



1-1-2007

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Recommended Citation

Few, CE, Davenport, TE, Watts, HG. A hypothesis-oriented algorithm for symptom-based diagnosis by physical therapists: description and case series. *Orthopaedic Physical Therapy Practice*. 2007;19(2):72-79. © 2007, Orthopaedic Section, APTA, Inc.

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A Hypothesis-oriented Algorithm for Symptom-based Diagnosis by Physical Therapists: Description and Case Series

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ABSTRACT

Study Design: Case series. **Subjects:** Two patients referred to physical therapy with a diagnosis of lower back pain (LBP). **Background:** The increasing role of physical therapists in primary care settings highlights the skills needed to determine the appropriateness of physical therapy for patients. A hypothesis-oriented algorithm for symptom-based diagnosis was developed for use by physical therapists. The goal of this process is to determine a diagnostic impression to guide decisions regarding patient disposition and physical therapist management. This case series demonstrates the process in two individuals with LBP referred to a community-based outpatient physical therapy clinic. **Diagnosis:** Despite the fact that both patients presented to physical therapy with a similar referral diagnosis, the hypothesis-oriented algorithm revealed a difference in diagnostic impressions formed by the physical therapist, and resulted in divergent decisions regarding the appropriateness of physical therapy between patients. Clinical findings based on the hypothesis-oriented algorithm directed treatment and case management. **Discussion:** A symptom-based diagnostic process

was used to determine the appropriateness of physical therapy for the patients described in this case series. The described approach is intended to provide physical therapists with a process to arrive at a diagnostic impression regarding the pathology underlying patients' presentations, in order to determine the appropriate disposition and treatment for individuals presenting to physical therapy. Additional research will assist in validating this approach and assess its effectiveness to prepare student physical therapists in entry-level, postprofessional, and residency programs.

Key Words: differential diagnosis, direct access, low back pain, primary care

BACKGROUND

Lower back pain (LBP) is a common symptom that causes significant disablement in the form of economic loss,¹ psychological and interpersonal difficulties,² and emotional distress.³ As a result, patients with LBP frequently seek physical therapy management. Many different conditions cause LBP. Some forms of pathology that cause LBP are amenable to physical therapist intervention, while it is ineffective at best and dangerous at worst for other forms of pathology. Therefore, physical therapists' primary responsibility is to determine the appropriateness of physical therapy for patients, which involves deciding whether to treat the patient, refer the patient for additional testing or treatment by another health care provider, or initiate both treatment and referral simultaneously. Such a decision depends on physical therapists' ability to identify the pathology underlying patients' clinical presentations through a diagnostic process. However, a review of the current literature revealed no papers describing a systematic process for symptom-based diagnosis by physical therapists.

Diagnostic reasoning is recognized as a

component of clinical reasoning by expert physical therapists. It involves the "formation of a diagnosis related to physical disability and impairment with consideration of associated pain mechanisms, tissue pathology, and the broad scope of potential contributing factors."^{4(p 322)} As with all their clinical reasoning strategies, master clinicians appear to optimize clinical efficiency by attending to cues provided by patients rather than following uniform protocols. This generally involves interplay between pattern recognition and clinical hypothesis testing.⁴ Similarly, an efficient system for symptom-based diagnosis for physical therapists appears to require these properties.

One of us (HGW) developed a hypothesis-oriented algorithm to determine a diagnostic impression upon which to base decisions regarding appropriate patient disposition and treatment (Table 1), which we have used to instruct students in entry-level, postprofessional, and Orthopaedic Residency programs since 1999. First, the patient's chief concern is identified. *Yellow Flags* are then identified. These previously have been characterized as psychosocial correlates of prognosis in individuals with persistent pain.⁵ In the context of this diagnostic process, *Yellow Flags* indicate possible obstructions to proper communication between a patient and physical therapist. Examples include language, culture, age, and gender differences between the patient and physical therapist. Although they do not imply the presence of a dangerous disease, *Yellow Flags* are similarly important because they may compromise optimal clinical decisions. *Yellow Flags* are considered early in the diagnostic process to clarify potential biases near the beginning of information gathering. Next, *Red Flag* features of the case are identified. Traditionally, *Red Flag* findings have been considered pathognomic of various health

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Table 1. Hypothesis-Oriented Algorithm for Symptom-Based Diagnosis by Physical Therapists

Identify patient's chief concern
Identify Yellow and Red Flags
Create a timeline of the chief concern
Consider all forms of pathology: Remote and Local
Sort pathology by likelihood from epidemiology (eg, age, sex, and geography)
Ask diagnostically focused questions
Re-sort possible pathology according to likelihood based on patient's response
Perform objective exam maneuvers in order of importance
Re-sort possible pathology based on patient's response to testing
Form diagnostic impression
Determine appropriate patient disposition
<ul style="list-style-type: none">• Refer for additional testing and treatment• Initiate physical therapy intervention• Initiate both treatment and referral
Determine appropriate treatment

conditions that require an immediate referral to another health care provider.⁶ However, recent evidence suggests these findings may be too nonspecific for use in this manner. Therefore, we define *Red Flags* as features of a specific patient's problem that raise the index of suspicion about one condition over the others. For example, a history of cigarette smoking in a patient with shoulder pain is a Red Flag for possible apical lung tumor. While cigarette smoking is widely considered a serious health risk, it typically is not included with traditional Red Flag symptoms and signs.

A timeline of the patient's chief concern is then created to recognize potentially relevant temporal relationships between a patient's disablement and significant events. The timeline may help rule less or more likely some of the possible causes. The timeline should include the onset of current symptoms, previous episodes of similar symptoms, symptom progression, timing and outcomes of previous treatments, diagnostic tests, and past medical history that may contribute to the current chief concern (eg, diagnosis of diabetes mellitus).

All possible forms of pathology that could cause the patient's chief concern are then considered. The mnemonic *TIM VaDeTuCoNe* was developed to represent the major categories of pathology, including Trauma, Inflammation, Metabolic, Vascular, Degenerative, Tumor, Congenital,

and Neurogenic/Psychogenic. Some conditions fail to fit simply into one diagnostic category, so there may be some diversity of classification among clinicians. The important function of *TIM VaDeTuCoNe* is to help physical therapists consider the wide range of possible pathologies that may contribute to the patient's chief concern while constructing a diagnostic hypothesis list, regardless of individual preferences in classification. Pathology is further divided among *remote* and *local* sources. *Remote* sources of pathology occur distant from where symptoms are perceived (eg, neurofibroma of the common peroneal nerve causing lower leg and foot pain) and include referred pain (eg, axillary pain from myocardial ischemia). By contrast, *local* sources of pathology occur in the immediate vicinity of a patient's chief concern (eg, calf muscle rupture causing lower leg pain). Remote sources of pathology should be considered before local sources, because they more commonly may be overlooked.

The potential diagnoses are then sorted by likelihood from epidemiology and specific features already known about the case (eg, pathology common to women versus men). Unlikely causes are then removed from the diagnostic hypothesis list. The physical therapist then asks focused questions to rule less likely a specific condition or pathologic category in order to further elucidate the nature of the problem. Using

the patient's responses, the physical therapist then re-sorts the diagnostic hypothesis list by eliminating less likely causes. Subsequently, tests are performed in the order of their importance to differentiate among the remaining candidates on the diagnostic hypothesis list. Finally, the physical therapist makes a diagnostic impression based on the information gathered, which guides the decision whether referral to another health care provider, initiation of intervention, or a combination of both is optimal to address the patient's chief concern.

This case series will demonstrate the use of this hypothesis-oriented algorithm for symptom-based diagnosis in physical therapist practice. Information from history and physical examination findings for 2 individuals referred to an outpatient physical therapy clinic with LBP will be used to illustrate its use. Case management and treatment considerations specific to each patient will be discussed.

PATIENT ONE

Case Description

Patient One was a 69-year-old retired female who was referred to physical therapy by a family practice physician with a referral diagnosis of "chronic LBP for 10 years." She also presented with a productive cough and conjunctivitis of the right eye, although she identified her LBP as her chief concern. She described episodic LBP since injuring

herself lifting a box at work. Her previous symptoms usually began slowly and resolved within a few days without treatment. The current episode began insidiously 2 months prior to physical therapy evaluation. Patient One described her symptoms as “constant, dull, and aching” pain across the lower back with occasional radiation to the anterior and posterior left thigh. She rated her minimum pain a 7/10 and maximum pain 8/10 on a 10-point verbal analogue scale (VAS), with 10 representing the worst imaginable pain. Her symptoms worsened with walking greater than 30 minutes. Her pain was described as worse in early morning and at the end of the day. She denied any alleviating factors. Recent magnetic resonance imaging of the lumbar spine demonstrated moderate central stenosis at L4-L5 due to spondylolisthesis, degenerative changes at L2-4 and L5-S1, and several cystic structures in the left posterolateral L4-5 lamina consistent with synovial cysts. Her medical history included non-Hodgkin’s lymphoma diagnosed 12 years prior to initial evaluation, successfully treated with chemotherapy and radiation; thyroid cancer diagnosed 8 years prior to initial evaluation; and squamous cell carcinoma of the larynx diagnosed 2 months prior to initial evaluation treated with a total laryngectomy. Her medications included levothyroxine (1 mcg/kg/day) and celebrex (200mg/day). Patient one showed limited knowledge regarding the nature of her previous cancer treatments, as well as the identity and specialties of her attending physicians. She presented with significantly impaired speech due to her recent laryngectomy. Her body weight was 70.3 kg and she measured 160 cm tall (body mass index [BMI] 27.5 kg/m²).

Process of Symptom-based Diagnosis

Identify the patient’s chief concern

Patient One reported her chief concern as back pain.

Determine Yellow Flags

Several Yellow Flags became apparent during the initial physical therapy evaluation for Patient One. Her recent laryngectomy made communication difficult and could have led to vital information being missed without special efforts. Her prior history of ‘mechanical’ LBP also could have led to neglecting further investigation of other causes of LBP that are not amenable to physical therapy intervention. Additionally, Patient One was new to her referring physician and her previous history of cancer may have been overlooked as a cause of lower back pain. She also was referred to physical therapy with a symptom-based diagnosis of “chronic LBP for 10 years.” During the initial portion of the evaluation, Patient One revealed her current complaint of back pain was ‘new’ in the last 2 months and ‘different’ from previous episodes. She considered this incident different in both quality and intensity compared to her previous episodes of LBP. This information was a Yellow Flag because it seemed inconsistent with the referral diagnosis.

Determine Red Flags

Red Flags that were identified from the overall clinical presentation included the patient’s age greater than 50 years coupled with a recent history of cancer. This information itself did not require immediate referral to a physician, but raised the index of suspicion regarding a potential recurrent

neoplastic condition with possible spinal metastasis. The traditional Red Flag of unremitting pain was considered less strongly due to its lack of specificity.⁷

Create a symptom timeline

Patient One had non-Hodgkin’s lymphoma 12 years prior to physical therapy evaluation followed by thyroid cancer 4 years later (Figure 1A). She underwent a recent total laryngectomy due to recurrence of her cancer 2 months prior to physical therapy evaluation, and at approximately the same time noted the onset of her LBP.

Create a diagnostic hypothesis list considering all the possible forms of remote and local pathology that could cause the patient’s chief concern

Possible causes of this patient’s symptoms were considered. These conditions included metastatic cancer, infection, rheumatologic disease, and neurologic disorders (Table 2). The possibility of referred pain from other visceral systems was also considered such as pelvic inflammatory disease, renal or urinary disease, and gastrointestinal disorders (eg, diverticulitis, duodenal ulcer). Local forms of pathology considered included spinal stenosis, facet arthropathy/degeneration, spondylolisthesis, myofascial pain, and Reiter syndrome (Table 2).

Sort the diagnostic hypothesis list by epidemiology and specific case characteristics

The diagnostic hypothesis list was re-sorted based on epidemiological factors of age and sex (Table 2A). Possible remote causes of Patient One’s symptoms included

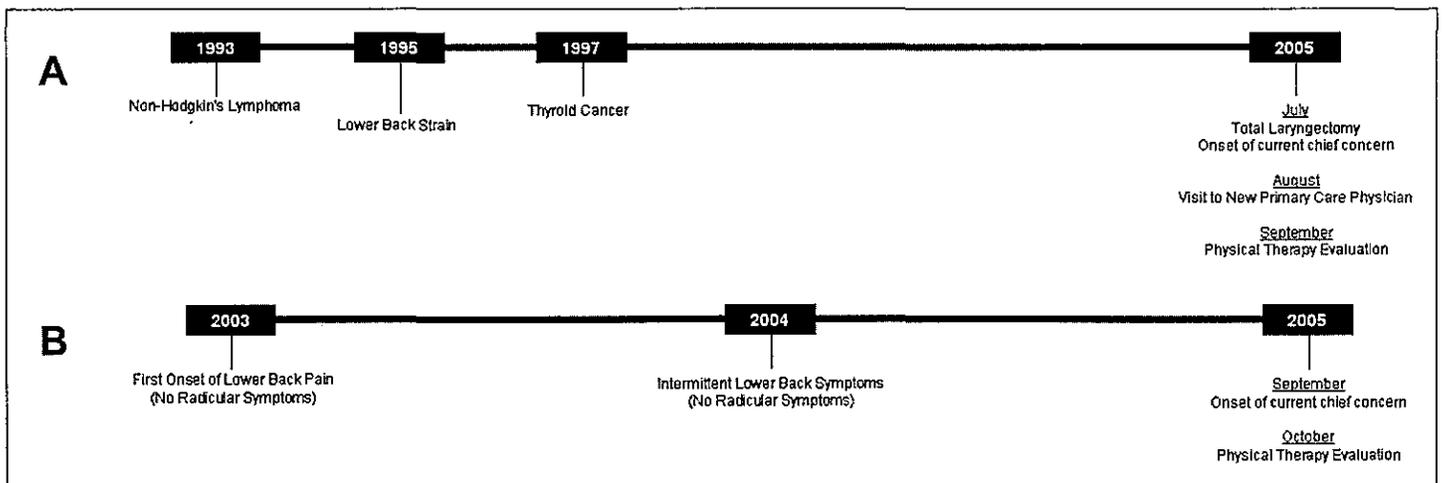


Figure 1. Timeline of symptoms for Patient One (A) And Patient Two (B).

Table 2. Conditions That May Lead to Lower Back Pain*

	Trauma	Inflammation	Metabolic	Vascular	Degenerative	Tumor	Congenital	Neurogenic/ Psychogenic
Remote	Not applicable	Aseptic Crohn's disease Septic Appendicitis Arachnoiditis/meningitis Bacterial endocarditis Cholecystitis Diverticulitis Duodenal ulcer Epidural abscess Herpes zoster Pancreatitis Pelvic inflammatory disease Pleuritis Prostatitis Renal or urinary tract infection Splenic abscess	Ectopic pregnancy Endometriosis	Aortic or iliac aneurysm Aortic or iliac arterioendarteriosclerosis Arteriovenous malformation of the spinal cord Epidural hematoma Infection: <ul style="list-style-type: none"> Kidney Spinal cord/conus medullaris Spleen 	Not applicable	Malignant Primary, such as: Carcinoma of the colon Multiple myeloma Retroperitoneal tumor Spinal cord tumor Malignant Metastatic, such as: Metastatic cancer (including from breast, lung, prostate, kidney and thyroid) Benign, such as: Ovarian cysts Uterine fibroids	Not applicable	Anxiety Depression Malingering Munchausen's syndrome Secondary gain Somatoform disorder
Local	Acute lumbar sprain/strain Disc disruption (with or without herniation) Facet syndrome Myofascial pain disorder Traumatic fracture <ul style="list-style-type: none"> Burst Compression Pars interarticularis Traumatic spondylolisthesis	Aseptic Ankylosing spondylitis Complex regional pain syndrome Fibromyalgia Psoriatic arthritis Polymyalgia rheumatica Reiter's syndrome Rheumatoid arthritis Septic Paraspinal muscle abscess Psoas muscle abscess Septic discitis Spinal osteomyelitis Subdural abscess Transverse myelitis Tuberculosis	Insufficiency fracture secondary to osteoporosis Paget's disease	Not applicable	Degenerative spondylolisthesis Disc degeneration Spinal stenosis Spondylolysis	Malignant Primary, such as: Primary bone tumor (eg, osteosarcoma, Ewing's sarcoma, fibrosarcoma, and chondrosarcoma) Malignant Metastatic, such as: Metastatic cancer (including from breast, lung, prostate, kidney and thyroid) Benign, such as: Intradiscal lipoma	Tethered spinal cord	Not applicable

*Diagnostic lists courtesy of Michael A. Andersen, DPT, OCS and J. Raul Lona, DPT in preparation as a textbook contribution.

metastatic disease, aseptic inflammation, and septic inflammation of the abdominal and pelvic organs. Local forms of pathology were considered, including traumatic (eg, lumbar disc disease, myofascial pain), degenerative (eg, facet arthropathy/degeneration, spondylolisthesis, spinal stenosis), aseptic inflammation (eg, Reiter syndrome), and septic conditions (eg, discitis, spinal osteomyelitis) primary malignant tumors (eg, osteosarcoma), malignant metastatic tumors (eg, from primary thyroid cancer), and benign tumors (eg, intraspinal lipoma).

Ask specific questions to rule specific conditions or pathologic categories less likely

Patient One was asked questions that addressed the possibility of remote conditions first. She denied involvement of multiple other joints (decreased likelihood of aseptic conditions); concomitant abdominal or pelvic pain (decreased likelihood of conditions involving these organs); change in bowel or bladder frequency, color, or consistency (decreased likelihood of gastrointestinal or renal/pelvic referral); and recent history of malaise, fever, chills, or nausea (somewhat

decreased likelihood of septic disease). Patient One acknowledged losing 14 kg over a period of 2 months, and she attributed this to her recent laryngectomy. In addition, she acknowledged night sweats that occurred 2 to 3 times per week over the prior 2 months.

Re-sort diagnostic hypothesis list based on the patient's responses to specific questioning

After obtaining the answers from the focused questions, pathology outside the scope of physical therapist practice could not be ruled less likely (Table 2B). Patient One's re-

Table 2A. Diagnostic Hypothesis List for Patient One Revised According to Pertinent Epidemiology and Information from the Patient Interview

	Trauma	Inflammation	Metabolic	Vascular	Degenerative	Tumor	Congenital	Neurogenic/ Psychogenic
Remote		Aseptic Crohn's disease Septic Pelvic inflammatory disease Renal or urinary tract infection		Aortic or iliac arterioendarteriosclerosis		Malignant Primary, such as: Carcinoma of the colon Multiple myeloma Retroperitoneal tumor Spinal cord tumor Malignant Metastatic, such as: Metastatic cancer (from thyroid) Benign, such as: Ovarian cysts Uterine fibroids		Anxiety Depression Malingering Somatoform disorder
Local	Acute lumbar sprain/strain Disc disruption (with or without herniation) Facet syndrome Myofascial pain disorder	Septic Septic discitis Spinal osteomyelitis	Insufficiency fracture secondary to osteoporosis		Degenerative spondylolisthesis Disc degeneration Spinal stenosis Spondylolysis	Malignant Primary, such as: Primary bone tumor (eg, osteosarcoma) Malignant Metastatic, such as: Metastatic cancer (from thyroid) Benign, such as: Intradiscal lipoma		

cent 14 kg weight loss in the 2 months prior to physical therapy evaluation accounted for nearly 20% of her total body weight. This is remarkable because an unintended weight change greater than 10% in one month may raise concern for neoplastic disease.⁸ In addition, she reported night sweats that occurred 2 to 3 times per week over the same time period, which may suggest neoplastic disorder or septic inflammation. Some of the local traumatic and degenerative pathologies were confirmed by previous MRI findings, so they remained on the diagnostic hypothesis list.

Perform tests to differentiate between the remaining diagnostic hypotheses

Patient One's oral temperature was 36.7°C. Peripheral neurologic evaluation revealed diminished bilateral patellar and Achilles reflexes, vibratory testing revealed intact sensation to bilateral lower extremities with the exception of impairment noted at the medial leg bilaterally. Manual muscle testing⁹ revealed hip flexors 3+/5 bilaterally; quadriceps 4/5 right, 4-/5 left; extensor hallucis longus 5/5 bilaterally; peroneals 5/5 bilaterally and tibialis anterior 5/5 bilaterally. Sustained active lumbar extension reproduced local lower back pain. The diagnostic hypothesis list was reorganized based on these focused physical examination findings (Table 2c).

Decide on a diagnostic impression and determine the appropriate patient disposition

Although several traumatic and degenerative conditions remained possible causes due to Patient One's reproduction of symptoms with active lumbar extension and ap-

parent neurologic deficits, the inability to rule tumor less likely as a cause of Patient One's symptoms prompted a referral to her oncologist. Patient One's previous history of cancer, age greater than 50 years, night sweats, and recent unintended 20% weight loss contributed to the physical therapist's diagnostic impression of possible neoplastic disease.^{8,10} Infection appeared less likely due to no recent history of fever, chills, malaise, or other symptoms typically related with infection. Her oncologist was selected rather than the referring internist due to his familiarity with the Patient One's case. Upon referral, blood tests and imaging were requested to help rule primary and metastatic cancer less likely as a cause of her symptoms. These additional tests revealed elevated thyroglobulin levels characteristic of a recurrence of thyroid cancer, which was confirmed as spinal metastasis with computed tomography.

PATIENT TWO Case Description

Patient Two was a 24-year-old male student referred to physical therapy by a family practice physician with a referral diagnosis of "low back pain." He reported an insidious onset of intermittent ache in the lower back with sharp radiating pain down the right posterior leg 1 month prior to physical therapy evaluation. Patient Two rated his LBP at 5/10 on VAS, and the occasional sharp shooting pain was rated 8-9/10. He reported his disablement had remained relatively stable since its initial onset. Aggravating factors included prolonged sitting, bending, lifting, and driving greater than 10 minutes, and his pain was worst early in the morning. Alleviating factors involved

laying supine with lower extremities elevated on a pillow. Patient Two's past medical history was significant for previous episodes of low back pain over a period of 2 years, which resolved without need for physical therapy intervention. These prior episodes were localized to the lower back. Otherwise, Patient Two considered himself to be 'healthy.' He took naprosyn (500 mg/BID) for approximately 22 days prior to physical therapy evaluation and reported no benefit. His body weight was 70.3 kg and he measured 178 cm tall (BMI 22.2 kg/m²).

Process of Symptom-based Diagnosis

Identify the patient's chief concern

Patient Two reported his chief concern as lower back pain.

Determine Yellow Flags

Yellow Flags included Patient Two's relatively young age and seeming good health, because these perceptions could lead a physical therapist away from investigating sources of pathology aside from trauma in determining the appropriateness of physical therapy to address his disablement.

Determine Red Flags

Patient Two's aggravation of symptoms with sitting and bending were considered indicative of lumbar disc pathology, particularly considering his radiating pain.

Create a symptom timeline

Patient Two reported a prior history of LBP 2 years ago which resolved without intervention. The onset of his current episode of LBP was 1 month prior to the physical therapy evaluation (Figure 1B).

Table 2B. Diagnostic Hypothesis List Revised for Patient One According to Physical Examination Findings

	Trauma	Inflammation	Metabolic	Vascular	Degenerative	Tumor	Congenital	Neurogenic/ Psychogenic
Remote						<p>Malignant Primary, such as: Carcinoma of the colon Multiple myeloma Retroperitoneal tumor Spinal cord tumor</p> <p>Malignant Metastatic, such as: Metastatic cancer (from thyroid)</p>		
Local	Facet syndrome Myofascial pain disorder		Insufficiency fracture secondary to osteoporosis		Degenerative spondylolisthesis Disc degeneration Spinal stenosis Spondylolysis	<p>Malignant Primary, such as: Primary bone tumor (eg, osteosarcoma)</p> <p>Malignant Metastatic, such as: Metastatic cancer (from thyroid)</p>		

Create a diagnostic hypothesis list considering all the possible forms of remote and local pathology that could cause the patient's chief concern

Possible remote causes of Patient Two's symptoms were considered next; these conditions included metastasis from testicular cancer, infection (meningitis), and renal/urinary disease (Table 2). Local forms of pathology were considered next; these conditions included disc disruption (with or without herniation), lumbar sprain/strain, and facet syndrome.

Sort the diagnostic hypothesis list by epidemiology and specific case characteristics

The list was resorted based on epidemiological factors (Table 3A). The possible remote causes of Patient Two's symptoms included referred pain from septic inflammation (eg, diverticulitis, duodenal ulcer, pelvic inflammatory disease), renal or urinary disease, primary malignant tumor (eg, osteosarcoma), and malignant metastatic tumor (eg, testicular cancer). Local forms of pathology included lumbar strain/sprain, disc disruption (with or without disc herniation), facet syndrome, myofascial pain, ankylosing spondylitis, Reiter syndrome, septic inflammatory disorders (eg, tuberculosis, discitis, spinal osteomyelitis), spondylosis, and tumors.

Ask specific questions to rule specific conditions or pathologic categories less likely

Patient Two first was asked a series of questions that considered the possibility of remote pathology. He denied recent history of coughing, malaise, fever, chills, or nausea (decreased likelihood of septic conditions); testicular or groin pain (decrease likelihood of testicular cancer/referral, pelvic inflammatory disease, and Reiter syndrome); involvement of multiple joints (decreased likelihood of aseptic inflammation, except perhaps ankylosing spondylitis); abdominal or pelvic pain, as well as change in bowel or bladder frequency, color, or consistency (decreased likelihood of gastrointestinal, renal, or pelvic organ referral). Patient Two then was asked a series of questions that considered the possibility of local lumbar spine pathology. He acknowledged experiencing an increase in LBP during coughing or sneezing, and confirmed his peripheralization of pain to the right lower extremity with flexed positions, such as sitting and bending forward.

Re-sort diagnostic hypothesis list based on the patient's responses to specific questioning

After obtaining the answers from the focused questions, it appeared that he did not present with signs associated with cancer or infection. Indeed, he denied any change in his health other than his current complaint of LBP. Following questioning, Patient

Two's symptoms appeared most consistent with local causes of pain, such as lumbar disc disruption with radiculopathy (Table 3B).

Perform tests to differentiate between the remaining diagnostic hypotheses

Vital signs were not taken at the time of initial evaluation because the diagnostically focused questions helped to decrease the likelihood of pyrogenic conditions. Selected tests focused mostly on the local forms of pathology considered. Neurological evaluation revealed normal bilateral Achilles and patellar reflexes, and vibration testing revealed intact sensation to bilateral lower extremities. Myotomal manual muscle testing² was normal. Ipsilateral straight leg raise peripheralized symptoms at occurred at 30° of hip flexion and contralateral straight leg raise reproduced these symptoms at 38° of hip flexion. Lumbar AROM revealed decreased lumbar flexion with a deviation to the left (with reproduction of symptoms), extension and side-bending range of motion appeared grossly within normal limits (with increased pain and peripheralization of symptoms during right sidebending).

Decide on a diagnostic impression and determine the appropriate patient disposition

History and physical examination findings suggested it was unlikely that Patient

Table 3A. Diagnostic Hypothesis List for Patient Two Revised According to Pertinent Epidemiology and Information from the Patient Interview

	Trauma	Inflammation	Metabolic	Vascular	Degenerative	Tumor	Congenital	Neurogenic/ Psychogenic
Remote		<p><i>Aseptic</i> Crohn's disease</p> <p><i>Septic</i> Renal or urinary tract infection</p>				<p><i>Malignant Primary, such as:</i> Multiple myeloma Retroperitoneal tumor Spinal cord tumor</p> <p><i>Malignant Metastatic, such as:</i> Metastatic cancer (including from breast, lung, prostate, kidney and thyroid)</p>		<p>Anxiety Depression Malingering Somatoform disorder</p>
Local	<p>Acute lumbar sprain/strain Disc disruption (with or without herniation) Facet syndrome Myofascial pain disorder</p>	<p><i>Aseptic</i> Ankylosing spondylitis Reiter's syndrome</p> <p><i>Septic</i> Paraspinal muscle abscess Psoas muscle abscess Septic discitis Spinal osteomyelitis</p>				<p><i>Malignant Primary, such as:</i> Primary bone tumor (eg, osteosarcoma)</p> <p><i>Malignant Metastatic, such as:</i> Metastatic cancer (including from breast, lung, prostate, kidney and thyroid)</p> <p><i>Benign, such as:</i> Intraspinous lipoma</p>		

Table 3B. Diagnostic Hypothesis List Revised for Patient Two According to Physical Examination Findings

	Trauma	Inflammation	Metabolic	Vascular	Degenerative	Tumor	Congenital	Neurogenic/ Psychogenic
Remote								
Local	Acute lumbar sprain/strain Disc disruption (with or without herniation) Facet syndrome Myofascial pain disorder							

Two presented with pathology that necessitated referral back to a physician for additional tests or treatment. Several findings implicated lumbar disc disruption. Disc herniations usually occur between the ages of 30 and 55 years.¹¹ Patient Two reported radiating pain down the posterior right lower extremity with occasional paresthesias, which was consistent with the L5 dermatome. His pain also was aggravated by sitting and flexed positions of the lumbar spine, which increase compressive forces and the intradiscal pressure.¹² His pain was alleviated with standing and extended postures. He reported increased pain during coughing/sneezing which also increases the intrathecal pressure and his pain was worse in the morning which is when the disc volume is at its greatest. Finally, ipsilateral and contralateral straight leg raise tests reproduced his characteristic symptoms. More importantly, however, other factors helped to rule other causes to be less likely, including the patient's denial of any recent weight loss, illness, fever, malaise, and other joint pain. Patient Two was treated for 6 weeks with McKenzie repeated extension exercises to centralize symptoms, manual traction, and lumbar stabilization exercises. He subsequently returned to his prior level of function without symptoms.

DISCUSSION

Increasing roles for physical therapists in primary care settings place a premium on efficient and thorough processes to determine the appropriateness of physical therapy for patients and direct treatment. The approach to symptom-based diagnosis for physical therapists described in this case series is characterized by a structured method of clinical hypothesis testing in an attempt to optimize accuracy. This approach aimed to optimize efficiency through diag-

nostically focused questions and tests that were customized to each patient's presentation, and used the knowledge of clinical presentation and underlying pathophysiology of specific medical conditions.

In this case series, the physical therapist's decisions regarding appropriate patient disposition were based on diagnostic impressions, involving a short list of most likely conditions culled from a list of all possibilities through the information gathered by history and physical examination. Clearly, the purpose of this hypothesis-based algorithmic process is not intended to determine authoritatively the exact cause of the patient's chief concern (ie, "THE Diagnosis"), but rather to suggest the most likely forms of pathology in order to decide the appropriateness for physical therapy for patients and direct treatment accordingly. The use of a hypothesis-oriented algorithm for symptom-based diagnosis by physical therapists does not appear to preclude the use of the various patient-oriented classification to direct treatment, including movement assessment, treatment-based classification, and application of clinical prediction rules. Rather, symptom-based diagnosis by physical therapists will facilitate optimal outcomes by strengthening initial selection for these patient-oriented classification schemes.

Physical therapy was determined to be inappropriate for Patient One at the time of the evaluation. This decision was made based on the information provided by Red Flags and questions asked in an attempt to rule tumor less likely as a cause of the patient's chief concern. The questions that were chosen are historically associated with medical screening, however, the focused questions and the accompanying physical examination techniques intended to test hypotheses highlighted the clinical

reasoning involved in this case series as a diagnostic process rather than true medical screening. Patient Two's physical examination findings suggested that it was unlikely he presented with pathology necessitating immediate referral to a physician. Interestingly, the physical therapist's relative confidence in the pathoanatomic diagnostic impression derived from history and physical examination findings guided the intervention. However, a definitive pathoanatomic diagnostic label is difficult to achieve in many patients with lower back pain.¹³

Physical therapists at all levels of experience appear capable of learning and using processes of symptom-based diagnosis because of their educational preparation in physiology, pathology, and movement dysfunction mandated by the Committee on Accreditation of Physical Therapist Education¹⁴ and described in the *Guide to Physical Therapist Practice*.¹⁵ Initial experience teaching this process to student physical therapists in entry-level, postprofessional, and residency programs has been promising. However, additional work appears necessary to determine the effectiveness and refine the efficiency of this process.

ACKNOWLEDGEMENTS

Dr. Few completed this case series in partial fulfillment of the requirements of the Residency in Orthopaedic Physical Therapy with the Division of Biokinesiology and Physical Therapy at the School of Dentistry of the University of Southern California. The authors thank Yogi Matharu, DPT, OCS, Residency Director for his support of this project. The authors affirm that they have no financial affiliation or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.

REFERENCES

1. Frymoyer JW, Cats-Baril WL. An overview of the incidences and costs of low back pain. *Orthop Clin North Am.* 1991;22:263-271.
2. Fritz JM, George SZ, Delitto A. The role of fear-avoidance beliefs in acute low back pain: relationships with current and future disability and work status. *Pain.* 2001;94:7-15.
3. Brox JI, Storheim K, Holm I, Friis A, Reikeras O. Disability, pain, psychological factors and physical performance in healthy controls, patients with sub-acute and chronic low back pain: a case-control study. *J Rehabil Med.* 2005;37:95-99.
4. Edwards I, Jones M, Carr J, Braunack-Mayer A, Jensen GM. Clinical reasoning strategies in physical therapy. *Phys Ther.* 2004;84:312-330; discussion 331-315.
5. Pincus T, Vlaeyen JW, Kendall NA, Von Korff MR, Kalauokalani DA, Reis S. Cognitive-behavioral therapy and psychosocial factors in low back pain: directions for the future. *Spine.* 2002;27:E133-138.
6. Bigos SJ, Bowyer OR, Braen GR, et al. *Acute Low Back Problems in Adults. Clinical Practice Guideline No. 14.* Rockville, MD: Agency for Health Care Policy and Research; 1994. AHCPR Publication No. 95-0642.
7. Harding IJ, Davies E, Buchanan E, Fairbank JT. The symptom of night pain in a back pain triage clinic. *Spine.* 2005;30:1985-1988.
8. Deyo RA, Weinstein JN. Low back pain. *N Engl J Med.* 2001;344:363-370.
9. Kendall FP, McCreary EK, Provance PG, Rogers MM, Romani WA, eds. *Muscles, Testing and Function.* 5th ed. Baltimore, Md: Williams & Wilkins; 2005.
10. Deyo RA, Diehl AK. Cancer as a cause of back pain: frequency, clinical presentation, and diagnostic strategies. *J Gen Intern Med.* 1988;3:230-238.
11. Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. *Ann Intern Med.* 2002;137:586-597.
12. Nachemson AL. Disc pressure measurements. *Spine.* 1981;6:93-97.
13. Deyo RA. Diagnostic evaluation of LBP: reaching a specific diagnosis is often impossible. *Arch Intern Med.* 2002;162:1444-1447; discussion 1447-1448.
14. American Physical Therapy Association. *A normative model of physical therapist professional education.* Alexandria: APTA; 2004.
15. American Physical Therapy Association. *Guide to physical therapist practice.* 2nd ed. *Phys Ther.* 2001;81:9-744.

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