

REVIEW

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Post-fracture care program in Egypt: merging subsequent fracture prevention and improving patients' outcomes—an initiative by the Egyptian Academy of Bone Health

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Abstract

Background Despite the associated high prevalence of morbidity and mortality, osteoporotic fragility fractures remain underdiagnosed and undertreated. Furthermore, those who sustain a fragility fracture are at imminent risk of sustaining subsequent fractures. Post-fracture care (PFC) programs are systematic, coordinated care programs that recognize, evaluate, and manage older adults who sustained a fragility fracture with the goal of managing all the risk factors and preventing succeeding fractures.

Main text This work was carried out to outline the PFC program adopted in Egypt and its applicability in standard clinical practice. A review of literature was conducted to identify an evidence-informed PFC strategies and protocols, which outlines the optimal manner to manage older adults living with fragility fractures. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) checklist was used to guide the reporting of this review. Based on this, a PFC integrated model of care based on a patient-centered approach has been developed aiming to optimize the outcomes.

Conclusion This manuscript described the integrated model of care adopted in Egypt to provide care for older adults presenting with fragility fractures. This will pave the way to standardize patient identification and management. Additionally, to prevent occurrence of subsequent fractures and to enhance equity of care for patients with fragility fracture and osteoporosis, expansion of such service to rural and remote areas is highly recommended.

Keywords PFC, Post-fracture care program, Osteoporosis, Sarcopenia, Falls, FRAX, FRAS, Egyptian Academy of bone health, Osteosarcopenia, Functional disability, Rehabilitation

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Introduction

Post-fracture care (PFC) services are comprehensive programs aiming at proper evaluation and management of patients with fractures after minor traumas or fragility fractures. Many forms of PFC services exist, among them the most popular are Fracture Liaison Services (FLSs); also known as secondary fracture prevention services, geriatric/orthogeriatric services (OGSs); and geriatric fracture centers [1]. While the FLS and OGS programs can be considered as complementary to each other; with OGSs are being delivered mainly as inpatient services with no out-patient follow-up and FLSs focus on out-patient follow-up, in Egypt, with few exceptions, post-fracture care is provided for both the in- as well as out-patients by the FLS teams.

The primary goals of PFC are to prevent subsequent fractures and to improve overall outcomes (morbidity, mortality, and/ or physical function) [2]. Based on that, PFC services consist of five main components: case identification; osteoporosis assessment including dual energy X-ray absorptiometry (DXA) scan to measure bone mineral density and fracture risk assessment; treatment initiation with an osteoporosis therapy; systems to improve adherence and persistence with therapy, in addition to falls risk assessment and management [3].

Over the last few years, there has been a significant shift toward implementing PFC as one of the standards of care for fractured patients, with a surge in the number of published research describing how PFC programs can enhance the identification, diagnosis, assessment and management for patients with osteoporosis [4, 5]. However in spite of such growing awareness of the vital role of PFC programs, national publication gaps remain in most countries. This article discusses the cracks in the PFC service, its current status in Egypt, assess its clinical as well as cost-effectiveness. It will also identify the barriers and solutions to implementation of PFC program in Egypt.

Methodology

Literature review

A search for peer-reviewed articles published between January 2010 and August 2022 that are listed in PubMed or Google Scholar using agreed literature search terms. Publications eligible for assessment in this work included original research articles, systematic reviews, meta-analysis, guidelines/recommendations, case studies. Abstracts and congress proceedings were not eligible for assessment in this analysis. All of the publications reviewed were English language manuscripts. The work was stratified into PFC subtopics with one leading author in charge of each section. One author, in consultation with the

other authors, assessed all retrieved articles for relevance to PFC programs. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) checklist was used to guide the reporting of this review.

Where are the cracks and how to heal?

FLS is most operative when it is set up to function in multiple settings: the primary care service, accident and emergency department, radiology and orthopedic surgery departments, hospital inpatients as well as outpatient clinics. While, to some extent, enactment may be easily feasible in a closed healthcare system; it can also be applicable in an open system. However, there are several barriers to implementation which need to be addressed. The success of FLS care lies in a collaborative systems-based approach with appropriate stakeholder engagement, leading to seamless integration of osteoporosis care [6]. Two main cracks have been identified in setting up PFC service:

1. The major barrier to the PFC service is the lack of adequate communication and share of information between and healthcare decision-makers. At the service provider level, the lack of knowledge might be reflected in inadequate patient identification, poor provider contacts regarding patient care, insufficient record keeping/data management/electronic notifications, and poor-quality control. Therefore, currently, in many centers, the post-fracture osteoporosis management is disintegrated and does not meet the optimum level. Whilst orthopaedic surgery focuses on the management of the fracture, geriatric main attention is dedicated to medical management of the patient's condition whereas physical medicine and rehabilitation focus on the rehabilitation program. Consequently, many patients with low trauma fractures still do not receive osteoporosis therapy. Combining FLS and OGS services into a PFC program model has reported a 2- to 5-fold improvement in outcomes, including an improvement in program enrolment, bone mineral density assessment, diagnosis, and initiation of osteoporosis therapy [7–10].
2. Another crack appears at the patients' level; patients may not feel the importance of having a post-fracture follow-up assessment with their treating HCPs regarding osteoporosis. This is attributed to a lack of clarity around what are the next actions to be taken or denial that occurrence of a primary fracture puts them at higher risk of developing a subsequent fracture. Patients may also be unwilling or have limited ability to participate in PFC programs due to the time required for follow-up visits, out-of-pocket expenses, and frailty [7]. Patient education, shared decision-

making as well as motivation are the main tools to tackle this crack.

National gaps in post-fracture care

In concordance with the barriers identified on the international level, the implementation of a program for care of patients with fragility fractures is challenging for the health system in Egypt for several reasons:

1. The structure of healthcare system in Egypt: Egypt has a highly pluralistic health care system, which includes a wide range of public and private health-care providers with no real communication between them having different treatment and financing policies, as well as different stakeholders.
2. Lack of electronic patient health records which makes it difficult to recruit the cases with suspected osteoporotic fractures while admitted for surgical intervention or to the outpatient clinics for follow-up after surgery or for rehabilitation services/physiotherapy.
3. Lack of adequate co-operation/information among health care professionals (HCP) which may be attributed to several reasons including underestimation of the magnitude of the problem and its negative impact on the patients' lives and society, insufficient knowledge regarding the management strategy, time shortage and extra-duties relative to the limited numbers of physicians, fear of unexpected side-effects, lack of adequate provider communications regarding patient education and follow-up, absence of structured system that allow comprehensive post-fracture care implementation, adequate data management and saving as well as long-term follow-up. Another major challenge is the lack of communication between health staff of different specialties mainly orthopaedic surgeons, radiologists, geriatrics and physical medicine doctors.
4. Lack of public awareness regarding osteoporotic fractures, and the importance of adherence to treatment program to prevent recurrence of fractures. Lack of national or regional patients' societies' active role is another factor that contribute to the difficulty in patient education and clinical research.
5. Commitment of older patients who sustained recent hip fractures to both follow up and medical management represent a major challenge too. The poor participation of the older adults with low trauma fractures has been linked to multiple factors including difficulty of transportation specially from remote areas, their unwilling to follow-up due to post-opera-

tive complications as chronic pain, poor wound healing, fear of falling, and sometimes depression.

6. Financial issues: Egypt is one of the lower-middle income countries (LMIC), with a Gross Domestic Product (GDP) per capita of 3100 USD in 2019 [11–13]. Health insurance organization (HIO) which is independent government organization covers about 60% of the populations mostly children, students, and employees [14]. The remaining 40% have been granted treatment at the state's expense, but unfortunately, PFC services are not included in the latter; hence, older adult Egyptians included in this sector of population will not have access to such service.

PFC economics: cost effectiveness

World-wide healthcare systems are now beginning to recognize the benefits of secondary fracture prevention. Despite effective treatments to reduce fracture risk, less than 50% of patients receive effective secondary fracture prevention after a fragility fracture. To address this care gap, several initiatives have been published to improve clinical services by implementing fracture liaison services (FLSs).

According to a recent study conducted in the USA, implementing FLS services was highly likely to be cost-saving, both improving future health outcomes and reducing healthcare spending compared with usual care, even with more patients' compliance to osteoporotic medications [15]. This was in agreement with the study of West Glasgow FLS when 1000 hypothetical cohorts were applied to Markov model, the FLS pathway was able to prevent 18 fractures, resulting in a cost savings of £312,000 and despite the higher cost of osteoporosis related medications, the FLS saved an estimated £21,000 over the lifetimes of 1000 patients [16]. The same results were reported in Austria and Japan [17, 18]. On the other hand, in Taiwan, the FLS group had a higher expenditure than the usual care group on osteoporosis-related medications but longer re-fracture-free survival (RFS) [19].

Unfortunately, so far, there are no studies have been conducted to evaluate the cost effectiveness of PFC programs in Egypt. However, PFC services in Egypt is a combination of the FLS and OGS approaches. Such combined programs have reported a 2- to 5-fold improvement in outcomes, including program enrolment, osteoporosis testing and diagnosis, and early initiation of osteoporosis therapy for hip fracture patients in particular [4, 7–10, 20–22]. The Egyptian Academy of bone health has developed an Egyptian FLS clinical standards for implementation of PFC in Egypt in agreement with the international FLS protocols. The six clinical standards are

identification, investigation, intervention, integration, information, and quality [23].

Principles of PFC programs

Establishment of PFC program requires the identification of a framework entailing the different phases of the program. To secure success, it is vital for PFC programs to be an integral part of healthcare systems, with the PFC protocols or program framework deeply embedded into the hospital/clinic practice. Sharing of best practices through collaboration of different teams as well as evaluation of outcomes play an important role in the establishment of PFC programs.

Elements of highly functioning PFC program

The traditional ineffectiveness of the osteoporotic fragility fracture care has been attributed to the fragmentation of the service. A major project was launched by the IOF to develop a comprehensive approach to post-fracture care [2]. This was based on variable components from several classification systems as well as clinical/quality standards. Figure 1 shows the main elements of a highly functioning PFC program.

Patient identification

Patient identification is mainly through notifications for any fragility fracture in patients above 50 years of age. Hip fracture patients may be identified from those attending trauma clinics, surgical wards, or outpatient clinics during follow-up visits in post-operative period. While spine fractures could be identified by three ways either notification from radiologists for patients incidentally diagnosed to have silent vertebral fractures, or spine surgeons for symptomatic vertebral fractures and lastly the known clinically stable vertebral fracture cases who attend the out-patient rehabilitation clinics. Screening

using spine X-ray of those above 50 years old and above patients attending rehabilitation clinics presenting with noticeable loss of height (> 2-inches) or chronic back pain without history of known recent trauma was proved to be a useful way to capture patients with unidentified vertebral fractures [24].

Investigation (patient assessment)

Patient assessment is done by health care professionals from the department of rheumatology, physical medicine, and rehabilitation. Assessment of hip fracture is mostly done post-operatively in surgery wards before discharge from the hospital. Whereas the other fractured patients are assessed as soon as the fracture is diagnosed. The Egyptian Academy of Bone health has developed a questionnaire for assessment of patients with recent fractures to evaluate both the fracture and falls risk with further assessment of associated secondary causes for osteoporosis, medical, and surgical history as well as assessment of sarcopenia and functional disability [23]. Based on this, individual scores are identified for each patient to reflect his/her risk of the following:

- 10 years probability of fracture (FRAX score).
- Imminent fracture risk.
- Falling risks.
- Sarcopenia risk.
- Functional disability score.
- Cognitive affection level

Following that, each patient will have assessment for the following:

- Bone mineral density using DXA scan.
- Laboratory tests for bone profile, as well as kidney functions.

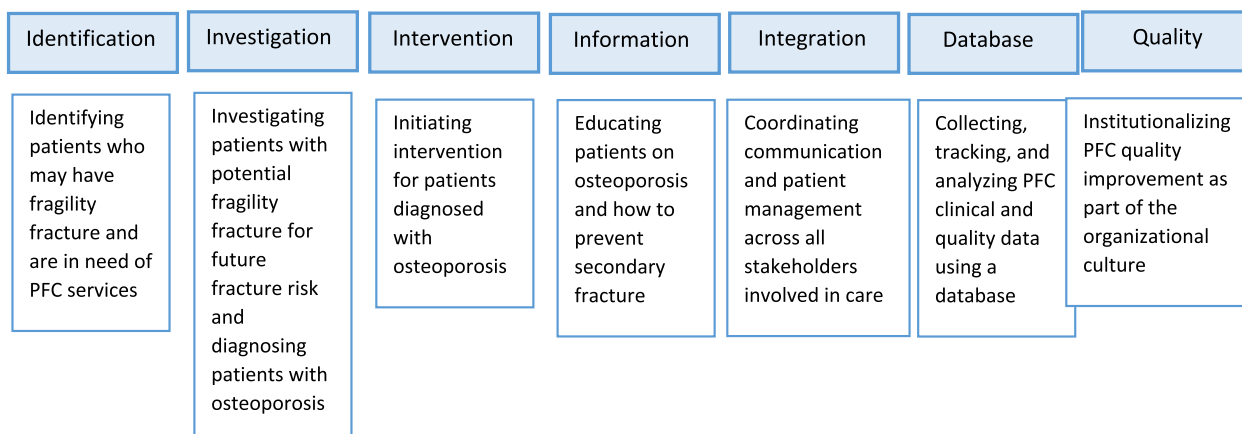


Fig. 1 The 7 elements (clinical standards) of highly functioning PFC program

Intervention

Management plan will be set up tailored to the individual patient's bone health status, fracture risk as well as comorbidity adopting a patient-centered approach and following the shared decision-making strategy. This includes the following:

- Medical management.
- Management of falling risks.
- Management of sarcopenia.
- Management of functional disability.

Information

Patient education help to increase patients' compliance to the program and positively affects their adherence to the rehabilitation program. Ideally it should start as early as possible while the patient is still admitted in the hospital in the post-operative period. Subsequently, the process continues to include all the patients attending the follow up out-patient trauma as well as the osteoporosis and PFC clinics. Patients' card was designed to give the fractured patient a brief idea about osteoporosis as the main cause of his/her disability and the importance of adherence to the PFC services to achieve maximum improvement and decrease the possibility of future fracture.

After a hip fracture, physical and psychological limitations are common, such as reduced mobility, impaired balance, lack of confidence, or fear of falling. Between 25% and 75% of people who walked independently before the fracture become dependent after 1 year or do not reach the same level before the fracture. Older hip fracture patients are at high risk for psychological problems related to the traumatic nature of the injury [25]. Therefore, early initiation of a personalized care plan aiming at restoring motion and function and minimizing the risk of another fracture should be among the primary goals of clinical care for hip fracture patients.

Patient educational program should be consisted of three phases: pre-surgical, post-surgical during hospital admission, and post-discharge transition to home. The educational program had triple purposes: to improve the patient's self-care capacity, provided that his baseline situation makes it possible; increase real and perceived competence in the patient and caregiver, and lastly make it possible for them to recognize and manage the warning signs [26]. These phases should be carried out in a coordinated style, such that the health education carried out during hospitalization (pre-surgical and post-surgical phase) is reinforced with recommendations on paper on how to recognize and manage warning signs, whereas support and guidance during the transition to discharge

(home phase) as well as the 15-day period after discharge, is carried out by caregiver professionals or trained family members [27].

In contrast to the pre-surgical phase where health program content includes information on the main complication derived from the hospitalization of the elderly, post-surgical educational program content aims at preventing delirium, malnutrition, falls, how to transfer from bed to chair with the presence of the caregiver, prevention of dislocations as well as assessment of adaptations for returning home. Home phase includes administration of medications and recognition of alarm signs by the patient and the caregiver, and providence of home adaptation appliances [28].

Supervised Home-based Exercise Therapy education: the home-based educational programs include showing the patients how to perform relevant home exercise. This should be carried out by the patient several times per week for several months under supervision of physical therapists. Videos of these programs should be provided to participants. Many studies hypothesized that home-based exercises would be superior to standard care; however, the results are controversial [26, 28]. However, providing patients with individualized education as part of secondary fracture prevention intervention to address their concerns about safety of exercise and timed ambulation and potential medication adverse events may increase osteoporosis treatment acceptance.

Integration

The integration of several providers into one system providing a comprehensive patient-centered care is the corner stone of the PFC program. Through such patient care integration and sharing of outcomes the PFC program show its cost effectiveness and value. Such integration will also ensure sustainability of the service and patients' compliance.

Also, to ensure the appropriate integration, it is important to ensure point of communication with other providers within the hospital or health center. This is achievable though the allocation of a post-fracture point of contact. Seeking patients' feedback is also important to ascertain their level of satisfaction with care

Quality (performance indicators)

Measuring quality of care is a relatively complex process. Traditionally, it is always assumed that the delivery of a model of care is by itself sufficient evidence for quality and that the quality will improve with the expansion of the coverage. However, in modern medicine such assumption and quality of care should be objectively tracked on regular basis, e.g., annually. The development of a patient-level key performance indicator set to

measure the effectiveness of fracture liaison services and guide quality improvement is major step to ascertain such quality [29]. This key performance indicator complements the existing Best Practice Framework to support FLSs to examine their own performance using patient-level data. By using this KPI set for local quality improvement cycles, FLSs will be able to efficiently realize the full potential of secondary fracture prevention and improved clinical outcomes for their local populations. The development of the Egyptian key performance indicators [23] would facilitate auditing the quality of the services provided by the different centers and within the same individual center.

Optimizing post-fracture management

Falls: risk assessment and management

For older adults, falls are considered one of the most common health concerns, they face in their lives. The negative impact of falling on the quality of life of older

persons, frequently leads to a decline in their self-confidence, capacity for self-care and their engagement in physical and social activities. It also causes distress, pain, injury, disability, loss of independence, as well as mortality. Independent of injuries, fear of falling, which appears in 20 to 39% of fallers, can cause people to limit their activities even more [30].

The Egyptian Academy of bone health and metabolic diseases has partnered fracture risk assessment with falls evaluation in its standard practice [31]. The Falls Risk Assessment Score (FRAS) [32] is used in combination with the FRAX questionnaire to assess subjects for fracture and falls risk in the standard practice or when people are referred for DXA scanning. This enabled fast screening of the patients and the identification of those at high risk of falling. FRAS was adopted for its validity, reliability as well as easiness to complete [32, 33]. Table 1 shows a summary of the clinical assessment of patients at risk of falling or who have past history of falling.

Table 1 Clinical assessment of patients at risk of falling or who present with history of falling

Item	Description
History	
History of falling	the number of falls in the past year The circumstances of falling History of loss of balance or feeling unsteady when walking Other medical condition Document falls history
Postural hypotension	Assess for risk factors: prolonged recumbency, medication side effects, and extrapyramidal manifestations. History of light-headedness, weakness, blurred vision, fatigue, headache, or syncope within 1 to several minutes of standing up. Cardiovascular assessment/consultation should be considered. Sleeping with the head of the bed elevated may reduce postural hypotension Preventive measures: e.g., reduce the dosage of blood pressure therapy, wearing compressive calf stocking.
Medications	Several classes of medications increase fall risk: anti-psychotics, anti-convulsant medications, anti-hypertensives, nonsteroidal anti-inflammatory drugs, muscle relaxants, and diuretics. More risk is liable with polypharmacy Choosing the appropriate medications with the least effective on balance and equilibrium is crucial in fall assessment prevention.
Clinical examination	
Fall-focused physical examination:	Assessment of the patient's gait and balance. Tools for assessment: Timed Up and-Go (TUG), the 30-Second Chair Stand test • Baseline cognitive assessment • Neurological examination • Visual examination.
Cardiac	• Cardiovascular assessment • Tilting test
Assessment of home hazards	Usually carried out by a trained professional, e.g., an occupational therapist. Hazards that need to be addressed are identified such as loose carpets, seats that are too low or dim lighting, or safety devices that need to be installed such as handrails or grabrails.
Screen for risk factors	Functional disability Sarcopenia and frailty

Management of fall risk

The targets of fall risk management include lowering the chances of falling, reducing the risk of injury, maintaining the highest possible level of mobility, and ensuring ongoing follow-up.

The clinical approach to high falls risk management:

- Collaborate with patients and their caregivers to address fall risk factors
- Discuss the importance of strength and balancing exercise especially that focus on improving strength and balance which have the most effective single intervention for reducing falls and fall-related injuries.
- Prioritize interventions for modifiable risk factors, the three key risk factors (balance, medications, and home safety) should be addressed for everyone at high risk.
- Connect patients to evidence-based community fall prevention programs
- These efforts are done in multi-disciplinary manœuvre including physiatrists, geriatric medicine specialists, physiotherapists and occupational therapist if available.

Management of osteosarcopenia in hip fracture patients

The pathogenesis of sarcopenia is associated with a change in the balance between protein catabolism and anabolism in the muscle tissue, which leads to a gradual loss of muscular mass [34], in addition to inflammatory cytokines which can also impact negatively on this balance. Therefore, the main lines of management can be summarized under a triad of nutrition, exercise, and drug intervention.

Non-pharmacological treatment of osteosarcopenia

There is increasing evidence that increasing protein intake and progressive resistive exercise can increase muscle mass and strength [35, 36]. Zhang et al. 2020 [37] concluded that muscle strength and function can improve using moderate to high intensity resistance exercises [8]. However, those with perioperative hip fracture cannot immediately tolerate an exercise intervention. Earlier data revealed that resistance exercise is recommended to be at least 2 to 3 times per week for this cohort of patients [38].

Dietary supplementation and over the counter medication in form of high-quality protein supplement (1.2–1.5 g/kg/day) in addition to dietary protein are recommended [39]. In addition, vitamin D (800–1000

IU/day) [40] and calcium intake (1000–1300 mg/day) [41] are also advised.

Pharmacological treatment in osteosarcopenia

All patients with low bone mineral density and *T* score less than -2.5 should start pharmacological treatment. No drug has been proven to be effective in treating sarcopenia. Angiotensin converting enzyme inhibitors are still under trial. Anti-myostatin therapies have demonstrated only modest efficacy [42, 43]. Recently, investigators discovered advantages of denosumab for older persons in terms of muscle and bone mass, as well as muscle strength and balance [44, 45]. Testosterone and growth hormone can be used clinically to improve sarcopenia, according to literature. Growth hormone can improve muscle mass to some extent but it will not improve muscle function [46].

Measuring outcome

Based on the definitions of sarcopenia, muscle mass, strength, and physical performance are regarded to be the most important outcomes to measure [47].

After treatment intervention functional outcome can be measured using the modified Barthel index, appendicular lean body mass using DXA and muscle strength using hand-held dynamometer.

Management of functional disability

Recent prospective study carried out by the Egyptian Academy of Bone Health and Metabolic Bone Diseases [33] recommended the “triad assessment” of falls risk, sarcopenia, and functional ability for the assessment of low trauma fracture risk at any time. Functional disability was assessed using a questionnaire of 10 questions that was extracted from the Arabic-Multidimensional Health Status Questionnaire (Arabic-MDHAQ) [48]. Results of the study revealed that these components are linked together in a rebound causative-effect relation where each one of them could lead to the other two; therefore, the triad assessment in addition to the fracture risk valuation will allow tackling of the three components at one point leading to better plan formatting with better results.

Managing functional disabilities includes education sessions to the patients and their caregivers about the nature of the condition, the importance of keep moving with taking all the precautions not to fall, following healthy diet with good amount of protein as well as adherence to therapy.

Performing strengthening and balance exercises on regular bases is of significant importance to improve the

function of osteoporotic and old patients as have been documented in several studies [33, 49].

Suggested corrective plan for pushing the consideration of functional disability in osteoporotic patients forward include spreading the information about the negative link between the falls, sarcopenia, and functional disability level and encouraging all HCPs to perform the triad assessment before building their plan of treatment. Besides, increasing the awareness about following a comprehensive, holistic, and multidisciplinary approach in treating functional disability in this population. In addition to increasing the awareness about the importance of adhering to the FLS protocol in Egypt which is a great step in the comprehensive care process of osteoporotic patients.

Rehabilitation management

The rehabilitation of elderly is rather complex including many aspects which not only involve the musculoskeletal system, but also the cognition, psychological status (involving self-esteem, depression, anxiety, and fears). All these factors affect the patients' compliance and impact on the family members' motivation to respond to the suggested management approach. Musculoskeletal system is frequently affected with overt postural abnormalities such as forward head posture, dorsal kyphosis, as well as flexion deformities of the hips and knees. The abnormal postural attitude may be further complicated by the common neurological manifestations of elderly population due to the degenerative disc lesion, stroke, Parkinson's disease, and peripheral neuropathy. Also, the presence of the common degenerative joint diseases and gouty arthritis may elicit pain during ambulation or limit the range of movement. Visual and hearing defects in the elderly population makes rehabilitation somehow difficult as it limits communication skills with the patient which are necessary to follow the instructions given. Extra care should be considered for patients with cardiac or respiratory disease to customize the rehabilitation program according to their comorbidity guided by respiratory functions and echo cardiography. Also, patients living a sedentary life should have a more gradual escalation of exercise intensity and duration.

Rehabilitation program should be tailored to the individual patient's condition and medical status. For example, individuals with vertebral fractures may have a number of challenges including kyphosis, alterations in trunk muscle control, and pain which affects their participation in exercise, daily activities, and reduces quality of life. Randomized controlled trials (RCT) and meta-analyses have demonstrated that exercise improves quality of life, reduces pain, and improves physical function post-vertebral fractures. The Too Fit To Fracture

recommendations have stressed the importance of individuals with vertebral fractures to engage in a multi-component exercise program, including resistance training and balance training [50].

It should be noted that exercise should be customized and graduated to consider the risk to benefit ratio with valuation of the patient response by measuring the effect of exercise on pain scoring, quality of life, mobility, activities of daily living. Intensity of exercise and resistance applied is customized to ensure safety and tolerability to prevent complications and ensure compliance. All of these exercises should follow the Centers for Disease Control and Prevention recommendations guidelines [51]. On another note, key considerations in prescribing assistive devices are to prevent further complications by appropriately fitting the device to the patient and providing proper education and assessment of understanding for their use [52].

Balance training should target the three sense of balance, the vestibular, visual, and proprioceptive sensations and ensure safety at the same time such as performing the exercise in a room corner with a chair in front. Progression of training to exercise on foam floor and challenging positions such as tandem standing and walking is progressed.

Meta-analyses and systematic reviews and of progressive resistance training, balance exercise, and structured supervised exercise interventions all revealed moderate to large positive results in physical function compared to controls in people post-hip fracture liaison rehabilitation, while on the other hand, home based exercise therapy has mixed outcome [53]. Future studies in different communities are still needed to determine which type of exercise program are cost effective especially in a community like Egypt where the elderly have less admission to senior homes, more chance of family support, lower economic status and difficult transportation that limit their chance to have the type of structured supervised exercise in medical facilities.

However, there is an agreement that exercise has a positive effect on patient general health, mood, functional status. Few published randomized controlled trials were carried out in Egypt to address the impact of different exercise protocol exercise on the bone mineral density. The study carried out by Thabet et al. [54] to investigate how closed and open kinetic chain exercises differed in their impact on bone mineral density (BMD) and fall risk in postmenopausal women with osteoporosis, results revealed that the strongest impact on BMD and fall risk was recorded by the closed kinetic chain exercise. Another study was carried out by Mowafy et al. [55] to evaluate the efficacy of the treadmill weight-bearing exercises on BMD and *t* score mean in cases of osteoporosis

in breast cancer patients receiving chemotherapy. Results revealed that the application of the treadmill weight bearing exercises and drug therapy (vitamin D supplements and calcium) had significant ($p < 0.001$) positive impact, more than application of the drug therapy alone in cases of osteoporosis in breast cancer patients receiving chemotherapy.

Light at the end of the tunnel

Implementation of post-fracture care service in Egypt

The World Osteoporosis Day, 20th of October, 2022; marks 3 years since the Egyptian Academy of Bone Health has launched the fracture liaison service in Egypt. Since its launch, the Capture the Fracture network has rapidly grown in Egypt and currently there are 14 FLS centers in Egypt covering nearly 70% of the population. All the centers have been recognized by the IOF and listed on the international Capture the Fracture world map. The enthusiastic cooperation from the different universities has been instrumental in energizing interest in FLS implementation and development across the country. Published the guidelines for osteoporosis management [56] as well as clinical standards for FLS [23] have helped in setting the groundwork for the prioritization of primary and secondary osteoporosis and fracture prevention at the national level. Several factors have participated in such success, these are the following:

IOF support to the FLS in Egypt

The international osteoporosis foundation (IOF) support not only helped the members of the Egyptian Academy of Bone in setting up the FLS service in Egypt and getting the national centers recognized and acknowledged internationally, but also has persuaded the Deans of several universities to authorize setting up the local services and persuade orthopaedic surgery as well as orthogeriatric departments to cooperate with the FLS activities. Also, this facilitated seeking the support of non-governmental health organizations. Endorsement of the Egyptian Academy of bone health scientific activities and meetings by the IOF, has also helped to spread the word and cooperate with several counties of the country from north (Alexandria) to far south (Aswan).

Research

PFC programs need to be an integral part of healthcare systems, with the PFC protocols or program framework deeply embedded into the hospital practice. A recent study carried out in Egypt highlighted that there is a large treatment gap in Egyptian adults aged ≥ 50 years. About 82.8% of those who sustained low trauma fracture, were identified to have a high fracture risk and met the definitions for increased risk of fragility fracture prior to

presenting fragility fracture, yet, they have not received any osteoporosis therapy [57]. This highlights the high need for PFC service in Egypt. The Egyptian guidelines for osteoporosis management [53] not only recommend specific actions and frameworks for post-fracture models of care but also help in endorsing education to both HCPs as well as patients.

Sustainability

To make this PFC program successful and to ensure long-term sustainability of the program, the Egyptian Academy of Bone Health set-up broad lines for a suggested successful PFC service, these include constructing multidisciplinary teamwork, designing an electronic software program, arranging public osteoporosis screening days and specialized clinics for osteoporosis.

Constructing a multidisciplinary team

Multidisciplinary teamwork is mandatory for successful implementation of PFC service. Meetings between different departments or the interested healthcare professionals of the orthopedics (hip and spine surgery units), orthogeriatrics, rheumatology, and physical medicine departments should be held regularly aiming to create a comprehensive service for the patients presenting with fragility fractures and motivate the orthopedic surgeon to see the positive impact of such service and how this joint effort could save their patients from sustaining a second fracture; in the meantime, it helps to increase the patients' adherence to the PFC services.

Designing an electronic software program for national database

The Egyptian Academy of Bone health and Metabolic Bone Diseases has developed its own electronic online data recording for the FLSs in Egypt [58]. The Fracture Liaison Service Database (EABoM) is clinically led, web-based national software for secondary fracture prevention in Egypt. It facilitated recording of patients' data with a highly organized statistical analysis tools which facilitates the auditing process and evaluation of the services provided against the international clinical standards with an intention to be disseminated among different health institutions to ensure maximum coverage of those elderly population with fragility fractures.

Osteoporosis screening days

Osteoporosis screening days were originally designed for screening populations above 50 years for osteoporosis. All attendees were assessed using the designed questionnaire. Educational sessions are provided to increase public awareness regarding the importance of treatment of osteoporosis and strategies to prevent osteoporotic

fractures. Interestingly, a considerable number of attendees were actually osteoporotic and some of them had history of osteoporotic fractures or any one of their relatives. FRAX is calculated for all patients and those with high probability for fracture risk are assessed by DXA scan and targeted for preventive and treatment measures. Recent studies had been conducted to evaluate the effect of screening for osteoporosis on fracture rates; they reported a reduction in hip fractures but did not find a reduction in other types of fractures [59–61].

Osteoporosis clinic

Osteoporosis clinics were established for evaluation and management of older adults with osteoporosis. These specialized clinics have a major role in identifying and developing management strategies for the variable risk levels of population, ensuring that all patients receive appropriate preventive, diagnostic, and treatment services when indicated based upon their fracture risk probability. In addition, raising awareness among the public regarding the silent nature of the disease and the risks of fractures. Also, they ensure patients' adherence and monitor outcomes within population in the community. Such information is vital to draw the map of osteoporosis in Egypt.

Cooperation with orthogeriatrics: orthogeriatric team member or rival?

In the Middle east and North Africa region (MENA), orthogeriatrics remains a novel concept, and dedicated orthogeriatric units are only just beginning to emerge. In Egypt, specifically, there is mounting interest in applying the principles of orthogeriatric co-management. One of the first organized units is, in Ain Shams University unit, performed a quality improvement study. The initial results were promising; with significant reductions in length of stay and time to surgery [62].

Orthogeriatric care focus mainly on patients admitted with fractures, usually hip fractures. This can be delivered through several models. A review article by [63] categorized them into routine geriatric consultations for elderly patients within an orthopedic ward (patient responsibility lies with the surgeon), or care within a geriatric ward with the orthopedic surgeon acting as a consultant (responsibility for the care is with the geriatrician). However, post-fracture care program goes beyond such scope. Integrated care model which includes orthopedics, orthogeriatrics, as well as rheumatology and rehabilitation would be the ideal approach to ensure providing the optimum care for the patients while they are admitted to the hospital and continue to provide the care as outpatient after discharge from the hospital. The Egyptian Academy of Bone Health has high hopes that

such expectation will become a reality and a model of comprehensive care for older adults who sustain fragility fractures.

In conclusion, post-fracture care program evaluates and manage patients with a fragility fracture or minimal trauma aiming to prevent subsequent fractures. This manuscript described the integrated model of care adopted in Egypt to provide care for this patients' cohort. It is time to set a national database and research-based protocol taking advantage of the national set of fracture liaison service in Egypt aiming at finding the best management option that suits the Egyptian community bearing in mind the limitations such as low economic status, transfer problem and lack of community consciousness of the benefits of fracture prevention, osteoporosis management as well as exercises for the Egyptian older adults.

Abbreviations

BMD	Bone mineral density
DXA	Dual energy X-ray absorptiometry
FLS	Fracture Liaison Services
FRAS	Falls risk assessment score
FRAX	Fracture risk assessment
GDP	Gross domestic product
HCP	Health care professionals
IOF	International Osteoporosis Foundation
LMIC	Lower-middle-income countries
MDHAQ	Multi-dimensional health assessment questionnaire
MENA	Middle East and North Africa region
OGSs	Orthogeriatric services
PFC	Post-fracture care
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
RCT	Randomized controlled trials
RFS	Re-fracture free survival
TUG	Timed Up and-Go

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Authors' contributions

Prof. El Miedany and Prof. Hassab Elnaby set up the design of the work and revising the final draft of the manuscript. Dr. M. Eissa wrote the section of post-fracture care; Dr. S. Gala wrote the section of patient education; Dr. H. Saber wrote the section of cooperation with orthogeriatrics; Dr. R. A. Ibrahim wrote the section of management of sarcopenia; Prof. S. Mahra wrote the section of functional disability; Prof. M. Hassab Elnaby wrote the section of Rehabilitation; Dr. S. Tabra wrote the section assessment and management of falls risk; Dr. M. Abu-Zaid wrote the section of where is the cracks; Dr. W. Elwakil wrote the section of national gaps in post-fracture care, PFC economics. All authors reviewed and approved the final form of the manuscript.

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