Supplementary Table S1. Mandatory minimum history elements enforced by the deterministic coverage gate

Baseline history domain	Mandatory history elements
Patient demographics and relevant medical background	Age, sex, relevant comorbidities and past medical history, occupation/activity level, prior spine trauma/surgery
Pain characterisation	Location, radiation, severity, character, aggravating and relieving factors
Pain trajectory / course	Onset, duration, and temporal course of symptoms
Neurological inquiry	Separately conducted motor, sensory, and bowel/bladder symptom inquiry, gait instability
Functional impact	Effect of symptoms on daily activity and function
Systemic red-flag screening	Systemic red-flag symptoms (categories in Supplementary Table S2)
Prior treatment and response	Previous treatments and the response to them
Prior diagnostic workup	Previous investigations and imaging

The coverage gate assessed whether each mandatory domain had been addressed or explicitly marked as not applicable before interview closure. It did not prescribe question order; the patient-facing agent selected questions adaptively according to the evolving clinical context.

Supplementary Table S2. A priori red-flag categories.

Red-flag category
Suspected acute or progressive neurological deficit
Previous malignancy
Systemic infection markers
Night pain with systemic features
New-onset back pain at advanced age
Recent significant trauma
Immunosuppression

These categories were specified a priori and screened for by the patient-facing agent during the interview.

Supplementary Table S3. Detailed reference diagnoses by study arm

Diagnostic category	Reference diagnosis	Model arm (n = 120)	Control arm (n = 120)
Degenerative / mechanical	Cervical disc herniation	12 (10.0)	13 (10.8)
Degenerative / mechanical	Cervical spondylotic myelopathy	8 (6.7)	9 (7.5)
Degenerative / mechanical	Lumbar disc herniation	34 (28.3)	32 (26.7)
Degenerative / mechanical	Lumbar spinal stenosis	20 (16.7)	21 (17.5)
Degenerative / mechanical	Lumbar spondylolisthesis	7 (5.8)	6 (5.0)
Degenerative / mechanical	Mechanical low back pain	18 (15.0)	19 (15.8)
Degenerative / mechanical	Thoracic disc herniation	0 (0.0)	1 (0.8)
Inflammatory axial spondyloarthritis	Axial spondyloarthritis	5 (4.2)	4 (3.3)
Serious spinal pathology	Brucellar spondylitis	2 (1.7)	2 (1.7)
Serious spinal pathology	Cauda equina syndrome	1 (0.8)	0 (0.0)
Serious spinal pathology	Multiple myeloma	1 (0.8)	1 (0.8)
Serious spinal pathology	Osteoporotic vertebral compression fracture	6 (5.0)	5 (4.2)
Serious spinal pathology	Pyogenic spondylodiscitis	2 (1.7)	2 (1.7)
Serious spinal pathology	Tuberculous spondylitis	1 (0.8)	1 (0.8)
Serious spinal pathology	Vertebral metastasis	3 (2.5)	4 (3.3)

Values are n (%), with percentages calculated within each study arm. Diagnostic categories correspond to those reported in Table 1. Serious spinal pathology comprised osteoporotic vertebral compression fracture, spinal infection, neoplastic disease, and cauda equina syndrome.

Supplementary Table S4. Expert-panel adequacy ratings overall and by item (model arm, n = 120)

Adequacy item	Mean	SD	95% CI	n (%) scoring >=4
Q1. Formulate differential diagnosis	4.29	0.85	4.14–4.45	104 (86.7)
Q2. Decide next diagnostic steps	4.35	0.90	4.19–4.51	101 (84.2)
Q3. Triage the patient	4.24	0.88	4.08–4.40	95 (79.2)
Q4. Identify safety-critical features	4.34	0.90	4.18–4.50	100 (83.3)
Q5. Proceed without repeating full history	3.92	0.93	3.76–4.09	86 (71.7)
Overall mean adequacy	**4.23**	**0.71**	**4.10–4.36**	**92 (76.7)**

Each item was rated on a five-point Likert scale (1, strongly disagree; 5, strongly agree). Overall adequacy was calculated as the mean of the five item scores for each case. The n (%) scoring ≥4 column reports the number and proportion of cases meeting or exceeding a score of 4.0. Confidence intervals for continuous scores are t-based. The overall per-case mean was tested against the prespecified threshold of 4.0 using a one-sample, one-sided t-test ($t = 3.54$, $df = 119$, $P < 0.001$; Cohen's $d = 0.32$). Inter-rater reliability for the overall adequacy score was assessed using a two-way random-effects, absolute-agreement, average-measures ICC; the estimate was 0.88 (95% CI, 0.83–0.91). CI, confidence interval; SD, standard deviation.

Supplementary Table S5. Diagnostic concordance with expert-panel consensus and confirmed diagnoses (model arm)

Concordance measure	Agreement, n/N (%)	95% Wilson CI
Top-1 (exact match to panel primary diagnosis)	87/120 (72.5)	63.9–79.7
Top-3 (panel primary within model top-3 differential)	106/120 (88.3)	81.4–92.9
Expert inter-rater agreement (panel unanimous on primary)	93/120 (77.5)	69.2–84.1
Fleiss’ κ for panel primary-diagnosis assignments	0.821	—
Top-1 (confirmed diagnosis ranked first)	56/85 (65.9)	55.3–75.1
Top-3 (confirmed diagnosis within model top-3 differential)	73/85 (85.9)	76.9–91.7

Top-1 concordance indicates exact agreement with the expert-panel consensus primary diagnosis; top-3 concordance indicates inclusion of that diagnosis within the model’s three highest-ranked differential diagnoses. Panel unanimity denotes cases in which all three panellists independently selected the same primary diagnosis. Fleiss’ κ was calculated across the three independent panellists for the categorical primary-diagnosis assignments. Analyses against a confirmed diagnosis were restricted to cases with an objective reference diagnosis. Confidence intervals are Wilson 95% CIs. CI, confidence interval.

Supplementary Table S6. Red-flag detection performance against two reference standards (model arm)

Reference standard	TP	FN	FP	TN	Sensitivity, % (95% CI)	Specificity, % (95% CI)
Expert panel, transcript (primary)	15	1	4	100	93.8 (71.7–98.9)	96.2 (90.5–98.5)
Post-examination verification (exploratory)	14	3	5	98	82.4 (59.0–93.8)	95.1 (89.1–97.9)

The primary analysis compared the model’s red-flag report with the expert panel’s transcript-based judgement. The exploratory analysis used the treating surgeon’s post-examination verification, which could include findings not derivable from history alone. Estimates are interpreted descriptively because of the low prevalence of true red flags. Confidence intervals are Wilson 95% CIs. CI, confidence interval; FN, false negative; FP, false positive; TN, true negative; TP, true positive.

Supplementary Table S7. Physician-led history-taking time by model arm

Metric	Model arm (n = 120)	Control arm (n = 120)
Mean (SD), minutes	6.77 (1.61)	10.22 (2.46)
Median (IQR), minutes	6.50 (5.70–7.78)	10.00 (8.20–11.53)

Timing included only the physician-led portion of history-taking in both arms; time spent completing the pre-visit SpineGPT-2 interview was recorded separately and was not included. Groups were compared using a two-sided Mann–Whitney U test ($U = 1579.5$, $P < 0.001$; rank-biserial $r = -0.78$). The mean reduction with model support was 3.45 minutes. IQR, interquartile range; SD, standard deviation.

Supplementary Table S8. Content accuracy and provenance audit

Finding	n	%	Wilson 95% CI (%)	Definition / comment
Any hallucinated content	10	8.3	4.6-14.7	Ten encounters contained at least one hallucinated-content instance; no safety-critical red-flag hallucination was identified.
Fabricated symptom	4			Subtype count among hallucinated-content instances.
Fabricated history element	3			Subtype count among hallucinated-content instances.
Temporal error	2			Subtype count among hallucinated-content instances.
Misattribution	1			Subtype count among hallucinated-content instances.
Unsupported clinical inference	6	5.0	2.3-10.5	Diagnostic or management-related conclusion not justified by recorded history or retrieved evidence.
Retrieval-provenance label error	8	6.7	3.4-12.6	Numbered reference or provenance label did not correspond to retrieved source evidence.

All 120 model-arm encounters were reviewed by comparing the system-log interview transcript with the surgeon-facing summary. Hallucination was defined as clinically relevant information in the summary that was unsupported by the interview transcript. Counts for any hallucinated content, unsupported clinical inference, and retrieval-provenance label error are encounter-level counts; hallucination-subtype rows are instance counts. Confidence intervals are Wilson 95% CIs. CI, confidence interval.

Supplementary Table S9. Operational and interaction-safety events in the model arm (n = 120)

Event category	n	% of model arm	Description
Any operational safety event	9	7.5	Sum of predefined event categories.
Technical failure	5	4.2 (95% CI, 1.8–9.4)	Connectivity drop (n=2) or session freeze (n=3).
Patient-initiated early exit	2	1.7 (95% CI, 0.5–5.9)	Patient ended the interaction before structured closure.
Patient-facing hard-rule violation	2	1.7 (95% CI, 0.5–5.9)	Diagnostic assertion or treatment recommendation reached the patient-facing interface.

Counts in the individual category rows refer to events, and a single encounter could contribute more than one event. Percentages use all 120 model-arm encounters as the denominator. Monitoring focused on operational and interaction-safety events because all patients were subsequently evaluated by the treating surgeon and no clinical decision relied solely on system output. Confidence intervals are Wilson 95% CIs. CI, confidence interval.

Supplementary Table S10. Information-gap taxonomy

Information-gap domain	n	% of all gap instances
Prior treatment and response	14	22.6
Functional impact	11	17.7
Prior diagnostic workup	9	14.5
Pain trajectory / course	8	12.9
Relevant medical history / comorbidities	7	11.3
Systemic red-flag screening	5	8.1
Neurological inquiry	5	8.1
Pain characterisation	3	4.8
Total information-gap instances	62	100.0
Encounters with at least one gap	33	27.5% (95% CI, 20.3–36.1)

Information gaps were assigned when the expert panel judged that clinically relevant history was missing. A single encounter could contribute more than one gap instance. Domain percentages use the 62 gap instances as the denominator; the proportion of encounters with at least one gap uses all 120 model-arm encounters as the denominator. Confidence intervals are Wilson 95% CIs. CI, confidence interval.

Supplementary Table S11. Patient experience and acceptability.

Measure	n	Mean	SD	Median	IQR	Range
Model arm CUQ total score	120	74.6	11.8	75.0	66.0-83.0	44-96

CUQ scores were standardised to a 0–100 scale and were collected only in the model arm; no patient-experience instrument was administered in the control arm. CUQ, Chatbot Usability Questionnaire; IQR, interquartile range; SD, standard deviation.

SpineGPT-2 RAG corpus manifest

Source ID	Organization	Guideline / document title	Year	Version	Clinical category	Access status
AO_Spine_30202904_ABSTRACT_ONLY	Congress of Neurological Surgeons	Congress of Neurological Surgeons Systematic Review and Evidence-Based Guidelines on the Evaluation and Treatment of Patients With Thoracolumbar Spine Trauma: Classification of Injury	2019	Not stated	Spinal trauma	Abstract only
AO_Spine_34715673_ABSTRACT_ONLY	Not stated in source document	An updated management algorithm for incorporating minimally invasive techniques to treat thoracolumbar trauma	2022	Not stated	Spinal trauma	Abstract only
AO_Spine_38526921_A_Clinical_Practice_Guideline_for_Prevention_Diagnosis_and_Management_of_Intraop	AO Spine / Praxis	A Clinical Practice Guideline for Prevention, Diagnosis and Management of Intraoperative Spinal Cord Injury: Recommendations for Use of Intraoperative Neuromonitoring and for the Use of Preoperative and Intraoperative Protocols for Patients Undergoing Spine Surgery	2024	Not stated	Intraoperative spinal cord injury	Full text (open access, PubMed Central)
AO_Spine_38526930_AO_SpinePraxis_Clinical_Practice_Guidelines_for_the_Management_of_Acute_Spinal_C	AO Spine / Praxis	AO Spine/Praxis Clinical Practice Guidelines for the Management of Acute Spinal Cord Injury: An Introduction to a Focus Issue	2024	Not stated	Acute spinal cord injury	Full text (open access, PubMed Central)
AO_Spine_39052928_Streamlining_the_Journey_of_Research_Into_Clinical_Practice_Making_Your_Patients	AO Spine (Knowledge Forum Tumor)	Streamlining the Journey of Research Into Clinical Practice: Making Your Patients and Practice Flourish Understanding and Setting Treatment Expectations for Patients With Metastatic Spine Tumors	2024	Not stated	Spinal oncology	Full text (open access, PubMed Central)
AO_Spine_39180743_Streamlining_the_Journey_of_Research_Into_Clinical_Practice_Making_Your_Patients	AO Spine (Knowledge Forum Trauma and Infection)	Streamlining the Journey of Research Into Clinical Practice: Making Your Patients and Practice Flourish Optimizing Management and Minimizing Risk of Osteoporotic Vertebral Fractures - Perspectives of the AO Spine KF Trauma and Infection Group Key Opinion Leaders	2024	Not stated	Osteoporosis and fragility fracture	Full text (open access, PubMed Central)
AO_Spine_39616557_ABSTRACT_ONLY	Not stated in source document	Guidelines for returning to activity after spinal deformity surgery	2025	Not stated	Adult spinal deformity	Abstract only
AO_Spine_39852953_Streamlining_the_Journey_of_Research_Into_Clinical_Practice_Making_Your_Patients	AO Spine (Knowledge Forum Trauma and Infection)	Streamlining the Journey of Research Into Clinical Practice: Making Your Patients and Practice Flourish Evaluation and Treatment of Pyogenic Spondylodiscitis of the Spine: AO Spine Knowledge Forum Trauma and Infection	2025	Not stated	Spinal infection	Full text (open access, PubMed Central)
AO_Spine_40153520_AO_Spine_Clinical_Practice_Recommendations_Current_Systemic_Oncological_Treatmen	AO Spine	AO Spine Clinical Practice Recommendations: Current Systemic Oncological Treatments with the Largest Impact on Patients with Metastatic Spinal Disease	2025	Not stated	Spinal oncology	Full text (open access, PubMed Central)
AO_Spine_40257837_AO_Spine_Clinical_Practice_Recommendations_for_Diagnosis_and_Management_of_Degen	AO Spine	AO Spine Clinical Practice Recommendations for Diagnosis and Management of Degenerative Cervical Myelopathy: Evidence Based Decision Making - A Review of Cutting Edge Recent Literature Related to Degenerative Cervical Myelopathy	2025	Not stated	Degenerative cervical myelopathy	Full text (open access, PubMed Central)
AO_Spine_40293504_AO_Spine_Clinical_Practice_Recommendations_Spinopelvic_Fixation_-_What_are_the_K	AO Spine	AO Spine Clinical Practice Recommendations: Spinopelvic Fixation - What are the Key Items to Understand Performance?	2025	Not stated	Adult spinal deformity	Full text (open access, PubMed Central)
AO_Spine_40483581_AO_Spine_Clinical_Practice_Recommendations_for_the_Surgical_Management_of_Acute	AO Spine	AO Spine Clinical Practice Recommendations for the Surgical Management of Acute Traumatic Spinal Cord Injury: Contemporary Concepts	2025	Not stated	Acute spinal cord injury	Full text (open access, PubMed Central)
AO_Spine_40498575_AO_Spine_Clinical_Practice_Recommendations_for_the_Surgical_Management_of_Degene	AO Spine	AO Spine Clinical Practice Recommendations for the Surgical Management of Degenerative Spondylolisthesis: When to Decompress Alone and When to Fuse	2025	Not stated	Degenerative lumbar spine	Full text (open access, PubMed Central)
AO_Spine_40521797_AO_Spine_Clinical_Practice_Recommendations_Reducing_the_Surgical_Footprint_of_Su	AO Spine	AO Spine Clinical Practice Recommendations: Reducing the Surgical Footprint of Surgery for Spinal Metastases	2026	Not stated	Spinal oncology	Full text (open access, PubMed Central)
AO_Spine_40658112_AO_Spine_Clinical_Practice_Recommendations_Evaluation_Implications_and_Managemen	AO Spine	AO Spine Clinical Practice Recommendations: Evaluation, Implications and Management of Osteoporosis in Adult Spinal Deformity	2026	Not stated	Adult spinal deformity	Full text (open access, PubMed Central)
AO_Spine_40851377_An_International_Delphi_Consensus_on_Defining_the_Optimal_Surgical_Composite_Out	AO Spine (Knowledge Forum Tumor)	An International Delphi Consensus on Defining the Optimal Surgical Composite Outcome in Metastatic Spine Disease	2025	Not stated	Spinal oncology	Full text (open access, PubMed Central)
AO_Spine_41206425_Protocol_for_the_development_of_enhanced_recovery_after_surgery_ERAS_recommendat	AO Spine (RECODE-DCM)	Protocol for the development of enhanced recovery after surgery (ERAS) recommendations for individuals undergoing surgery for degenerative cervical myelopathy	2025	Not stated	Degenerative cervical myelopathy	Full text (open access, PubMed Central)
AO_Spine_41580985_AO_Spine_Clinical_Practice_Recommendations_for_the_Management_of_Subaxial_Spine	AO Spine	AO Spine Clinical Practice Recommendations for the Management of Subaxial Spine Fractures	2026	Not stated	Spinal trauma	Full text (open access, PubMed Central)

Source ID	Organization	Guideline / document title	Year	Version	Clinical category	Access status
AO_Spine_41700822_AO_Spine_Clinical_Practice_Recommendations_for_Adjunctive_Medical_Therapies_in_A	AO Spine	AO Spine Clinical Practice Recommendations for Adjunctive Medical Therapies in Acute Traumatic Spinal Cord Injury: Contemporary Concepts	2026	Not stated	Acute spinal cord injury	Full text (open access, PubMed Central)
AO_Spine_41725136_AO_Spine_Clinical_Practice_Recommendations_An_Overview_of_the_Current_State_of_F	AO Spine	AO Spine Clinical Practice Recommendations: An Overview of the Current State of Fusion Surgery for Patients With Spinal Metastasis: Is Fusion Necessary?	2026	Not stated	Spinal oncology	Full text (open access, PubMed Central)
NASS_NASS_Adult_Isthmic_Spondylolisthesis_2014	North American Spine Society (NASS)	Adult Isthmic Spondylolisthesis	2014	Not stated	Degenerative lumbar spine	Full text (publisher document)
NASS_NASS_Antibiotic_Prophylaxis_in_Spine_Surgery_2013	North American Spine Society (NASS)	Antibiotic Prophylaxis in Spine Surgery	2013	Not stated	Perioperative care	Full text (publisher document)
NASS_NASS_Antithrombotic_Therapies_Revision_In_Progress	North American Spine Society (NASS)	Antithrombotic Therapies for Adults Undergoing Spine Surgery	Not stated	Revision in progress	Perioperative care	Full text (publisher document)
NASS_NASS_Antithrombotic_Therapies_in_Spine_Surgery_2009	North American Spine Society (NASS)	Antithrombotic Therapies in Spine Surgery	2009	Not stated	Perioperative care	Full text (publisher document)
NASS_NASS_Cervical_Radiculopathy_from_Degenerative_Disorders_2010	North American Spine Society (NASS)	Cervical Radiculopathy from Degenerative Disorders	2010	Not stated	Degenerative cervical spine	Full text (publisher document)
NASS_NASS_Degenerative_Lumbar_Spinal_Stenosis_2011	North American Spine Society (NASS)	Degenerative Lumbar Spinal Stenosis	2011	Not stated	Degenerative lumbar spine	Full text (publisher document)
NASS_NASS_Degenerative_Spondylolisthesis_2014	North American Spine Society (NASS)	Degenerative Spondylolisthesis	2014	Not stated	Degenerative lumbar spine	Full text (publisher document)
NASS_NASS_Diagnosis_and_Treatment_of_Low_Back_Pain_2020	North American Spine Society (NASS)	Diagnosis and Treatment of Low Back Pain	2020	Not stated	Low back pain	Full text (publisher document)
NASS_NASS_Lumbar_Disc_Herniation_with_Radiculopathy_2012	North American Spine Society (NASS)	Lumbar Disc Herniation with Radiculopathy	2012	Not stated	Degenerative lumbar spine	Full text (publisher document)
NASS_NASS_Neoplastic_Vertebral_Fractures_2024	North American Spine Society (NASS)	Neoplastic Vertebral Fractures	2024	Not stated	Spinal oncology	Full text (publisher document)
NASS_NASS_Osteoporotic_Vertebral_Compression_Fractures_2024	North American Spine Society (NASS)	Osteoporotic Vertebral Compression Fractures	2024	Not stated	Osteoporosis and fragility fracture	Full text (publisher document)

SpineGPT-2 — Patient-Facing Agent (PFA) Interview Log

Session SPG-OQLX · interview language: English · 95 messages (47 patient turns) · duration 893 s
Verbatim transcript

1 ASSISTANT
Hello, I am the digital history-taking assistant for this clinic. My role is to gather information about your condition and prepare a report for the doctor you will be seeing. I am not here to make a diagnosis — that is your doctor's job. I will simply ask you some questions to help them understand your situation better. Shall we begin?

2 PATIENT
Yes please

3 ASSISTANT
Thank you. To start, may I ask how old you are?

4 PATIENT
I am 78 years old.

5 ASSISTANT
Thank you. And what is your gender?

6 PATIENT
I am a woman.

7 ASSISTANT
Thank you. What is your occupation, or what kinds of activities do you do most days?

8 PATIENT
I am a retired teacher. I spend my days mostly in my home reading and knitting and sometimes working in my garden.

9 ASSISTANT
Thank you. What is the main problem or symptom that brought you to see the spine doctor today?

10 PATIENT
I have a bad back.

11 ASSISTANT
You mentioned having a bad back. Could you tell me exactly where in your back you feel the pain or discomfort? For example, is it in your lower back, mid-back, or upper back/neck?

12 PATIENT
It is in my mid back.

13 ASSISTANT
Thank you for clarifying that your pain is in your mid-back. On a scale from 0 to 10, where 0 means no pain and 10 means the worst pain imaginable, how severe is your back pain right now?

14 PATIENT
It is around 5 now.

15 ASSISTANT
Thank you for sharing that your pain is currently a 5 out of 10. What is the highest your mid-back pain gets on a typical day, and what is it like at its best (for example, when you first wake up or after resting)?

16 PATIENT
When it is at highest, I would say 7. When it is at its best, I would say 3.

17 ASSISTANT
You mentioned your pain ranges from 3 to 7 out of 10 during the day. Could you describe what the pain feels like — for example, is it sharp, dull, burning, aching, or something else?

18 PATIENT
It is mostly dull, but if I do some abrupt movement such as twisting, it rather becomes sharp.

19 ASSISTANT
You mentioned that your pain is usually dull but becomes sharp if you make an abrupt movement like twisting. Are

there any other specific movements, positions, or activities that tend to make your mid-back pain worse?

20 PATIENT

It gets worse if I bend down.

21 ASSISTANT

You mentioned that bending down makes your mid-back pain worse. Does the pain ever spread or radiate to other areas, such as your chest, abdomen, or down your legs?

22 PATIENT

It does not radiate.

23 ASSISTANT

You mentioned that bending down makes your pain worse. Is there anything you have found that helps relieve or ease your mid-back pain, such as certain positions, medications, or activities?

24 PATIENT

When I lie down and rest, the pain somehow improves. Putting hot water bags on my back also helps.

25 ASSISTANT

To better understand exactly where you feel pain, I would like to show you a body diagram where you can mark the areas.

26 PATIENT

I marked.

27 ASSISTANT

Thank you for marking the area. You mentioned that your pain gets worse when you bend down and improves when you lie down or use a hot water bag. Over the past weeks or months, has your mid-back pain been getting better, worse, or staying about the same?

28 PATIENT

It has gotten worse since it had started. But it has been same for the last days.

29 ASSISTANT

You mentioned that your mid-back pain has gotten worse since it started, but has stayed about the same in the last few days. When did your pain first begin, and was there any specific event or injury that triggered it?

30 PATIENT

It had started on the last April. I was preparing the flower beds and probably I bent down too much.

31 ASSISTANT

You mentioned your pain started last April after bending down a lot while preparing flower beds. Since then, have you noticed any new symptoms besides the back pain — such as numbness, tingling, weakness, or anything else unusual?

32 PATIENT

No.

33 ASSISTANT

Thank you for letting me know. Have you noticed any numbness or loss of sensation in your legs, feet, or groin area?

34 PATIENT

No.

35 ASSISTANT

Have you noticed any weakness in your legs, such as difficulty lifting your foot, standing on your toes, or climbing stairs?

36 PATIENT

It was already difficult for me to climbing stairs, but I assumed that it was because of the knee arthritis. And yes, it is difficult to standing on my toes, but my feet are stiff somehow. I guess I also have arthritis in my feet.

37 ASSISTANT

You mentioned that standing on your toes is difficult, and you have stiffness in your feet, which you think might be

due to arthritis. Focusing on the difficulty standing on your toes — has this problem gotten worse over time, or has it stayed about the same?

38 PATIENT

It is same.

39 ASSISTANT

Thank you for clarifying. Have you noticed any problems with your walking or balance, such as feeling unsteady or stumbling more than usual?

40 PATIENT

Actually I rather feel unsteady lately. It is like I am about to fall forward. That's why I have started to use a cane.

41 ASSISTANT

You mentioned feeling unsteady lately and starting to use a cane because you feel like you might fall forward. When did this unsteadiness begin, and has it been getting worse, staying the same, or improving?

42 PATIENT

I have noticed that situation a few months ago. Because now I am using a cane, I do not know if got worse. But I feel like I am hunched forward more.

43 ASSISTANT

You mentioned feeling more hunched forward lately. Have you noticed any change in the shape of your back, such as increased rounding or a visible curve, since your symptoms began?

44 PATIENT

I did not notice any change, but then again, I can not see my back clearly on a mirror.

45 ASSISTANT

You mentioned feeling more hunched forward lately. Have you experienced any new or increasing back pain or discomfort when you try to stand up straight?

46 PATIENT

Yes.

47 ASSISTANT

You mentioned that you feel more hunched forward and that you have new or increasing back pain when you try to stand up straight. When you attempt to stand up straight, does the pain feel different from your usual mid-back pain, or is it the same type of pain but just stronger?

48 PATIENT

It is same but stronger.

49 ASSISTANT

You mentioned that the pain is the same type but stronger when you try to stand up straight. Since your symptoms began, have you had any trouble with bladder or bowel control, such as difficulty holding urine or stool, or accidents?

50 PATIENT

Actually I have bladder problems more than twenty years but I have been told that it was because of the weakness of my pelvic muscles.

51 ASSISTANT

You mentioned having bladder problems for more than twenty years and were told it was due to weak pelvic muscles. Since your back pain and unsteadiness began, have you noticed any new changes in your bladder control, such as more frequent accidents, difficulty starting or stopping urination, or a change in sensation?

52 PATIENT

No.

53 ASSISTANT

Thank you for clarifying that there have been no new changes in your bladder control since your back pain and unsteadiness began. Have you had any fevers, night sweats, or unexplained weight loss recently?

54 PATIENT

No. It is difficult to lose weight when you are as old as me!

55 ASSISTANT

Thank you for sharing that. You mentioned you have arthritis in your knees and feet. Besides these, do you have any other health conditions, or do you take any regular medications? If so, could you please tell me the names and doses of your medications?

56 PATIENT

No. If there is too much pain in my knees I am taking a painkiller, but not regularly.

57 ASSISTANT

Thank you for letting me know about your occasional use of painkillers for knee pain. Could you tell me the name of the painkiller you take when your knees hurt, and how much you usually take at one time?

58 PATIENT

Its name is diclomec. I was taking it probably two or three times a week. But since my back pain had started, I take it almost everyday.

59 ASSISTANT

Thank you for letting me know that you are now taking diclomec almost every day for your back pain. When you take diclomec, does it help reduce your back pain? If so, how much relief do you get, and how long does the effect last?

60 PATIENT

It helps and it usually help me through the day.

61 ASSISTANT

You mentioned that diclomec helps your back pain and usually gets you through the day. Over the past months, have you noticed that you need to take more diclomec than before to get the same relief, or has the amount stayed about the same?

62 PATIENT

Actually I would like to take more than one, but my GP tells me it is not good to take much painkiller in the old age. She had told me it can damage my stomach or kidneys.

63 ASSISTANT

Thank you for sharing that your GP advised you to limit your use of painkillers because of possible effects on your stomach or kidneys. Have you ever had any problems with your stomach, such as ulcers, bleeding, or indigestion, especially since you started taking diclomec more often?

64 PATIENT

Thankfully, no.

65 ASSISTANT

Thank you for clarifying. Have you ever had any type of cancer in the past?

66 PATIENT

Yes. I was diagnosed with breast cancer 15 years ago. But I am fine now.

67 ASSISTANT

You mentioned you were diagnosed with breast cancer 15 years ago and are fine now. Did you receive any treatments for your breast cancer, such as surgery, chemotherapy, or radiation? And have you had any follow-up scans or check-ups since then?

68 PATIENT

I had surgery, chemo and radiotheraoy all. I had my check-ups regularly. There was no problem. Why did you ask me that? Do you think it might be cancer coming back?

69 ASSISTANT

Thank you for sharing your history. I understand your concern, and I want to reassure you that my questions are routine for anyone with back pain, especially when there is a history of cancer. This helps the doctor get the full picture. Since your breast cancer treatment, have you ever had any imaging tests (like MRI, CT, or X-ray) of your spine? If so, do you remember what they showed?

70 PATIENT

A few years ago I fell down and my back got hurt. I had an X-ray of my spine in the emergency room. I have been told that there was no fracture but my bones were really thin and I needed to see a specialist for that.

71 ASSISTANT

You mentioned that after your fall a few years ago, you were told your bones were "really thin." Were you ever diagnosed with osteoporosis, or have you had any bone density tests since then?

72 PATIENT

Actually I did not go to see a specialist.

73 ASSISTANT

You mentioned that you did not go to see a specialist after being told your bones were thin. Since that fall, have you had any other injuries or falls, or have you noticed any new or worsening back pain after minor bumps or movements?

74 PATIENT

I did not have any injury, but yes, I am having a back pain that gets worse with even minor movements

75 ASSISTANT

You mentioned that your back pain gets worse even with minor movements. Has this increased sensitivity to movement been present since your pain first started, or is it something that has developed more recently?

76 PATIENT

I think it built up gradually.

77 ASSISTANT

You mentioned that your back pain has gradually become more sensitive to even minor movements. Have you noticed any new areas of tenderness or spots on your back that are especially painful to touch or press?

78 PATIENT

I can not tell for sure because I can not reach the painful area with my hand.

79 ASSISTANT

Thank you for explaining. Since you mentioned your bones were described as "really thin" and your back pain has gradually become more sensitive to minor movements, have you ever been told you have a condition that weakens your body's defenses (for example, have you ever had chemotherapy, long-term steroid use, or an organ transplant), or have you recently had any infections?

80 PATIENT

I have had chemotherapy 15 years ago. Other than that, I do not have such conditions.

81 ASSISTANT

Thank you for clarifying that you had chemotherapy 15 years ago but no recent infections or other conditions that weaken your body's defenses. Have you ever had any surgery or major injury to your spine, other than the fall you mentioned where no fracture was found?

82 PATIENT

No.

83 ASSISTANT

Thank you for confirming you have not had any other spine surgery or major injury. Earlier, you mentioned you spend your days mostly at home, reading, knitting, and sometimes gardening. Since your back pain began, have you noticed any activities at home—such as sitting for long periods, reading, or gardening—that make your pain worse or limit what you can do?

84 PATIENT

I have no problem with sitting for long periods. But I have to stop gardening. Because bending down or lifting things from the ground got more difficult for me.

85 ASSISTANT

You mentioned that you had to stop gardening because bending down or lifting things from the ground has become more difficult. Is this mainly because of pain, or do you also feel weakness, unsteadiness, or another problem when you try to do these activities?

86 PATIENT

It is because of the pain.

87 ASSISTANT

Thank you for clarifying that the pain is the main reason you had to stop gardening and bending down. Is there anything I have not asked about that you would like to mention, or anything else you think is important for the doctor to know?

88 PATIENT

No, thank you.

89 ASSISTANT

Thank you for your patience. One more question: In the past few months, have you had any conditions or taken any medicines that weaken your body's defenses (such as long-term cortisone/steroid use, or an organ transplant), or have you used any street or illegal drugs with a needle?

90 PATIENT

No.

91 ASSISTANT

Thank you for clarifying. Just to confirm, have you had any recent dental procedures, skin infections, or other infections anywhere in your body in the past few months?

92 PATIENT

No.

93 ASSISTANT

Thank you for your answers. Just to confirm, besides the chemotherapy you had many years ago, have you ever been told you have a condition or take any medicine that weakens your body's defenses, such as long-term steroid use, or have you ever had an organ transplant?

94 PATIENT

No.

95 ASSISTANT

Thank you for sharing all this information with me. Your interview is now complete. You may proceed to your consultation with the surgeon. I wish you good health.

PATIENT'S STORY

Demographics:
78-year-old woman, retired teacher. She spends most days at home reading, knitting, and occasionally gardening.

Primary Complaint:
Persistent mid-back pain ("I have a bad back") that began in April after bending down repeatedly while gardening. The pain has worsened since onset but has been stable over the last few days.

Pain Characteristics:

- **Location and radiation pattern**: Mid-back (upper thoracic region per pain map). No radiation to chest, abdomen, or legs.
- **Character**: Mostly dull, becomes sharp with abrupt movements such as twisting or bending down.
- **Severity**: Verbal rating 0-10: baseline 3, peak 7, currently 5. Fluctuates between 3 and 7 during the day.
- **Temporal course**: Worsened since onset, now stable for several days.
- **Aggravating factors**: Bending down, abrupt movements, attempting to stand up straight.
- **Relieving factors**: Lying down, rest, use of hot water bag, diclomec (NSAID) provides daily relief.

Neurological Symptoms:

- No numbness or tingling in legs, feet, or groin.
- No new weakness in legs; longstanding difficulty with stairs and standing on toes attributed to knee and foot arthritis.
- Reports feeling unsteady and "about to fall forward" for the past few months, leading to cane use. Feels more hunched forward lately.
- No new bowel or bladder symptoms since back pain onset; longstanding bladder issues (>20 years) attributed to pelvic muscle weakness.
- No fevers, night sweats, or unexplained weight loss.
- Pertinent negatives: No radiating pain, no new sensory loss, no new bladder/bowel dysfunction, no recent infection or immunosuppression.

Functional Impact:

- No difficulty with prolonged sitting.
- Had to stop gardening due to pain with bending/lifting.
- Feels unsteady and uses a cane; feels more hunched forward.
- Pain limits ability to perform activities involving bending or lifting.

Treatment History:

- Uses diclomec (NSAID) almost daily for back pain; previously used intermittently for knee pain. Reports effective pain relief lasting through the day.
- GP advised limiting NSAID use due to age-related risks.
- No prior spine surgery.
- History of a fall a few years ago; spinal X-ray at that time showed no fracture but "really thin" bones; no follow-up with specialist, no formal osteoporosis diagnosis.
- No recent imaging of the spine since onset of current symptoms.

Medical History:

- Osteoarthritis (knees, feet).
- Breast cancer 15 years ago (treated with surgery, chemotherapy, radiotherapy; regular follow-up, no recurrence).
- No other chronic illnesses or regular medications.
- No known allergies.
- No history of smoking, alcohol, or illicit drug use.
- No recent infections, dental procedures, or immunosuppressive medications.

DIAGNOSTIC IMPRESSION

1. Clinical Reasoning

Step 1: The patient presents with persistent, gradually worsening mid-back (thoracic) pain, exacerbated by movement and relieved by rest, with no radiation or acute trauma. This suggests a mechanical or structural etiology rather than a neuropathic or visceral cause [general training data].

Step 2: The pain began after repetitive bending, is aggravated by minor movements, and is associated with a sensation of being hunched forward and new unsteadiness. There is a history of "really thin" bones (likely osteoporosis) and prior breast cancer, both of which increase risk for vertebral compression fracture and metastatic disease, respectively.

EVIDENCE

[*1] Source: NASS_NASS_Osteoporotic_Vertebral_Compression_Fractures_2024, Section: NASS Osteoporotic Vertebral Compression Fractures (2024)

, EVIDENCE

[*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

Step 3: The absence of constitutional symptoms (fever, weight loss, night sweats), lack of recent infection or immunosuppression, and no new neurological deficits (no bowel/bladder dysfunction, no new sensory or motor loss) make infection and acute myelopathy less likely. The functional impact (loss of ability to garden, need for cane, increased kyphosis) and pain pattern are most consistent with a vertebral compression fracture, possibly osteoporotic or metastatic in origin. The history of breast cancer raises concern for possible metastatic involvement, but the long disease-free interval and lack of systemic symptoms make this less likely than osteoporotic fracture, though it cannot be excluded without imaging. EVIDENCE

[*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

2. Differential Diagnosis

1. **Osteoporotic vertebral compression fracture**
- Supporting evidence: Elderly woman, history of "really thin" bones, prior fall, pain started after bending, pain worsened by movement and relieved by rest, progressive kyphosis, functional decline, no trauma required, no systemic symptoms, no new neurological deficits. EVIDENCE

[*1] Source: NASS_NASS_Osteoporotic_Vertebral_Compression_Fractures_2024, Section: NASS Osteoporotic Vertebral Compression Fractures (2024)

- Against: No formal osteoporosis diagnosis, but clinical context strongly supports.

2. **Metastatic vertebral lesion (breast cancer)**
- Supporting evidence: History of breast cancer (treated, 15 years ago), thoracic spine is a common site for metastasis, similar pain pattern, progressive kyphosis, functional decline. EVIDENCE

[*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

- Against: Long disease-free interval, no constitutional symptoms, no known recurrence, no other sites of pain.

3. **Degenerative thoracic spondylosis/arthritis**
- Supporting evidence: Age, history of osteoarthritis, chronicity, pain with movement.
- Against: Abrupt worsening, progressive kyphosis, and functional decline are less typical.

4. **Pathologic fracture due to other neoplastic or metabolic bone disease**
- Supporting evidence: Age, prior cancer, bone fragility.
- Against: No evidence of other malignancy or metabolic disease.

3. Red Flags

- **History of cancer (possible spinal metastasis)**: identified — prior breast cancer, now presenting with new, persistent, and progressive mid-back pain and functional decline. Urgency: URGENT [needs to be validated by a medical professional]

- **Osteoporotic vertebral compression fracture**: identified — elderly patient, history of bone fragility, new thoracic pain after minor trauma, progressive kyphosis, and functional decline. Urgency: URGENT [needs to be validated by a medical professional]

- **Spinal infection**: not explored — recommend direct assessment for recent fever, chills, night sweats, history of bacteremia, recent dental or skin infection, IV drug use.

- **Acute myelopathy/cord compression**: not explored — recommend direct assessment for new-onset lower extremity weakness, sensory level, sphincter dysfunction, and objective neurological examination.

RECOMMENDED NEXT STEPS

Physical Examination:

- A focused neurological examination should be performed, including assessment of lower extremity strength, sensation, and reflexes, to evaluate for any subtle signs of myelopathy or radiculopathy, given the patient's unsteadiness and progressive kyphosis. EVIDENCE

  [*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

- Gait assessment and observation for truncal balance and degree of kyphosis should be performed to quantify functional impact and risk of falls.

- Palpation of the thoracic spine for point tenderness should be performed to localize possible vertebral fracture.

Imaging Studies:

- An urgent MRI of the thoracic spine should be obtained to evaluate for vertebral compression fracture, assess for possible metastatic disease, and rule out spinal cord compression, given the patient's history of cancer, progressive pain, and new functional decline. EVIDENCE

  [*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

- If MRI is contraindicated or unavailable, a CT scan of the thoracic spine should be considered as an alternative for bony detail.

Laboratory Investigations:

- Basic laboratory workup including CBC, ESR, and CRP should be considered to screen for occult infection or malignancy, given the patient's age and cancer history. EVIDENCE

  [*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

Triage:

This patient requires URGENT evaluation due to the combination of new, progressive thoracic pain, functional decline, history of osteoporosis and breast cancer, and possible vertebral compression fracture or metastasis. Prompt imaging and specialist assessment are indicated to rule out spinal instability or cord compression and to guide management. EVIDENCE

[*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)

References

[*1] Source: NASS_NASS_Osteoporotic_Vertebral_Compression_Fractures_2024, Section: NASS Osteoporotic Vertebral Compression Fractures (2024)

[*2] Source: NASS_NASS_Neoplastic_Vertebral_Fractures_2024, Section: Neoplastic Vertebral Fractures (2024)