

Appendix

Questionnaire: Survey Items from “The Secondary Prevention of Fragility Fractures”

Note: For those who are going to use this questionnaire, we have the following suggestions:

- A. A clear definition of each choice for the behavior questions (e.g., questions 6 and 24) would be helpful to avoid a misleading answer. For instance, the “always” choice from question 6 can be defined as “for >80% patients.”
- B. Add another question of “Do you perform bone mineral density (BMD) measurement with dual x-ray absorptiometry (DXA) for patients with fragility fractures?” Answer should also be clearly defined as in A (above).

1. Please rate your knowledge level for the following items:

1.1 The definition of fragility fracture	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.2 Risk factors for osteoporosis	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.3 The diagnostic criteria for osteoporosis	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.4 Pharmacologic therapy	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.5 Nonpharmacologic therapy	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.6 Follow-up of patients	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.7 Patient education	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor
1.8 Causes of secondary osteoporosis	A. Excellent	B. Good	C. Average	D. Poor	E. Very poor

2. How do you know about the secondary prevention of fragility fractures? (Choose all that apply)

- A. Original article
- B. Review article
- C. Textbook
- D. Training
- E. Academic conference
- F. Experiences shared from counterparts
- G. Continuing medical education
- H. Experts from pharmaceutical manufacturers
- I. Media such as television, newspapers, and the Internet
- J. First-hand clinical experiences
- K. Other_____
- L. I do not know much about this issue

3. How often do you receive training regarding the secondary prevention of fragility fractures?

- A. Always
- B. Often
- C. Average

D. Rarely

E. Never

4. How often do you read guidelines or literature about the secondary prevention of fragility fractures?

A. Always

B. Often

C. Average

D. Rarely

E. Never

5. Is there any clinical pathway for the management of patients with fragility fractures in your workplace?

A. Yes, and the pathway received adequate attention

B. Yes; however, the pathway did not receive adequate attention

C. None

6. Do you evaluate the risk factors of osteoporosis when patients with fractures are admitted?

A. Always

B. Often

C. Average

D. Rarely

E. Never

7. What risk factors do you usually evaluate for patients with fractures? (Choose all that apply)

- | | |
|---|--|
| <input type="checkbox"/> The process and site of current fracture | <input type="checkbox"/> Calcium insufficiency |
| <input type="checkbox"/> Previous falls | <input type="checkbox"/> Vitamin D insufficiency |
| <input type="checkbox"/> Previous fragility fracture | <input type="checkbox"/> Lack of physical activity |
| <input type="checkbox"/> Parental history of fracture or osteoporosis | <input type="checkbox"/> Smoking |
| <input type="checkbox"/> Height loss | <input type="checkbox"/> Alcohol intake |
| <input type="checkbox"/> Kyphosis | <input type="checkbox"/> Medication use (glucocorticoids or heparin) |
| <input type="checkbox"/> Spine deformation | <input type="checkbox"/> Gastrointestinal diseases |
| <input type="checkbox"/> Low BMI (body mass index) | <input type="checkbox"/> Rheumatoid arthritis |
| <input type="checkbox"/> Male | <input type="checkbox"/> Hyperparathyroidism |
| <input type="checkbox"/> Female | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Age >65 years old | <input type="checkbox"/> None |
| <input type="checkbox"/> Hypogonadism | |
| <input type="checkbox"/> Early menopause | |
| <input type="checkbox"/> Malnutrition | |
| <input type="checkbox"/> Vegetable or fruit insufficiency | |

8. In what situation will you recommend osteoporosis-related tests for patients with fractures?

- A. All patients with fractures should undergo osteoporosis-related tests
- B. Patients with any risk factor (as listed in question 7) should undergo osteoporosis-related tests
- C. Patients with ≥ 3 risk factors (as listed in question 7) should undergo osteoporosis-related tests
- D. Never recommend osteoporosis-related tests for patients with fractures
- E. Other situations, in your opinion, that should involve osteoporosis-related tests _____

9. What will you do if you consider osteoporosis in patients with a fracture?

- A. Treat fracture independently; diagnose and treat osteoporosis independently
- B. Treat fracture with consultation with orthopaedic surgeons; diagnose and treat osteoporosis independently
- C. Treat fracture independently; diagnose and treat osteoporosis with consultation of specialists
- D. Treat fracture independently; refer patients to specialists for diagnosis and treatment of osteoporosis
- E. Treat fracture independently; refer patients to general practitioners for diagnosis and treatment of osteoporosis
- F. Treat fracture independently; do not provide advice or treatment for potential osteoporosis

10. What tests do you usually use for diagnosing osteoporosis?

- A. Quantitative ultrasound (QUS)
- B. Single-photon absorptiometry (SPA)
- C. X-ray
- D. Single x-ray absorptiometry (SXA)
- E. Dual x-ray absorptiometry (DXA)
- F. Quantitative computed tomography (QCT)
- G. Bone turnover biomarkers
- H. Fracture risk assessment tool (FRAX)/Osteoporosis Self-Assessment Tool for Asian (OSTA)
- I. Hormone tests (parathyroid hormone [PTH], estrogen, etc.)
- J. Blood tests (alkaline phosphatase [ALP], calcium, etc.)
- K. Other _____

11. The percentage of confirmed osteoporosis among your patients with fractures is _____%.

12. The percentage of missed diagnosis of osteoporosis among your patients with fractures is _____%.

13. What are the reasons for the missed diagnosis of osteoporosis among patients with fractures? (Choose all that apply)

- A. The patient does not describe his/her related history
- B. The patient does not show apparent clinical manifestation
- C. The patient refuses to undergo related tests
- D. The patient is worried about the excessive costs of tests
- E. Tests are not available in my workplace
- F. Physicians lack related knowledge
- G. Physicians neglect the potential of osteoporosis
- H. Physicians neglect the primary causes of osteoporosis
- I. Limited time
- J. Other _____

14. Will you initiate pharmacologic therapies for osteoporosis in the following situations? (Choose all that apply)

- A. Vertebral fracture
- B. Hip fracture
- C. Hip BMD (femoral neck or total hip) T-score ≤ -2.5
- D. Lumbar spine BMD T-score ≤ -2.5
- E. Low bone mass (osteopenia) and a U.S.-adapted World Health Organization (WHO) 10-year probability of a hip fracture $\geq 3\%$
- F. Low bone mass (osteopenia) and 10-year probability of any major osteoporosis-related fracture $\geq 20\%$
- G. Patient preferences
- H. Other _____
- I. I never treat osteoporosis in my daily practice

15. Do you initiate pharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?

- I never initiate pharmacologic therapy for osteoporosis in my daily practice
- I use the following pharmacologic therapy (please check the frequency of each medication):

15.1 Bisphosphonates	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.2 Calcitonin	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.3 Teriparatide	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.4 Denosumab	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.5 Strontium ranelate	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.6 Vitamin D supplement	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.7 Calcium supplement	A. Always	B. Often	C. Average	D. Rarely	E. Never
15.8 Estrogen/hormone therapy (ET/HT)	A. Always	B. Often	C. Average	D. Rarely	E. Never

16. How do you use pharmacologic therapy in your daily practice? (Skip this part if you do not initiate pharmacologic therapy.)

- A. According to guidelines
- B. According to the literature
- C. According to medication instructions
- D. According to the instructions of our department
- E. According to my own experiences

17. Will you pay attention to side effects of the following medications when you use them? (Skip this part if you do not initiate pharmacologic therapy.)

17.1 Bisphosphonates	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.2 Calcitonin	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.3 Teriparatide	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.4 Denosumab	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.5 Strontium ranelate	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.6 Vitamin D supplement	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.7 Calcium supplement	A. Always	B. Often	C. Average	D. Rarely	E. Never
17.8 Estrogen/hormone therapy (ET/HT)	A. Always	B. Often	C. Average	D. Rarely	E. Never

18. Please rate the effectiveness of pharmacologic therapy in preventing subsequent fragility fractures.

- A. Very effective
- B. Somewhat effective
- C. Average
- D. Somewhat ineffective
- E. Very ineffective

19. Do you initiate nonpharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?

- I never initiate nonpharmacologic therapy for osteoporosis in my daily practice
- I use the following nonpharmacologic therapy (please check the frequency of each therapy):

19.1 Nutrition (adequate intake of calcium and vitamin D)	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.2 Regular weight-bearing exercise	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.3 Muscle-strengthening exercise	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.4 Balance exercise	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.5 Fall prevention	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.6 Cessation of smoking or drinking	A. Always	B. Often	C. Average	D. Rarely	E. Never
19.7 Moderate exposure to sunlight	A. Always	B. Often	C. Average	D. Rarely	E. Never

20. Please rate the effectiveness of nonpharmacologic therapy in preventing subsequent fragility fractures.

- A. Very effective
- B. Somewhat effective
- C. Average
- D. Somewhat ineffective
- E. Very ineffective

21. What are the reasons for the poor effectiveness of osteoporotic treatment? (Choose all that apply)

- A. Patients refuse the treatment for a fracture because of excessive costs
- B. Patients refuse the treatment for osteoporosis
- C. Side effects of medications
- D. Poor adherence to pharmacologic therapy
- E. Patients do not pay attention to the treatment of osteoporosis after recovery from the fracture
- F. Patients do not change lifestyle (e.g., cessation of smoking and excessive drinking)
- G. The effectiveness of treatment for the fracture was poor
- H. Physicians' improper usage of medications
- I. Physicians do not make good use of nonpharmacologic therapy
- J. Other _____

Questions 22-27: Patient Education

22. Among your patients with fractures, who do you target for education?

- A. All patients with fractures
- B. Patients with risk factors of osteoporosis
- C. Only those patients with confirmed osteoporosis

23. How do you perform patient education for the targeted population? (Choose all that apply)

- A. Clinic interview
- B. Telephone
- C. Social network such as WeChat, Weibo, or Haodafu web sites
- D. Lecture
- E. Leaflet
- F. Posters in communities
- G. Other _____

24. Do you educate your target patients about osteoporosis and fragility fracture?

- A. Always
- B. Often

- C. Average
- D. Rarely
- E. Never

25. What is your education content? (Choose all that apply)

- A. Routine health checkups (e.g., BMD tests)
- B. Balanced diet such as adequate calcium intake
- C. Initiate therapy such as pharmacologic therapy and use medications that affect bone metabolism with caution
- D. Maintain a healthy weight
- E. Regular weight-bearing, muscle-strengthening, and balance exercise
- F. Adequate outdoor activities and sun exposure
- G. Fall prevention
- H. Cessation of smoking and excessive drinking
- I. Other _____

26. Please rate the effectiveness of patient education in preventing subsequent fragility fractures.

- A. Very effective
- B. Somewhat effective
- C. Average
- D. Somewhat ineffective
- E. Very ineffective

27. What are the reasons for the poor effectiveness of patient education? (Choose all that apply)

- A. Physicians are not familiar with the educational content
- B. Physicians ignore the guidance for helping to change patients' lifestyles
- C. Limited time for physicians' clinic interview
- D. Physicians cannot make full use of various communication tools to perform patient education
- E. There is no any education platform
- F. Other _____

28. How often do you ask your patients with fragility fractures to visit the clinic for a reexamination?

28.1 (Choose 1) Before recovery from fracture

- A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. Never

28.2 (Choose 1) After recovery from fracture

- A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. Never

29. The percentage of your patients with fragility fractures who undergo clinic reexamination as required is _____%.

30. What, in your opinion, is the appropriate frequency of following up with patients after fragility fractures?

30.1 (Choose 1) Before recovery from fracture

A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. No need to follow up

30.2 (Choose 1) After recovery from fracture

A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. No need to follow up

31. Do you follow up with your patients with fragility fractures?

31.1 (Choose 1) Before recovery from fracture

A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. Never

31.2 (Choose 1) After recovery from fracture

A. 1 month B. 3 months C. 6 months D. 12 months E. >2 years F. Never

32. The percentage of following up with your patients with fragility fractures is _____%.

33. How do you perform follow-up with your patients? (Choose all that apply)

- A. Clinic interview
- B. Telephone
- C. Social network such as WeChat, Weibo, or Haodaifu web sites
- D. Mail
- E. Other _____

34. What are the contents of the clinic reexamination/follow-up? (Choose all that apply)

- A. Recovery from fracture
- B. Readminister the BMD test
- C. Readminister bone turnover biomarkers test
- D. Readminister blood tests (ALP, calcium, etc.)
- E. Readminister hormone tests
- F. Medication side effects
- G. Medication adherence
- H. Calcium and vitamin D supplement usage
- I. Diet
- J. Exercise
- K. Other _____

35. What are the goals of clinic reexamination/follow-up? (Choose all that apply)

- A. Recovery from fracture
- B. Subsequent fracture prevention
- C. Therapy effectiveness
- D. Discover side effects in time
- E. Adjustment of therapies
- F. Lifestyle improvements
- G. Promote medication adherence
- H. Collect data for research
- I. Other _____

36. Please rate the effectiveness of clinic reexamination in preventing subsequent fragility fractures.

- A. Very effective
- B. Somewhat effective
- C. Average
- D. Somewhat ineffective
- E. Very ineffective

37. Please rate the effectiveness of follow-up in preventing subsequent fragility fractures.

- A. Very effective
- B. Somewhat effective
- C. Average
- D. Somewhat ineffective
- E. Very ineffective

38. What are the reasons for the poor effectiveness of clinic reexamination and how come some patients cannot undergo clinic reexamination as required? (Choose all that apply)

- A. Excessive cost of patients' time
- B. Excessive cost of patients' money
- C. Patients refuse clinic reexamination
- D. Physicians do not ask their patients for clinic reexamination
- E. Physicians do not perform reexamination carefully, educate patients, or adjust therapies
- F. Limited time for clinic reexamination
- G. Other _____

39. What are the reasons for the poor effectiveness of follow-up? (Choose all that apply)

- A. Patients refuse to cooperate
- B. Cannot contact patients
- C. Excessive physician time

D. Excessive other physician costs

E. Physicians do not have a keen sense of responsibility

F. There are no regulations or requirements of follow-up for physicians

G. Lack of supervision

H. Other_____

TABLE E-1 Assignment of Sensitivity Score System

Sensitivity Score A	Score				
Item	5	4	3	2	1
Do you evaluate risk factors for osteoporosis when patients with fractures are admitted?	Always	Often	Average	Rarely	Never
Do you initiate pharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?	Yes				No
Do you initiate nonpharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?	Yes				No
Do you educate your target patients about osteoporosis and fragility fracture?	Always	Often	Average	Rarely	Never
Do you follow up with your patients with fragility fractures after recovery from fracture?	1 month	3 months	6 months	12 months	>2 years/never

Sensitivity Score B	Score				
Item	1	1	0	0	0
Do you evaluate risk factors for osteoporosis when patients with fractures are admitted?	Always	Often	Average	Rarely	Never
Do you initiate pharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?	Yes				No
Do you initiate nonpharmacologic therapy for confirmed osteoporosis among patients with fragility fractures?	Yes				No
Do you educate your target patients about osteoporosis and fragility fracture?	Always	Often	Average	Rarely	Never
Do you follow up with your patients with fragility fractures after recovery from fracture?	1 month	3 months	6 months	12 months	>2 years/never

TABLE E-2 Associations Between Knowledge Score and Physicians' Characteristics from a Multivariable Linear Regression Model Using Imputed Data Sets*

Characteristics	Unadjusted β Coefficient (95% CI)	P Value	Adjusted β Coefficient (95% CI)†	P Value
Training experiences regarding the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	5.78 (4.65 to 6.92)	<0.001	2.43 (1.16 to 3.70)	<0.001
Reading experiences of guidelines or literature about the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	5.89 (4.91 to 6.87)	<0.001	4.03 (2.89 to 5.17)	<0.001
Clinical pathway for fragility fracture care in my workplace				
None	Reference		Reference	
Yes‡	2.91 (1.80 to 4.02)	<0.001	1.49 (0.48 to 2.51)	0.004
Job title				
Resident and attending	Reference		Reference	
Associate chief and chief	3.05 (1.83 to 4.26)	<0.001	1.15 (-0.18 to 2.48)	0.090
Hospital level				
Below 3A	Reference		Reference	
3A	-1.41 (-2.57 to -0.25)	0.017	-1.42 (-2.35 to -0.49)	0.003
Age, per year	0.22 (0.14 to 0.31)	<0.001	0.07 (-0.02 to 0.17)	0.141

*CI = confidence interval. †Adjusted model included all variables shown in the table. ‡Included "The pathway received adequate attention" and "The pathway did not receive adequate attention."

TABLE E-3 Associations Between Effectiveness Score and Physicians' Characteristics and Knowledge Score from a Multivariable Linear Regression Model Using Imputed Data Sets*

Characteristics	Unadjusted β Coefficient (95% CI)	P Value	Adjusted β Coefficient (95% CI) [†]	P Value
Training experiences regarding the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	0.85 (0.44 to 1.26)	<0.001	0.23 (-0.28 to 0.74)	0.368
Reading experiences of guidelines or literature about the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	0.82 (0.46 to 1.18)	<0.001	0.28 (-0.18 to 0.74)	0.226
Clinical pathway for fragility fracture care in my workplace				
None	Reference		Reference	
Yes [‡]	0.45 (0.08 to 0.82)	0.016	0.19 (-0.19 to 0.57)	0.331
Job title				
Resident and attending	Reference		Reference	
Associate chief and chief	0.68 (0.26 to 1.10)	0.002	0.62 (0.12 to 1.13)	0.016
Hospital level				
Below 3A	Reference		Reference	
3A	-0.21 (-0.58 to 0.17)	0.274	-0.20 (-0.58 to 0.17)	0.286
Age, per year	0.02 (-0.01 to 0.05)	0.109	-0.03 (-0.06 to 0.01)	0.161
Knowledge score	0.09 (0.06 to 0.12)	<0.001	0.06 (0.02 to 0.09)	0.004

*CI = confidence interval. [†]Adjusted model included all variables shown in the table. [‡]Included "The pathway received adequate attention" and "The pathway did not receive adequate attention."

TABLE E-4 Sensitivity Analysis: Associations Between Sensitivity Score A and Physicians' Characteristics, Knowledge Score, and Effectiveness Score from a Multivariable Linear Regression Model (Complete Cases Only)*

Characteristics	Unadjusted β Coefficient (95% CI)	P Value	Adjusted β Coefficient (95% CI) [†]	P Value
Training experiences regarding the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	2.14 (1.35 to 2.93)	<0.001	-0.01 (-0.94 to 0.91)	0.977
Reading experiences of guidelines or literature about the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	2.16 (1.46 to 2.85)	<0.001	0.47 (-0.36 to 1.30)	0.270
Clinical pathway for fragility fracture care in my workplace				
None	Reference		Reference	
Yes [‡]	2.06 (1.36 to 2.76)	<0.001	1.16 (0.48 to 1.85)	0.001
Job title				
Resident and attending	Reference		Reference	
Associate chief and chief	1.48 (0.71 to 2.25)	<0.001	-0.38 (-1.23 to 0.47)	0.382
Hospital level				
Below 3A	Reference		Reference	
3A	-0.37 (-1.11 to 0.37)	0.325	0.12 (-0.51 to 0.76)	0.701
Age, per year	0.14 (0.08 to 0.19)	<0.001	0.09 (0.03 to 0.16)	0.006
Knowledge score	0.27 (0.21 to 0.33)	<0.001	0.14 (0.07 to 0.20)	<0.001
Effectiveness score	0.80 (0.63 to 0.97)	<0.001	0.66 (0.50 to 0.83)	<0.001

*CI = confidence interval. [†]Adjusted model included all variables shown in the table. [‡]Included "The pathway received adequate attention" and "The pathway did not receive adequate attention."

TABLE E-5 Sensitivity Analysis: Associations Between High Sensitivity (Sensitivity Score B \geq 4) and Physicians'

Characteristics, Knowledge Score, and Effectiveness Score from a Multivariable Logistic Regression Model (Complete

Cases Only)*

Characteristics	Unadjusted OR (95% CI)	P Value	Adjusted OR (95% CI)†	P Value
Training experiences regarding the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	4.00 (2.43 to 6.77)	<0.001	1.21 (0.50 to 2.94)	0.671
Reading experiences of guidelines or literature about the secondary prevention of fragility fractures				
Average/rarely/never	Reference		Reference	
Always/often	4.26 (2.73 to 6.76)	<0.001	1.97 (0.94 to 4.17)	0.073
Clinical pathway for fragility fracture care in my workplace				
None	Reference		Reference	
Yes‡	4.19 (2.64 to 6.80)	<0.001	2.47 (1.33 to 4.68)	0.005
Job title				
Resident and attending	Reference		Reference	
Associate chief and chief	1.88 (1.16 to 3.06)	0.011	0.64 (0.27 to 1.50)	0.306
Hospital level				
Below 3A	Reference		Reference	
3A	0.86 (0.56 to 1.32)	0.489	1.06 (0.59 to 1.90)	0.846
Age				
1st quartile (lowest)	Reference		Reference	
2nd quartile	1.38 (0.76 to 2.52)	0.286	1.07 (0.50 to 2.28)	0.865
3rd quartile	2.27 (1.29 to 4.04)	0.005	2.47 (1.08 to 5.81)	0.035
4th quartile (highest)	2.99 (1.60 to 5.69)	0.001	1.98 (0.65 to 6.09)	0.230
Knowledge score				
1st quartile (lowest)	Reference		Reference	
2nd quartile	2.59 (1.43 to 4.82)	0.002	2.97 (1.39 to 6.58)	0.006
3rd quartile	3.86 (2.05 to 7.44)	<0.001	3.27 (1.40 to 7.90)	0.007
4th quartile (highest)	17.92 (9.02 to 37.54)	<0.001	7.66 (3.03 to 20.46)	<0.001
Effectiveness score				
\leq 12	Reference		Reference	
13 to 14	2.59 (1.24 to 5.87)	0.016	2.28 (0.90 to 6.31)	0.095
15 to 16	5.30 (2.58 to 11.83)	<0.001	3.63 (1.47 to 9.84)	0.007
\geq 17	12.59 (5.22 to 33.00)	<0.001	8.91 (2.92 to 29.85)	<0.001

*OR = odds ratio, and CI = confidence interval. †Adjusted model included all variables shown in the table. ‡Included “The pathway received adequate attention” and “The pathway did not receive adequate attention.”

Methods

Instrument

The final 39-item questionnaire included the following sections: (1) knowledge about osteoporosis and fragility fractures, (2) training and working environment, (3) diagnosis of osteoporosis and fragility fractures, (4) treatment of osteoporosis, (5) patient education, (6) follow-up of patients, (7) effectiveness of preventive measures, and (8) sociodemographic information.

Knowledge Score of Osteoporosis and Fragility Fractures

This score included 8 questions. Respondents were asked to rate their knowledge level regarding (1) the definition of fragility fractures, (2) risk factors for osteoporosis, (3) the diagnostic criteria for osteoporosis, (4) pharmacologic therapy, (5) nonpharmacologic therapy, (6) follow-up of patients, (7) patient education, and (8) causes of secondary osteoporosis, all on a 5-point Likert scale.

Training Regarding the Secondary Prevention of Fragility Fractures

Training frequency and reading experiences (guidelines and literature) were evaluated with a 5-point Likert scale. We also asked the respondent whether there was a clinical pathway for the management of patients with fragility fractures in their workplace.

Diagnosis, Treatment Practice, Patient Education, and Follow-up of Patients

A Likert scale was used to assess whether an orthopaedic surgeon performed risk-factor evaluation when patients with fractures were admitted. Surgeons also were asked about the opportunities for patient education and follow-up with patients. A binary response (*yes* or *no*) was used to assess whether orthopaedic surgeons initiate pharmacologic therapies or nonpharmacologic therapies.

Effectiveness Score of Measures for Preventing Secondary Fragility Fracture

This score comprised 4 items, each measured on a 5-point Likert scale to rate self-perceived effectiveness for the measures to prevent secondary fragility fracture, including (1) pharmacologic therapies, (2) nonpharmacologic therapies, (3) patient education, and (4) follow-up of patients.

Sociodemographic Information

Respondents were asked to report sociodemographic information, including age, sex, job title, specialty type, region, hospital level, and whether they had worked in their clinic for ≥ 3 months. They had the option to submit their names, telephone numbers, or e-mail addresses for participation in future studies.

Osteoporosis and Fragility Fracture Continuing Education in China

We also retrieved information about orthopaedic academic conferences for the past 10 years from 3 commonly used orthopaedic conference web sites⁹⁸⁻¹⁰⁰. We further calculated

the percentage of conferences with themes containing “osteoporosis,” “fragility fracture,” or “osteoporotic fracture.”

Statistical Analysis

Associations Between Knowledge Score, Effectiveness Score, and Orthopaedic Surgeon Characteristics

We used a multivariable linear regression model to determine the associations between knowledge score and orthopaedic surgeon characteristics, training experiences, and working environment (Table E-2). The selection of variables was based on a priori importance and the results from bivariate analyses. For missing values, multiple imputations were conducted to generate 20 data sets with 10 iterations and 20 multiple imputations⁹¹. The combined coefficient estimates across 20 imputed data sets were obtained according to Rubin’s rules^{92,93}.

The associations between effectiveness score and orthopaedic surgeon characteristics, training experiences, working environment, and knowledge score were explored with the same methods as mentioned above (Table E-3). Multiple imputations were performed as mentioned above for missing variables. Two-sided p values of <0.05 were considered significant. All analyses were performed using CRAN.R version 3.3.3 (mice package)⁹¹.