation for each indicator was identified with its source reference [16]. The indicators were evaluated with the Appraisal of Indicators through Research and Evaluation (AIRE) tool [17] and those that did not meet the operational definition of methodological quality were eliminated; the result was an initial list of 44 indicators.

The RAND/UCLA-type consensus was made up of panelists from 9 Mexican societies and schools, led by the Mexican Association of Bone and Mineral Metabolism, A.C. (AMMOM). The other participating societies were the Mexican Academy of Geriatrics, A.C. (AMG), the Mexican College of Internal Medicine of Mexico, A.C. (CMIM), the Mexican College of Orthopedics and Traumatology, A.C. (CMO), the Mexican College of Rheumatology, A.C. (CMR), the Mexican Federation of Orthopedics and Traumatology Colleges, A.C. (FEMECOT), the National College

Table 1 Search strategies

Database	Search phrase	Limits/filters
PubMed/MEDLINE	((“Hip Fractures”[Mesh]) AND “Quality of Health Care”[Mesh]) ((“Hip Fractures”[Mesh]) AND (“Quality Indicators, Health Care”[Mesh])) ((“Quality Indicators, Health Care”[MeSH]) OR (“Quality of Health Care”[Mesh]) OR (“quality measure” OR “quality criteria” OR “quality assessment” OR ((Quality[ti] OR performance[ti] OR satisf*[ti]) AND (indicator*[tw] OR criteri*[ti] OR assess*[ti] OR measur*[ti] OR scale[ti] OR validat*[tw]))) AND (“Hip Fractures”[Mesh]) OR (hip fragility fracture*[ti]) NOT (letter[pt] OR editorial[pt] OR comment[pt] OR case reports[pt]) Filters: Meta-Analysis, Systematic Review, in the last 10 years = 430 (((((quality indicators, health care[MeSH Terms]) OR (indicators[MeSH Terms])) OR (assessment, healthcare quality[MeSH Terms])) OR (quality criterium)) OR (quality measures)) OR (assess*[Title]) AND (hip fractures[MeSH Terms])) OR (hip fragility fracture[Text Word]) = 80 (((((healthcare quality indicator[MeSH Terms]) OR (quality indicator, healthcare[MeSH Terms])) OR (quality measure*[Text Word])) OR (quality criterium[Text Word])) OR (quality performance[Text Word])) OR (quality assessment[Text Word])) AND ((hip fractures[MeSH Terms]) OR (hip fragility fracture[Text Word])) <i>Filters applied: Consensus Development Conference, Consensus Development Conference, NIH, Meta-Analysis, Practice Guideline, Preprint, Review, Systematic Review, English, from 2012–2022</i>	Abstract, Consensus Development Conference, Consensus Development Conference, NIH, Dataset, Meta-Analysis, Practice Guideline, Preprint, Systematic Review, in the last 10 years, English Books and Documents, Consensus Development Conference, Consensus Development Conference, NIH, Dataset, Meta-Analysis, Practice Guideline, Preprint, Review, Systematic Review, English, from 2012–2022
Second investigator	(((((“Hip Fractures”[Mesh]) AND “standards”[Subheading]) AND “Quality Assurance, Health Care”[Mesh]) OR “Quality Improvement”[Mesh]) OR “Quality Indicators, Health Care”[Mesh]) OR “Health Care Quality, Access, and Evaluation”[Mesh]) OR “Quality of Health Care”[Mesh]	
Cochrane Library	Hip Fractures AND Quality Indicators	
Google Scholar	allintitle: hip fracture quality indicators “hip fracture” OR or OR “hip fragility fracture”	

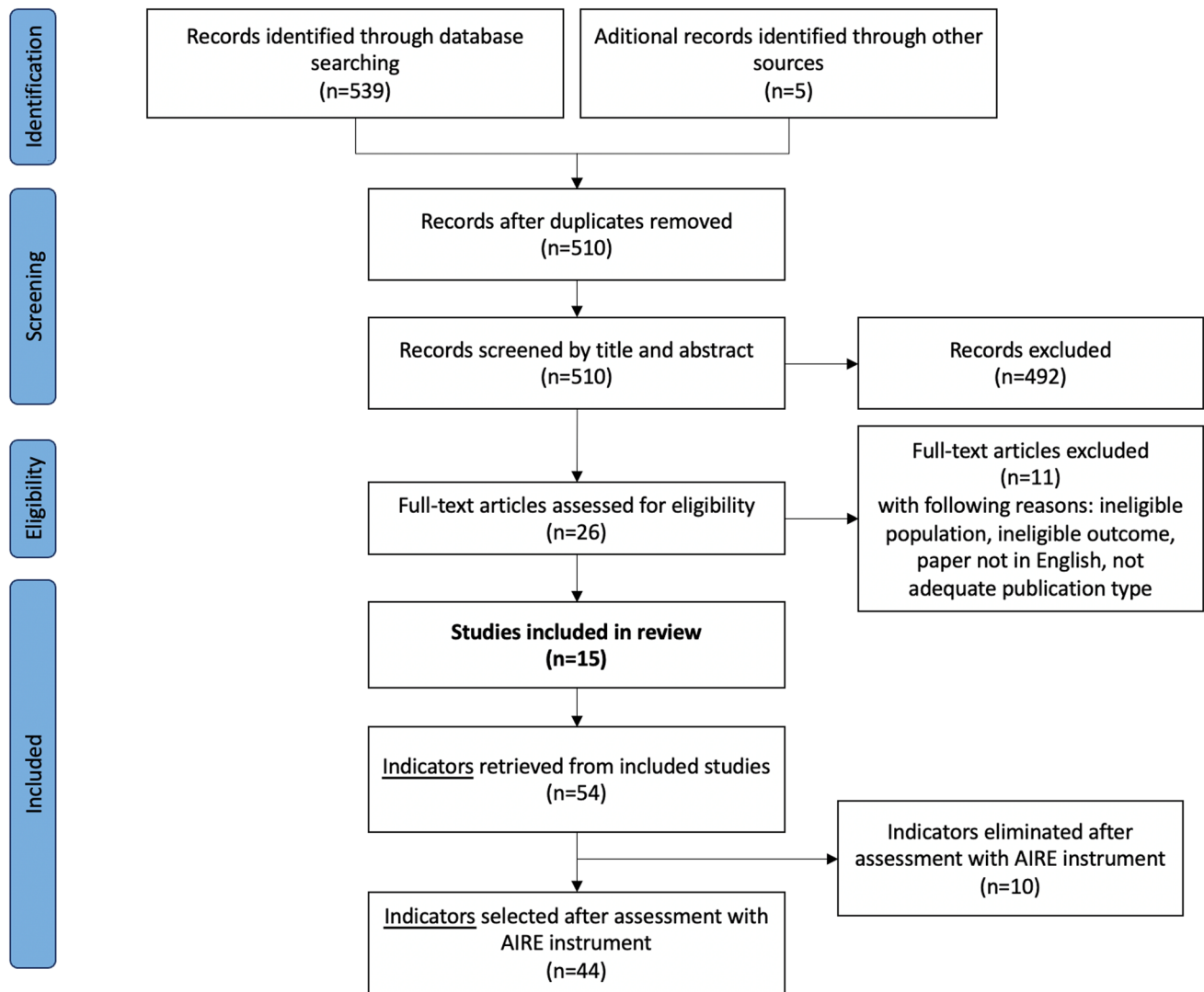


Fig. 1 PRISMA systematic literature review

of Geriatric Medicine, A.C. (CONAMEGER), and the GeriatrIMSS System (Table 2). These scientific organizations with national representation constituted a panel of experts

from disciplines related to hip fracture care. The specialties included were orthopedics, geriatrics, rehabilitation medicine, internal medicine, and bone health. There were

Table 2 Participating societies

Participating associations	
AMMOM	Mexican Association of Bone and Mineral Metabolism, A.C
CMIM	Mexican College of Internal Medicine of Mexico, A.C
CMO	Mexican College of Orthopedics and Traumatology, A.C
CMR	Mexican College of Rheumatology, A.C
FEMECOT	Mexican Federation of Orthopedics and Traumatology Colleges, A.C
CONAMEGER	National College of Geriatric Medicine, A.C
GeriatrIMSS	Institutional geriatric plan GeriatrIMSS, Mexican Social Security Institute
AMG	Mexican Academy of Geriatrics, A.C
COMEFyR	Mexican College of Electrodiagnostic Medicine, Physical Medicine and Rehabilitation, A.C

two panelists representing each scientific society, and the societies had the liberty to propose their representative with the requirement of having clinical experience in hip fracture care and osteoporosis.

With this consensus, we sought to obtain a proposal of indicators that reflected with methodological robustness the opinion of a multidisciplinary team regarding fragility hip fractures.

Each indicator had to meet the following characteristics: it had to allow evaluating the care process or a health result, be clinically relevant for the patient, and be modifiable based on continuous improvement policies.

According to the RAND/UCLA methodology, the opportunity and necessity of each QI must be evaluated. For this, three virtual work meetings were held: the first informative, the second to evaluate and discuss the opportunity, and the third to evaluate and discuss its necessity. Opportunity is defined as when the expected health benefit exceeds the expected negative consequences by a sufficient margin that the procedure or indicator is worth performing, regardless of the cost. Each indicator was evaluated by panelists independently, on a scale of 1 to 9, where 1 means that the expected harm greatly exceeds the benefit, 5 means that the harm and benefit are approximately equal, and 9 means that the expected benefit greatly exceeds the expected harm. Necessity establishes that an indicator is indispensable when its benefit outweighs the risks by a sufficient margin so that the doctor is forced to identify or record it; it would be inappropriate not to do so; it would be unethical not to do so; there is a great opportunity that this indicator will benefit the patient; the magnitude of the expected benefit is not small. Each indicator was evaluated from 1 to 9, where 1 means that the procedure is clearly not necessary and 9 means that the procedure is clearly necessary. After the opportunity and necessity assessment process, a virtual meeting was held to discuss the indicators with borderline ratings. During this meeting, each panelist had the opportunity to present their perspective, and after hearing all viewpoints, a final rating was assigned by re-evaluating each indicator and providing a definitive numerical value.

Each QI was classified based on its phase of the hospitalization cycle as presurgical, trans-operative, post-surgical, or perioperative. They were also classified based on whether they corresponded to infrastructure, organization, or results.

Results

After the systematic review, 44 indicators (Table 3) were analyzed by the panelists. After being rated for opportunity, 8 indicators were eliminated for not meeting the arithmetic mean greater than 7, after which 3 indicators were eliminated in the necessity evaluation. Following the virtual

opportunity assessment meeting, the 4-h indicator in the emergency department was modified to 8 h by unanimous vote to better align with the Mexican healthcare system. This adjustment reflects the panel's consensus on adapting the indicator to the practical realities and specific demands of local healthcare facilities. After consensus, a list of 33 final indicators was obtained (Table 4). As a final part of the project, operational definitions were established, as well as numerators and denominators for future adoption (Table 5), which were accepted by consensus.

Discussion

To the best of the authors' knowledge, this is the first multidisciplinary proposal that unites the leading scientific and academic societies across the specialties involved in hip fracture care. Additionally, this proposal provides a framework for continuous improvement, with regular reviews and adaptations to facilitate its implementation and enhance outcomes in hip fracture care.

The process of adopting indicators from the leading countries in the generation of quality proposals in hip fracture, and the adaptation in the operational definitions for Mexico, promotes homogeneity in the criteria of good practices. It should be noted that the evaluation of opportunity and necessity, which are part of the RAND/UCLA consensus methodology, allowed us to analyze the importance and impact of including each QI in the proposal for our country.

In contrast with other international proposals [10, 12, 13, 18], the number of indicators derived from the consensus process was quite large. In Mexico, this high number of indicators could be seen as a limitation, as it may complicate implementation in hospitals with heavy workloads. However, it is important to emphasize that this represents an initial proposal in an ongoing process, which will eventually lead to the selection of the most essential indicators. We considered other limitations such as the potential variability in resources across different healthcare institutions in Mexico. Additionally, the challenges of adapting international QIs to the Mexican context could be further explored.

The authors aimed to maintain a balanced number of indicators across the preoperative, intraoperative, and postoperative phases. This process represents the first step in refining the selection of indicators based on expert consensus. Each institution or medical group will then be responsible for implementing the indicators that best align with their available resources.

This first proposal raises awareness about the need for public policies that contribute to the process of continuous improvement and epidemiological surveillance, both in the public and private sectors of our health system. It will also

Table 3 Indicators with AIRE

Indicator name		AIR (% average)	Chance	Need
1	Imaging options for suspected occult fracture	60	7	7
2	Early surgery < 24 h	87.5	7.5	-
3	Early surgery < 36 h	87.5	7.5	-
4	Early surgery < 48 h	92.5	9	9
5	Less than 4 h in the emergency room	52.5	5.5	-
	Less than 8 h in the emergency room		8	8
6	Auxiliary diagnostic tests from the emergency room	56.25	9	8
7	Pre-surgical solids fasting of no more than 10 h	53.75	6.5	-
8	Pre-surgical fasting of no more than 4 h	53.75	7	8
9	Antimicrobial prophylactic	65	8.5	8
10	Type of surgery according to NICE guidelines	76.25	7.5	8
11	Nutritional assessment	65	8.5	9
12	Early mobilization out of bed in the post-surgical	86.25	9	9
13	Return to original home in 120 days	56.25	6.5	-
14	Risk of falls	66.25	9	9
15	Post-surgical physiotherapy	68.75	9	9
16	Occupational therapy on the 3rd day	52.5	6.5	-
17	Planning discharge with 48 h of anticipation	52.5	7.5	7
18	Bone health approach	73.75	9	9
19	Calcium supplementation at discharge	70	9	8
20	Vitamin D supplementation at discharge	70	9	8
21	Independent mobility 30 days after hospital discharge	65	8.5	8
22	Limitation of post-surgical transfusion	72.5	7	7
23	Partial loading the day after surgery	93.75	7	7
24	Orthogeriatric Assessment	93.75	9	9
25	Multimodal analgesia from the emergency room	53.75	8	8
26	Cognition screening	63.75	8	8
27	Risk of pressure ulcers or their development during hospitalization	77.5	9	9
28	Avoid routine urinary catheter	55	7	7
29	Pharmacological thromboprophylaxis	90	9	9
30	Multidisciplinary joint management	71.25	9	9
31	Screening and management of delirium	61.25	9	9
32	Mortality (in-hospital, 30 days, 90 days)	60	8.5	9
33	Time between fracture and emergency room	51.25	7.5	7
34	Total operation time	57.5	6	7
35	Time between fracture and rehabilitation	65	8	7
36	Echocardiogram or cardiological evaluation in cases of: acute heart failure, angina, new-onset arrhythmias, severe valvular disease, new-onset murmurs	50	7.5	-
37	Regional anesthesia preference	53.75	7.5	8
38	Diagnosis of pre-fracture gait	52.5	8	7
39	Participation in national hip fracture registry	65	8	7
40	Anticoagulation reversal protocol	51.25	7	-
41	Complications management protocol	50	8.5	8
42	Percentage of institutionalization	50	5.5	-
43	Measurement of quality of life	50	8	9
44	Number of hospital readmissions	50	8	8

Table 4 Final indicators

	Indicator name	Type	Phase of the orthogeriatric cycle
		Process (P) Structure (E) Results (R)	
1	Imaging options for suspected occult fracture	P, E	Pre-surgical
2	Early surgery < 48 h	P	Pre-surgical
3	Less than 8 h in the emergency room	E	Pre-surgical
4	Auxiliary diagnostic tests from the emergency room	P, E	Pre-surgical
5	Pre-surgical fasting of no more than 4 h	P	Pre-surgical
6	Antimicrobial prophylactic	P	Pre-surgical
7	Type of surgery according to NICE guidelines	E	Trans-surgical
8	Nutritional assessment	P	Trans-surgical
9	Early mobilization out of bed after surgery	P	Post-surgical
10	Risk of falls	P	Post-surgical
11	Post-operative physical rehabilitation	E	Post-surgical
12	Bone health approach	P	Post-surgical
13	Calcium supplementation at discharge	P	Post-surgical
14	Vitamin D supplementation at discharge	P	Post-surgical
15	Independent mobility 30 days after hospital discharge	R	Post-surgical
16	Limitation of post-operative transfusion	P	Post-surgical
17	Partial loading the day after surgery	P	Post-surgical
18	Orthogeriatric assessment	E	Perioperative
19	Multimodal analgesia from the emergency room	P	Perioperative
20	Cognition screening	P	Perioperative
21	Risk of pressure ulcers or their development during hospitalization	P	Perioperative
22	Avoid routine urinary catheter	P	Perioperative
23	Pharmacological thromboprophylaxis	P	Perioperative
24	Multidisciplinary joint management	P, E	Perioperative
25	Screening and management of delirium	P	Perioperative
26	Mortality (in-hospital, 30 days, 90 days)	R	Post-surgical
27	Total operation time	P	Trans-surgical
28	Regional anesthesia preference	P	Perioperative
29	Diagnosis of pre-fracture gait status	P	Perioperative
30	Participation in national hip fracture registry	P, E	Perioperative
31	Complications management protocol	R	Perioperative
32	Measurement of quality of life	R	Perioperative
33	Number of hospital readmissions	R	Post-surgical

likely drive the development of national indicators based on epidemiological data.

The process indicators that obtained the highest rating in the necessity evaluation, and the authors considered to be the essentials in Mexican hospitals are surgery before 48 h, mobilization and loading the day after surgery, orthogeriatric co-management, nutritional assessment, fall prevention strategies, delirium detection and treatment strategies, pressure ulcers prevention, secondary fracture prevention upon discharge from the hospital, and pharmacological thromboprophylaxis. Although from a methodological point of view, these indicators are just as

relevant as the rest, it is considered that they would be the most feasible to be used in the first phase.

The indicators of the pre-surgical phase are aimed at optimizing time and promoting early surgery. The RAND/UCLA consensus allowed us to identify that some of the indicators found in the literature, despite having an evidence-based profile that favors better results, are not timely or necessary for the Mexican health care system. For example, a stay of less than 4 h in the emergency room and surgery in less than 24 h; therefore, the consensus chose a stay of 8 h or less in the emergency room and a surgical delay of less than 48 h.

Table 5 Operational definitions of the final indicators, as well as numerators and denominators of each indicator

Number of quality indicator	Quality Indicator	Operational definition	Numerator	Denominator
1	Imaging options for suspected occult fracture	Magnetic resonance imaging (MRI) or tomography (CT) is performed for negative radiographs with a high index of suspicion of hip fracture	Number of patients undergoing MRI or CT with negative radiograph and high suspicion of fracture with inconclusive radiograph to rule out fracture	Total number of patients presenting to the emergency room with a high suspicion of fracture and negative x-ray
2	Early surgery (< 48 h)	Time elapsed between admission to the emergency department and the start of surgery less than 48 h	Number of patients undergoing surgery for hip fracture in less than 48 h from admission to the operating room	Total patients with hip fracture undergoing surgery for hip fracture who were admitted to the emergency department
3	Stay in the emergency room less than 8 h	Time elapsed between admission to the emergency department and admission to the hospitalization floor	Number of patients with hip fracture admitted to hospital with a stay in the emergency room of less than 8 h	Total patients with hip fracture admitted to hospitalization
4	Auxiliary diagnostic tests from the emergency room	The minimum essential laboratories are requested for surgery programming from the emergency service	Number of patients with preoperative auxiliary diagnostic test protocol carried out in the emergency room	Total patients with hip fracture admitted to hospitalization
5	Pre-surgical liquid fasting of no more than 4 h	The liquid fasting time prior to the surgical procedure is no more than 4 h	Number of patients with hip fracture undergoing surgery who fasted to liquids < 4 h before surgery	Total number of patients with hip fractures admitted to surgery
6	Antimicrobial prophylaxis	Antimicrobial administered prophylactically 1 h before surgery	Number of patients with hip fracture who received antimicrobial prophylaxis 1 h before surgery	Total number of patients with hip fractures admitted to surgery
7	Type of surgery according to NICE recommendation	The implant was chosen based on the NICE recommendations for the type of hip fracture: (a) Intracapsular = prosthesis or hemiarthroplasty, (b) transacetabular = intramedullary nail or sliding plate, (c) subtrochanteric = intramedullary nail	Number of hip fracture patients undergoing surgery with implant selection based on NICE guideline recommendations	Total number of patients with hip fractures admitted to surgery
8	Nutritional assessment	Screening of nutritional status at the time of admission and strategies to avoid malnutrition during the hospital stay	Number of patients with hip fracture with nutritional assessment and intervention	Total number of patients with hip fractures admitted to the emergency department
9	Early mobilization out of bed in the immediate post-operative period	Mobilization out of bed (sitting or beginning of standing) the day after surgery	Number of patients with hip fracture undergoing surgical treatment and mobilized out of bed the day after surgery	Total number of patients with hip fractures admitted to surgery
10	Fall risk assessment	The fall that caused the fracture was addressed, the risk of new falls was evaluated, and strategies were established to prevent falls in the future	Number of hip fracture patients who received a fall risk assessment	Total number of patients with hip fractures admitted to the emergency department
11	Post-operative physical rehabilitation	Starting a rehabilitation program the day after surgery	Number of patients with hip fracture starting physical rehabilitation the day after surgery	Total patients with hip fracture undergoing surgery

Table 5 (continued)

Number of quality indicator	Quality Indicator	Operational definition	Numerator	Denominator
12	Bone health approach	screening previous fractures, vit D levels, causes of secondary osteoporosis and initiation of antiresorptive or osteo forming treatment	Number of patients receiving bone health approach	Total number of patients with hip fractures admitted to the emergency department
13	Calcium supplementation at discharge	It is supplemented with 500 mg of calcium and continued upon discharge	Number of hip fracture patients with calcium supplementation	Total number of patients with fractures admitted to the emergency department
14	Vitamin D supplementation at discharge	It is supplemented with 800 to 1200 U of vitamin D and is continued upon discharge	Number of hip fracture patients receiving vitamin D supplementation	Total number of patients with hip fractures admitted to the emergency department
15	Independent mobility 30 days after hospital discharge	Independent walking at least indoors 30 days after discharge	Number of patients with hip fracture who manage to walk independently indoors 30 days after discharge	Total number of patients with hip fractures undergoing surgery
16	Limitation of post-operative transfusion	Avoid blood products with Hemoglobin > 8 g/dl or asymptomatic	Number of hip fractured patients with hemoglobin equal to or > 8 g/dl who are not transfused	Total patients with hip fracture with hemoglobin greater than or equal to 8 g/dl
17	Partial loading the day after surgery	Beginning of weight-bearing or standing the day after surgery	Number of patients with hip fracture undergoing surgery who begin weight-bearing (total or partial) or standing the day after the intervention	Total number of patients with hip fracture undergoing surgical treatment
18	Orthogeriatric assessment	Comprehensive geriatric assessment with approach to geriatric syndromes during hospitalization	Number of patients with hip fracture who were evaluated by a geriatrics team	Total number of patients with hip fractures admitted to the emergency department
19	Multimodal analgesia from the emergency room	Assessment of anesthesiology or algology and administration of pharmacological analgesia and/or analgesic block	Number of patients who received multimodal analgesia with administration of pharmacological analgesia and/or analgesic block	Total number of patients with hip fractures admitted to the emergency department
20	Cognition screening	Screening of cognitive status was performed prior to and at the time of admission to the emergency room	Number of patients who received a cognitive status screening upon admission	Total patients with hip fracture
21	Risk of pressure ulcers or their development during hospitalization	The risk of pressure ulcer development during hospitalization was established	Number of patients whose risk of pressure ulcers was determined	Total patients with hip fracture admitted to hospitalization
22	Avoid routine urinary catheter	A perioperative urinary catheter is used in the case of precise medical indications (urinary retention, hemodynamic instability, kidney injury, etc.)	Number of patients in whom a urinary catheter was placed without precise indication	Total patients with hip fracture admitted to hospitalization
23	Pharmacological thromboprophylaxis	Pharmacological treatment for thromboprophylaxis is administered (unfractionated heparin, low molecular weight heparin, new oral anticoagulants)	Number of patients with hip fracture and pharmacological prophylactic antithrombotic therapy	Total number of patients with hip fractures admitted to the emergency department

Table 5 (continued)

Number of quality indicator	Quality Indicator	Operational definition	Numerator	Denominator
24	Multidisciplinary joint management	The patient was cared for by a multidisciplinary team in fragility fracture care (traumatology, geriatrics, nursing, rehabilitation, others)	Number of patients with hip fracture who were treated by a multidisciplinary team	Total number of patients with hip fractures admitted to the emergency department
25	Screening and management of delirium	A screening was carried out to detect delirium, as well as strategies for its prevention and treatment	Number of patients with hip fracture with delirium screening and intervention for its prevention	Total number of patients with hip fractures admitted to the emergency department
26	Mortality (In-hospital, 30 days, 90 days)	In-hospital mortality was measured at 30 and 90 days	Number of patients who died in the hospital, 30 and 90 days after discharge from the hospital	Total number of patients with hip fractures admitted to the emergency department
27	Total operation time	The intraoperative period lasted less than 3 h	Number of patients with hip fracture with surgery lasting less than 3 h	Total number of patients with hip fracture undergoing surgical treatment
28	Regional anesthesia preference	The anesthetic technique of first choice in patients with hip fractures undergoing surgery was regional anesthesia	Number of patients with hip fracture undergoing surgery with regional anesthesia technique	Total patients with hip fracture with surgical treatment
29	Diagnosis of pre-fracture gait characteristics	A diagnosis of gait characteristics was made prior to the fracture	Number of patients with hip fracture who underwent a diagnosis of gait characteristics prior to the fracture	Total number of patients with hip fractures admitted to the emergency department
30	Participation in the national hip fracture registry	The center participates in a national or regional hip fracture registry	Number of hip fractured patients included in the selected area and timelapse in the audit	Total of hip fractures during a certain period of time in certain region
31	Complications management protocol	There is a pre-established protocol for the care of common complications after a hip fracture	Number of patients in whom a complication occurred and was managed according to a local established protocol	Total number of patients with hip fractures admitted to the emergency department
32	Quality of life measurement	Quality of life was evaluated with a validated instrument after hip fracture	Number of patients with hip fracture who had a quality-of-life evaluation in the first year after hospital discharge	Total number of patients with hip fractures discharged from the hospital
33	Number of hospital readmissions	The patient was admitted to the hospital within 90 days of discharge	Number of patients readmitted to the hospital 90 days after discharge	Total patients with hip fracture admitted after surgery or conservative management

Altogether, the indicators that favor the formation of multidisciplinary teams include orthogeriatric assessment, the inclusion of the anesthesiologist in the process including multimodal pain management from the emergency room [19], as well as early physical rehabilitation [20]. This scenario is being implemented with a greater tendency in various countries; however, in Mexico, there are still few medical units with multi- or interdisciplinary teams formed with these characteristics.

Finally, operational definitions were generated for implementation, as well as well-established numerators and denominators to be measured as indicators. This favors its inclusion in a potential regional or national registry, as has been done in the UK National Hip Fracture Database [21] or the Spanish Registry of Hip Fractures [22]. With information from regional or national registries, the operational definitions could be reviewed and adapted to what is considered necessary by the multidisciplinary consensus. The authors are aware that the generation of indicators entails a different and complex process, with strict methodological rigor and obtained based on local data. However, since this information was not available in Mexico, it was decided to adapt indicators developed in other countries.

This work presents new information at the national level and might be the first step to promote future projects of continuous improvement in the care of patients with hip fractures in our country, with a multidisciplinary and comprehensive vision.

To the best of our knowledge, this is the first Mexican project that brings together a group of experts representing medical societies from various specialties of importance in the care of patients with hip fragility fractures, with the aim of proposing QIs that are relevant for the national reality. These efforts have been carried out in other countries, in which it was possible to establish goals and standards for their implementation in hospitals that care for patients with hip fractures, favoring not only adherence to the indicators themselves, but also the formation of orthogeriatric and multidisciplinary joint co-management. Likewise, it has been possible to improve the functional prognosis of these patients and reduce the incidence of complications [13].

The successful dissemination and adoption of the proposed quality indicators will require a coordinated strategy involving academic institutions, professional medical societies, and healthcare authorities. Educational campaigns, workshops, and integration into clinical guidelines, if possible, will be essential to promote awareness and facilitate uptake among healthcare providers. Pilot implementations in diverse healthcare settings will help assess the feasibility and practicality of the indicators, allowing for the identification of barriers and enablers in real-world contexts. Additionally, establishing mechanisms for continuous monitoring and feedback will be vital to evaluate performance, guide quality

improvement initiatives, and inform necessary updates. Periodic reevaluation of the indicators will ensure their continued relevance, adaptability to emerging evidence, and alignment with the evolving needs of the Mexican healthcare system.

Conclusions

This consensus proposal of QIs for the care of patients with fragility hip fracture represents the first multidisciplinary initiative in Mexico focused on an important public health problem and promotes continuous improvement in comprehensive care.

The 33 indicators selected by a panel of interdisciplinary experts have the potential to improve care outcomes, reduce costs, and standardize the quality of health care provided to patients with hip fragility fracture.

These indicators can also contribute to the promotion of projects, such as regional, national, or institutional registries of fragility hip fractures, which allow identifying areas of opportunity to improve the quality of comprehensive medical care. It is essential to recognize that the continuous application and constant assessment of these indicators are crucial aspects for their refinement, both at a conceptual and operational level. The recurring evaluation will reflect the maturity of the orthogeriatric teams in Mexico and will guarantee the relevance and effectiveness of the indicators over time.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11657-025-01561-0>.

Declarations

Human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, informed consent is not required.

Conflict of interest None.

References

1. Cauley JA (2017) Burden of hip fracture on disability. *Lancet Public Health* 2(5):e209–e210. [https://doi.org/10.1016/S2468-2667\(17\)30067-1](https://doi.org/10.1016/S2468-2667(17)30067-1). (Epub 2017 Apr 11)
2. Chatziravdeli V, Vasiliadis AV, Vazakidis P, Tsalidou M, Katsaras GN, Beletiotis A (2021) The financial burden of delayed hip fracture surgery: a single-center experience. *Cureus* 13(3):13952. <https://doi.org/10.7759/cureus.13952>. (two)
3. Mohd-Tahir NA, Li SC (2017) Economic burden of osteoporosis-related hip fracture in Asia: a systematic review. *Osteoporos Int* 28(7):2035–2044. <https://doi.org/10.1007/s00198-017-3985-4>. (Epub 2017 Mar 17)

4. Cenzer IS, Tang V, Boscardin WJ, Smith AK, Ritchie C, Wallhagen MI et al (2016) One-year mortality after hip fracture: development and validation of a prognostic index. *J Am Geriatr Soc* 64(9):1863–1868. <https://doi.org/10.1111/jgs.14237>. (Epub 2016 Jun 13)
5. Drevet S, Bornu BC, Boudissa M, Bioteau C, Mazière S, Merloz P et al (2019) Mortality of people aged 75 and over after a fracture of the upper end of the femur: follow-up of a prospective cohort [One-year mortality after a hip fracture: prospective study of a cohort of patients aged over 75 years old]. *Geriatr Psychol Neuropsychiatr* 17(4):369–376. <https://doi.org/10.1684/pnv.2019.0821>. (French)
6. González Marcos E, González García E, González-Santos J, González-Bernal JJ, Del Pilar M-R, Santamaría-Peláez M (2022) Determinants of lack of recovery from dependency and walking ability six months after hip fracture in a population of people aged 65 years and over. *J Clin Med* 11(15):4467. <https://doi.org/10.3390/jcm11154467>
7. Carlos F, Clark P, Maciel H, Tamayo JA (2009) Direct costs of osteoporosis and hip fracture: an analysis for the Mexican Social Insurance Health Care System. *Salud Publica Mex* 51(Suppl 1):S108–S113. <https://doi.org/10.1590/s0036-36342009000700014>
8. Viveros-García JC, Rodríguez-Sánchez B, BaldenebroLugo LS, Guillermo-Nuncio EA, Nieto-Sandoval HR, VázquezCantero E (2021) Costs due to surgical delay in fragility hip fracture. *Orthotips* 17(4):195–201. <https://doi.org/10.35366/102216>
9. Voeten SC, Krijnen P, Voeten DM, Hegeman JH, Wouters MWJM, Schipper IB (2018) Quality indicators for hip fracture care, a systematic review. *Osteoporos Int* 29(9):1963–1985. <https://doi.org/10.1007/s00198-018-4558-x>
10. National Institute For Health and Care Excellence (2011) Hip fracture: management. Disponible en: www.nice.org.uk/guidance/CG124. Accessed 24 Aug 2023
11. Hip fracture care for people with fragility fractures. Health Quality Ontario 2017. Disponible en: <https://www.hqontario.ca>. Accessed 19 Sept 2023
12. Pioli G, Barone A, Mussi C, Tafaro L, Bellelli G, Falaschi P et al (2014) On behalf of GIOG. The management of hip fracture in the older population. Joint position statement by Gruppo Italiano Ortogeriatría (GIOG). *Aging Clin Exp Res* 26(5):547–53. <https://doi.org/10.1007/s40520-014-0198-y>
13. Walsh ME, Ferris H, Coughlan T, Hurson C, Ahern E, Sorensen J et al (2021) Trends in hip fracture care in the Republic of Ireland from 2013 to 2018: results from the Irish Hip Fracture Database. *Osteoporos Int* 32(4):727–736. <https://doi.org/10.1007/s00198-020-05636-1>
14. Fitch K (ed) (2001) The RAND/UCLA appropriateness method user's manual. Santa Monica (CA): RAND Corporation, 126:978-0-8330-2918-8. Available from: https://www.rand.org/pubs/monograph_reports/MR1269.html
15. Donabedian A (1988) The quality of care. How can it be assessed? *JAMA* 260(12):1743–8. <https://doi.org/10.1001/jama.260.12.1743>
16. Scottish Intercollegiate Guidelines Network (SIGN) (2019) SIGN 50: a guideline developer's handbook. Rev ed. Edinburgh: SIGN. Available from: https://www.sign.ac.uk/media/2038/sign50_2019.pdf
17. De Koning J, Smulders A, Klazinga NS (2007) Appraisal of indicators through research and evaluation (AIRE): Department of Social Medicine. University of Amsterdam, Academic Medical Center
18. Scottish Government. Scottish standards of care for hip fracture patients. Edinburgh: Scottish Government; updated Jul 2019. Endorsed by SCOT, RCEM, BGS, OTS, AAGBI, ROS, Healthcare Improvement Scotland. Available from: https://www.shfa.scot.nhs.uk/_docs/2019/Scottish-standards-of-care-for-hip-fracture-patients-2019.pdf
19. Ritcey B, Pageau P, Woo MY, Perry JJ (2016) Regional nerve blocks for hip and femoral neck fractures in the emergency department: a systematic review. *CJEM* 18(1):37–47. <https://doi.org/10.1017/cem.2015.75>
20. Handoll HH, Cameron ID, Mak JC, Panagoda CE, Finnegan TP (2021) Multidisciplinary rehabilitation for older people with hip fractures. *Cochrane Database Syst Rev* 11(11):CD007125. <https://doi.org/10.1002/14651858.CD007125.pub3>
21. National Hip Fracture Database. Royal College of Physicians. Available at: www.nhfd.co.uk. Accessed 12 Oct 2023
22. National Hip Fracture Registry. Available is: <https://rnfc.es/>. Accessed 12 Oct 2023

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