A 74-year-old woman was transferred from a local acute care hospital to the stroke rehabilitation unit in my rehabilitation center. She had been admitted to the hospital 9 days earlier after experiencing unsteady gait and left hemiparesis for 24 hours. A computed tomography (CT) scan of the head in the acute care facility indicated that the patient had a right-sided parietal infarct and that she had a pre-existing left frontal infarct that had gone undetected until the current episode. She had a history of non–insulin-dependent diabetes mellitus, emphysema and recurring bronchitis, hyperlipidemia, and hypertension. The patient was treated with aspirin and 2 liters of oxygen per minute delivered through a nasal cannula. Medications prescribed during hospitalization and continued during rehabilitation included Lasix* (furosemide, a diuretic) and Sectral† (acebutolol hydrochloride, a beta blocker) to treat hypertension, Zocor‡ (simvastatin) to treat hyperlipidemia, and Aerolate§ (theophylline, a bronchodilator) to treat emphysema. The patient lived alone in a single-level, 6-room house that required climbing 5 steps to enter. Two years earlier, she had retired from her job as a factory worker on disability compensation because of pulmonary disease. She was independent in all mobility and self-care activities prior to admission; however, she had stopped driving years earlier after an accident. Her sister regularly drove her to the grocery store. Her diet largely consisted of prepared, processed food that was reheated in a microwave. She spent most of her time crocheting and watching television. She continued to smoke 1.5 packs of cigarettes a day. Her goal was to return home independently. Because she did not have insurance, the social worker on the stroke rehabilitation unit began the paperwork for Medicaid coverage. My examination of the patient revealed several perceptual deficits. She was unable to discriminate left from right during mobility tasks and during general direction tasks. Requests to turn and look to the left were not followed. She could be cued to lock the right wheelchair brake; however, she could not locate the left brake and explored only as far left as the inside of the wheel-

Clinical question: Does the presence of ideomotor apraxia affect the prognosis of functional recovery in a woman who has had a stroke?

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* Aventis Pharmaceuticals, 300 Somerset Corporate Blvd, Bridgewater, NJ 08807-2854.
† Wyeth Pharmaceuticals, 555 Lancaster Ave, St Davids, PA 19087.
‡ Merck & Co Inc, One Merck Dr, PO Box 100, Whitehouse Station, NJ 08889-0100.
§ Fleming & Co, 1733 Gilsum Ln, Fenton, MO 63026.
chair armrest. She demonstrated left-side neglect; she could not locate items on the left side of her breakfast tray, and she was unable to identify objects on the left side of a paper cancellation test. Her score of 16 (out of a maximum score of 34) on the ideomotor apraxia subscale of the Boston Apraxia Test, the standard test for apraxia, indicated major impairment. Ideomotor apraxia is manifested as difficulty with motor planning and sequencing. Although patients with ideomotor apraxia are able to perform most automatic movements, they cannot perform movements on command and have difficulty with novel movements.

This patient's perceptual impairments were evident when she performed mobility tasks. Although she did not display major strength deficits in any muscle group, she required moderate assistance (she performed 50% to 75% of the activity) to maintain standing balance. She stood with her right foot directly beneath her center of mass with little weight bearing on the left foot (her heel did not remain in contact with the floor), limiting her base of support and stability. She was able to come to a standing position from the wheelchair with minimal assistance (she performed approximately 75% of the activity). Transfers from the wheelchair to the mat table required maximum assistance (she performed 25% to 50% of the activity) to pivot. Apraxia was the limiting factor in her transfers, because she was unable to formulate a motor plan to complete the movement. The patient was unable to follow directions to propel or direct the wheelchair, and she required moderate assistance to walk on level surfaces for 6 m (20 ft). Ideomotor apraxia caused further difficulties when she turned to sit in the wheelchair, making the transition unsafe. As with transfers and wheelchair mobility, she was unable to formulate the motor plan to perform the turn.

This patient's functional mobility and independence were limited by her severe perceptual deficits. She did not have health insurance or savings to defray the costs of her hospitalization. Her social supports were limited to a sister who lived 10 miles away and who was the primary caregiver for her own husband.
To plan for discharge, I needed to consider the patient’s prognosis for recovery. I was less comfortable with making a prognosis in this case because the patient’s motor deficits were not as severe as her perceptual deficits. I consulted the Guide to Physical Therapist Practice to help guide my clinical decision making. I determined that this patient should be classified under practice pattern 5D (“Impaired Motor Function and Sensory Integrity Associated With Nonprogressive Disorders of the Central Nervous System–Acquired in Adolescence or Adulthood”). There were no findings that would classify her conditions under additional patterns. According to the Guide to Physical Therapist Practice, I would expect optimal motor function and the highest level of functioning to occur within 12 months, and I would expect the number of visits for the episode of care to range from 10 to 60 in 80% of patients.

This information did not help me to specify my expectations for this patient. Her limited medical insurance and social support made discharge planning particularly complicated. I knew that her motor impairments did not limit her mobility status as much as her perceptual impairments did. However, I was uncertain whether the primary literature supported the assumption that perceptual impairments delay return to function. I decided to search for articles that document the effect of ideomotor apraxia on the prognosis for return to function following stroke.

**Database used for search:** MEDLINE

As an alumnus of the university where I received my physical therapy degree, I have access to the online database, MEDLINE, through the university library’s subscription to Ovid Online. The US National Library of Medicine produces MEDLINE, which is an extensive source for abstracts and bibliographic references in the medical and health care literature, including physical therapy and physical and cognitive rehabilitation. Therefore, MEDLINE seemed to be an appropriate tool to answer my question. I also was familiar with MEDLINE’s print equivalent, *Index Medicus*. The online database includes more than 10.8 million records, representing more than 3,000 peer-reviewed journals, with coverage starting in 1966.

Ovid is a collection of more than 90 databases, including MEDLINE and other databases specific to the health care professions, such as the *Cumulative Index to Nursing and Allied Health Literature* (CINAHL) and Current Contents. Moreover, databases for business, the humanities, engineering, and social sciences can be searched through Ovid. The database also includes full-text articles from some journals. I performed this search on April 4, 2002.

**Initial keywords:** apraxia AND stroke AND prognosis

I began my search with 3 keywords: apraxia, stroke, and prognosis. Because I did not know whether MEDLINE used these keywords, I conducted individual searches on each keyword to find the search terms used by the database or to confirm that the keyword was the proper term. Then, I would combine the search results because I was interested in each keyword only as it related to the others.

First, I entered stroke into the keyword entry box. Because the box above the keyword entry box, called Map Term to Subject Heading, was checked as a default, MEDLINE informed me...
that the term mapped to cerebrovascular accident. Mapping helps match search terms to the subject headings that MEDLINE uses. With this box checked, MEDLINE automatically searched related terms for more appropriate keywords than the one I typed into the keyword entry box.

When I clicked on the subject heading cerebrovascular accident, it led me to a subject heading tree (a stratified list of related terms, some that were more general and some that were more specific than the one I used) showing a narrower, more specific subject heading—brain infarction. Cerebrovascular disorders was the more general term in the tree, and this term included cerebrovascular accident and brain infarction as well as terms that were unrelated to my patient, such as basal ganglia cerebrovascular disease, carotid artery diseases, dementia, and vascular headaches. I chose to check the Explode box next to the term cerebrovascular accident. With the Explode box checked, the database would retrieve citations using both subject headings cerebrovascular accident and brain infarction.
After checking the **Explode** box next to **cerebrovascular accident** and then clicking on **Continue**, Ovid brought me to a screen that listed subheadings—such as **epidemiology, drug therapy, prognosis, psychology, and rehabilitation**—that could be used to narrow my search. However, I decided not to select any subheadings at this point, because I did not want to restrict the search results until I determined how my 3 keywords would combine. So I clicked on **Continue** again, and Ovid returned me to the main search page, listing 18,596 results.

I then started to search using my next keyword—apraxia. When I typed **apraxia** into the keyword entry box and clicked on the **Perform Search** button, MEDLINE informed me that the term mapped to the subject heading **apraxias**. The tree for apraxias displayed the more specific subject headings **apraxia, ideomotor** and **gait apraxia**. I decided to explode **apraxias** as well, because its tree indicated that 32 citations were generated by **apraxia, ideomotor** and only 11 by **gait apraxia**. With so few citations available, I did not want to limit my search too narrowly. So I clicked on the **Explode** box to the right of **apraxias** on the Tree screen, then on **Continue**. As with cerebrovascular accident, I did not want to limit my search to any particular subheadings just yet, so I clicked on **Continue** again without specifying subheadings. The Search History table listed 1,427 results for this term.

I wanted to include the term **prognosis** in my search because I was particularly interested in the effect of apraxia on my patient’s predicted outcome. When I typed **prognosis** into the keyword search box, MEDLINE led me to the tree that included the more specific term **treatment outcome**. I decided to explode **prognosis** as well, in order to retrieve all citations associated with this subject heading. This action retrieved 319,491 citations.

To combine the 3 sets of citations retrieved for my subject headings after they appeared in the search history, I typed **and/1-3** into the search box. I learned about several short cuts like this one using the following page on the Ovid Web site: www.ovid.com/support/tech_tips.cfm. This shortcut returned only those citations included in lines 1, 2, and 5 of my search history. Six citations were retrieved. Next, I checked off 2 limit boxes—**Human** and **English Language**—that appear below the keyword entry box. The results indicated that I did not lose any of the 6 citations by imposing these limits. However, as I scrolled down to review the titles of the articles retrieved using these search terms (Fig. 2), I did not find an article that provided the information I needed to better understand the effect of apraxia on prognosis for return to function for my patient. This search resulted in articles that covered oral apraxia, using a specific test (Halstead Category) to predict upper-extremity recovery, articularatory apraxia, and recovery from aphasia.

**Additional keyword:** activities of daily living

Because my search resulted in 6 citations that did not adequately answer my question, I decided to try using the word **activities of daily living**. I used this term because I was interested in predicting functional limitations and disabilities in this area for my patient. This keyword retrieved 21,488 hits. I combined my searches for **apraxias** and **activities of daily living** by typing **2 and 6**, which combined those lines from my search history, and limiting the search to **human** and **English language**. This resulted in 18 citations (Fig. 3).

**Selection of articles for review:** After clicking on the **Display** button (which is located next to each line in the search history) to retrieve the citation list produced by my last search, I briefly read through the titles of the 18 articles cited to get a sense of their relevance to my question. Because I used **activities of daily living** as a search term rather than **cerebrovascular accident**, many of the citations seemed to be about patients with Alzheimer disease and Down syndrome, and the focus of several articles was on gait apraxia, pathophysiology, or measurement of apraxia. These articles did not seem relevant to my question, so I did not pursue them further. Two titles seemed to be exactly related to prognosis for return to function in patients with apraxia after a stroke. I decided to read these 2 abstracts on MEDLINE. On the screen displaying the citation list, the buttons **Abstract** and **Complete Reference** follow each citation. I clicked on **Abstract**, and the abstract for that particular citation was displayed.


**OBJECTIVES:** The study was aimed at improving the accuracy of prognosis for recovery of function in patients suffering a first stroke. **MATERIALS AND METHODS:** Two-hundred and forty-eight patients were enrolled. The mean interval since the stroke was 23 days. Patients entered a rehabilitation program lasting 60 days. The predictive value of 12 factors were analyzed, namely motor, cognitive and sphincter sub-items of Functional Independence Measure at admission (FIM-a), age, sex, education, body mass index (BMI), depression, neglect, aphasia, ideomotor and constructive apraxia. FIM score at discharge was the dependent variable. **RESULTS:** A multiple regression revealed that only age, cognitive and sphincter sub-items of FIM-a, neglect and ideomotor apraxia were significantly associated with outcome. Moreover, these factors accounted for only 72% of the variance in outcome scores. A decision of unfavorable prognosis on the basis of a FIM-a value lower than 40 was incorrect in 2.8% of the patients in this study and in 8.2% of those having a FIM score lower than 40.
CONCLUSIONS: The use of statistical methods to examine the outcome after stroke is useful for expressing probability on a group basis but is unsuitable for determining the prognosis of individual patients. Such data should not be used for fiscal management. A significant minority of patients presenting with a FIM lower than 40 can regain a useful measure of independence. The errors in prognosis based upon available methods, although small, have unacceptable effects in human terms if they lead to the clinical decisions which deny patients rehabilitation. All of the patients should therefore be admitted for rehabilitation after their first stroke. Severe co-morbidity requires special attention.


After reading the abstract, I knew that I needed to read the entire article. The authors used a multiple regression equation to determine the variables that predict the level of functional recovery in patients who have had a stroke. Apraxia was one of the variables that was included in the equation, and it was found to be significant. We have a state university in the city where I live, and, as a state resident, I am able to use the medical library. I was able to obtain the article there and read it in its entirety.

The study was performed in 3 rehabilitation centers in Italy. The purpose of this study was to use a large number of clinical variables to predict functional outcomes in patients who were admitted to the stroke units in the rehabilitation centers. The researchers used scores for individual items on the Functional Independence Measure (FIM) at admission as well as the variables of age, sex, education, body mass index, depression, left-side neglect, aphasia, lesion side and etiology, comorbidities, and ideomotor and constructional apraxia to predict FIM scores at discharge in 248 patients who had had a stroke. The final multiple linear regression equation accounted for 72% of the variance in the discharge FIM score. The 5 variables that predicted this amount of variance were age, left-side neglect, ideomotor apraxia, and FIM admission scores for cognition and sphincter control. The authors reported that the smallest improvement over time was noted in FIM discharge scores on shower and tub, stairs, and lower-extremity dressing items.

After reporting their findings, the authors’ tone in the discussion section took on the flair of a social commentary. Their resulting equation accounted for a substantial proportion of the variance (72%), yet the authors focused their discussion on the insignificant number of people whose return to function was not predicted by the regression equation. The authors seemed to use the data to argue for more therapy for all patients, although their results did not support their statements. Because the authors’ research was used to predict the outcome of populations rather than individuals, I did not base my decisions on the discussion portion of the article, but on the results.

The subjects in this study received 2 months of intensive inpatient rehabilitation and were admitted to the rehabilitation units an average of 23 days after their strokes. My patient’s stroke occurred only 9 days before admission to the rehabilitation center, and she would receive no more than 2 weeks of inpatient therapy because of her limited medical insurance coverage. Furthermore, I used the Boston Apraxia Test to measure her apraxia impairments, whereas Giaquinto et al used a different measure, the De Renzi Test, to diagnose apraxia. Nevertheless, extrapolating from the information in this study, I concluded that our rehabilitation team would need to scale back our goals and expectations for this patient, particularly in the areas of bathing, lower-extremity dressing, and negotiating stairs. I based my decision on the fact that we had little time to work with her in intensive rehabilitation, she had no one at home to offer her regular assistance, and she had 4 of the 5 factors that predicted the level of recovery of function in this study—advanced age (she was 74 years of age and the average age of the sample in this study was 68), apraxia, left-side neglect, and a low admission score (10/21) on the FIM cognition subscale.

I wanted to know more about how I could predict this patient’s outcome, given the fact that she had apraxia. The second abstract that interested me appears below. I was able to get this article from the same medical library where I obtained the first article.


The degree of self-care in 120 patients who had suffered unilateral cerebrovascular accident (CVA) was assessed at different stages of recovery. The level of ADL (activities of daily living) function was determined on admission and discharge. Patients with right-sided hemiplegia (r. hem.) were given a set of apraxia tests on admission to the hospital. The results of ADL evaluation showed improved ADL function between admission and discharge, but a worsening after returning home. There were some significant relationships between ADL function in hospital and apraxia. All the apraxia variables are significant as predictors of subsequent dependency. The results show the seriousness of problems related to apraxia in rehabilitation of stroke patients with a lesion in the left hemisphere. One conclusion is that the treatment procedure ought to be directed to the various symptoms of apraxia. The effect of apraxia on ADL in the domestic situation has to be given more attention. More treatment should be given in the home, as
patients seem to have difficulty in transferring the skills learned in hospital to the home situation and in maintaining them.


The purpose of this study was to determine the relationship between self-care and neuropsychological tests, including the Boston Apraxia Test, by measuring ideomotor apraxia. The study design, however, had several problems that limited its usefulness in answering my question. The self-care measures of dressing, grooming, and transfers were not standardized. Functional ability was assessed at admission and at discharge by occupational therapists, and the authors acknowledged that the criteria of the occupational therapists who performed the data collection “may have varied slightly.” Patients were classified as either dependent or independent, but the scale used in this study did not discriminate further than this dichotomy. Furthermore, the long-term assessment was provided by a self-report questionnaire that gave a patient’s or caregiver’s opinion of functional ability 6 months after discharge. The authors compared these self-reports to earlier measures collected by the occupational therapists. Moreover, the authors referred to an unpublished manuscript when they stated, “The information derived from the questionnaire is sufficiently reliable to be used in studies on patient groups.” The validity of the long-term data, therefore, was suspect. Furthermore, the patients in this study were admitted to rehabilitation an average of 134.5 days after their stroke, much later than my patient.

The authors concluded that the relationship between apraxia and recovery of function was significant. When I looked closely at the table providing the results, however, I saw that this relationship was less impressive than the abstract and the body of the article implied. The t-test, which compared patients who were independent in activities of daily living at discharge with patients who were dependent, did not differ on their scores for ideomotor apraxia at discharge. The results at 6 months after discharge, however, were significant, with patients who were determined to be independent scoring nearly twice as high on the test for ideomotor apraxia as patients who were deemed to be dependent for activities of daily living. The authors concluded that patients with apraxia do learn to perform grooming, dressing, and transfer tasks with rehabilitation, but they are more likely to remain dependent in these skills than patients without apraxia.

I concluded that the results of this study did not provide a strong level of evidence because of the poor study design and the authors’ method of assessing function. Moreover, I had to be cautious of applying these results to my patient. The patients described in this study all had a lesion in the left hemisphere. In contrast, my patient’s acute infarct was in the right hemisphere, although her CT scan revealed a pre-existing infarct in the left hemisphere.

**Clinical decision:** Based on the limited results of my search, I decided that the literature did not offer very strong evidence for apraxia as a predictor for functional recovery after stroke. Many clinicians believe that apraxia would limit a patient’s recovery; however, I found little evidence on the effect of ideomotor apraxia on recovery after stroke. The article by Giaquinto et al did offer strong evidence to support the idea that the presence of apraxia, in combination with advanced age, left-side neglect, and admission scores on cognition and sphincter control subtests of the FIM, predicts limited functional recovery, particularly in the areas of stair climbing, lower-extremity dressing, and using the shower or tub. However, I was surprised that my search revealed no other citation that considered a similar research question.

I decided that my patient would not be able to return home from the rehabilitation hospital independently in as short a period as 2 weeks. Although the study by Giaquinto and colleagues is (in my opinion) the only well-designed study related to my question that I found in my search, their results were enough for me to decide that, in the short-term, discharge to home without assistance would not be a feasible outcome for my patient. She had enough of the impairments that predicted poor recovery of function that, because she did not have strong social support, I judged she would need more time in the stroke rehabilitation unit to be safe in her home. The rehabilitation team (which included the social worker, nursing staff, the occupational therapist, the speech-language pathologist, and me) began immediately to plan for alternative, short-term placement, with the social worker discussing options with the patient’s sister. Depending on funding, the patient could have a home health aide to help with bathing and toileting, or she would need to live with her sister to ensure her safety throughout the day. The rest of the team immediately began to prepare the patient to expect that she would need additional care in order to be safe after discharge from the hospital.

**References**


**Tips for accessing online databases:** Dr Riolo had access to online databases through her alma mater and access to the articles at the local medical library. To find libraries that will provide research services to the public in your state, access the National Network of Libraries of Medicine online (nnlm.gov). From there, users can click on Librarian and Health Educator Resources, then on Find NN/LM Member Libraries. Every region has access to a medical library that will perform literature searches and provide access to databases, often free of charge. Other libraries have nominal service charges for access to their resources.