was available for this organism. In 1959 Runyon[3] published his well known classification of the mycobacteria, dividing them into four groups according to cultural characteristics. The current classification of mycobacteria in use at the Public Health Laboratory in Toronto is shown in Table II. The annual report of this laboratory for the year 1972-73 lists 1616 atypical strains identified out of approximately 60 000 specimens submitted for culture because of suspected tuberculosis. In 13 instances more than one strain was cultured from a specimen. Strains that did not conform biochemically to a specific species were simply reported according to Runyon's grouping.

A number of publications on the atypical mycobacteria have appeared in Canada. One of the earliest was by Hiltz and Kloss[4] in 1968, reporting 46 cases from the Nova Scotia Sanatorium. In 1969 Jeanes, Davies and McKinnon[5] reported the results of skin testing 24 763 secondary school students and several thousand volunteers across Canada with tuberculin and, simultaneously, Gause, Battey or avian antigens. The frequency of positive reactions to the atypical strains was several times the frequency of positive reactions to tuberculin and this sensitivity was surprisingly uniform across Canada. This was confirmed by Grzybowski, Brown and Stothard in a study conducted in British Columbia.[6] In another study conducted in British Columbia Robinson and colleagues[7] documented 29 cases of infection with atypical mycobacteria, 18 of pulmonary disease and 11 of cervical adenitis; 6 of the patients with pulmonary disease died. Klotz[8] reported 12 cases of atypical mycobacteria in the urine but did not consider the organisms to be pathogenic in the urinary tract. Kahana, Richardson and Cole[9] reported six cases illustrating the problems in diagnosis and treatment. Recently much intensive work has been done to determine the nature of mycobacterial species. Stanford and Grange[10] examined over 1000 strains in immunodiffusion analyses, allotting the majority to 20 named species.

The source of infection with atypical mycobacteria is still unknown, though soil, dust and drinking water have been suspected. It may be that most of these organisms are, in fact, "opportunistic" and will only multiply in tissues already "devitalized". We are always concerned, however, when *M. kansasii* or *M. intracellulare* is isolated, for these organisms sometimes appear to possess invasive powers in healthy tissues. Clinical experience has shown, on the other hand, that the infection is not usually contagious, indicating that there must be some breakdown of host resistance before an infection is acquired.

A simplified classification

Runyon[11] appears to have clarified once again the complex and confusing subject of the identification of mycobacteria. He has abandoned his classification by groups and now recognizes only 10 kinds of mycobacterial diseases caused by the following 10 species or species complexes: *M. leprae, M. ulcerans, M. tuberculosis* complex, *M. kansasii, M. marinum, M. simiae, M. szulgai, M. avium–scrofulaceum* complex, *M. xenopei* and *M. fortuitum* complex. He urges that only the correct species name be used, that subspecies within a species complex no longer need to be clearly defined, that all nonpathogens be placed in a single category, and that many biochemical tests for species identification be discontinued because they have no clinical value.

It is suggested that a classification such as Runyon now proposes be considered, so that the difficult and costly process of identification of mycobacterial species may be simplified.

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Addendum

Since this article was written, the study has been extended to Dec. 31, 1975. In this 6-year period atypical mycobacteria have been recovered from 112 out of 2161 patients admitted consecutively, of whom 62 were suffering from disease caused by the mycobacteria isolated. Sixteen of these 62 patients died and a further 14 responded poorly to chemotherapy.

Evaluation of stroke disability

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The disabilities resulting from a stroke are not well understood from the epidemiologic or functional point of view. The stroke may impair mental status, perception, sensation, communication and motor ability; the total resulting disability is related to the extent of impairment in each of these areas. A complete evaluation in all these areas has to be done to determine the degree of disability before any rehabilitation program is planned. A comprehensive approach to evaluating stroke disability is presented that includes correlating the degree of impairment in each of the above-mentioned areas with the overall functional ability of the patient.

D'un point de vue épidémiologique ou fonctionnel, l'invalidité consécutive à un accident vasculaire cérébral est mal perçue. Un accident vasculaire cérébral peut affecter l'état mental, la perception, les sensations, la communication et la capacité motrice; l'invalidité qui en résulte est proportionnelle à l'étendue de l'atteinte de chacun de ces facteurs. Une évaluation complète de tous les facteurs doit être entreprise afin d'évaluer le degré d'invalidité du patient avant de mettre au point un programme de réhabilitation. On présente un moyen d'aborder dans son ensemble l'évaluation de l'invalidité résultant d'un accident vasculaire cérébral, moyen qui inclue la corrélation du degré d'atteinte de chacun des facteurs énumérés précédemment avec la capacité fonctionnelle totale du patient.

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Persons disabled by a stroke form a sizable proportion of the population receiving health services. Yet not only are knowledge of and interest in stroke disability lacking, but also the approaches used to evaluate the disability vary and the evaluation is often incomplete.

Stroke is the third most common cause of death after the age of 65, and it produces serious disability, often permanent, in a large percentage of survivors. The incidence of stroke per 100 000 population per year in the United States ranges from 171[1] to 213,[2] and the prevalence is about 1250 per 100 000.[3] In Great Britain it is estimated that one out of every four persons who have a stroke will be seriously disabled and the remainder will either die or recover.[4] And in Sweden persons disabled by strokes occupy 5.7% of all nursing home and hospital beds.[5] Evaluation of the disability, therefore, should be an important first step in the management of the patient who has had a stroke, after the acute condition has been treated.

This paper provides an account of a comprehensive approach to evaluating stroke disability, with a view to determining the patient's total functional ability.

Scoring functional ability

Overall ability (Table I)

To facilitate evaluation of the functional ability of the patient who has had a stroke, seven functional categories have been established. Included in the assessment is social independence, which is defined as the ability of a person to live alone, and therefore goes beyond the classic concept of independence in self-care and activities of daily living. The degree of social independence often determines whether a person can return to his or her previous environment, and is related in most cases to the degree of impairment of perceptual function and mental status rather than to the degree of motor recovery. Because financial factors should not hinder social independence, they are not considered.

The overall functional score for each patient is determined by the degree of impairment of mental status, perception (including sensation and purposeful movement [apraxia]), communication and motor ability. Impairment in each of these areas has also been divided into seven categories so that progress in the patient's overall function and in each area of impairment can be correlated. Specific factors preventing further independence will be more easily identified with this approach. A patient's score for overall function cannot be greater than the minimum score obtained in rating the four areas of impairment. Lack of progress in overall functional ability can thus be related to specific areas of impairment; treatment can then be directed more rationally and the functional prognosis can be more accurate.

Table I—Overall functional ability of stroke patient

Score	Description
0	Totally unable to function.
1	Dependent socially and for self-care.
2	Socially dependent; requires assistance or supervision in self-care.
3	Socially dependent; self-care independent.
4	Socially and self-care independent; employable only in sheltered situation.
5	Socially and self-care independent; can undertake part-time or modified employment.
6	Able to return to former lifestyle, including employment.

Mental status (Table II)

This is evaluated by observing during treatment activities the patient's short-term memory, attention span, reasoning and affect. Short-term memory is considered to be severely, moderately or mildly impaired when the patient is unable to remember treatment instructions for more than 2, 10 or 60 minutes, respectively. Attention span (concentration) is defined as severely, moderately or mildly impaired when the patient's concentration span during functional activities is 3, 5 or 10 minutes, respectively. Reasoning is considered severely impaired when the patient is unable to foresee consequences of a single action; moderately impaired when he can foresee consequences only of actions related to self-care; and mildly impaired when he is unable to generalize on specifics (i.e., explain a proverb) but is able to carry out simple transactions and social interactions.

Table II—Mental status

Score	Description
0	Periods of semiconsciousness.
1	Total disorientation or severe memory impairment.
2	Severe impairment of long- or short-term memory, judgement or reasoning.
3	Moderate impairment of short-term memory and reasoning; mild disorientation in time and place; severe distractibility or reduction of attention span.
4	Mild impairment of short-term memory and reasoning; mild to moderate affect problems; moderate distractibility or reduction of attention span
5	Mild affect problems; reduced attention or concentration span; mild distractibility.
6	Normal orientation to time and place, judgement, affect, short- and long-term memory, reasoning, concentration and attention.

Moderate and mild impairment of affect are defined as consistently and occasionally, respectively, inadequate behavioural response to treatment instructions.

Perception (Table III)

Apraxia and impairment of perception and sensation are identified and rated by means of the test "Identification of Agnosia and Apraxia", developed by the study group of the Toronto branch of the Canadian Association of Occupational Therapists. Body-image deficit is evaluated by our own assessment procedure, adapted from a method published by Developmental Learning Material Incorporated.

Table III—Perception

Score	Description
0	Severe motor apraxia and agnosia (visual, tactile, proprioceptive, body-image, space) and impairment of all peripheral sensation.
1	Severe motor apraxia or agnosia (visual, tactile, proprioceptive, body-image, space).
2	Severe perseveration or moderate motor apraxia, visual agnosia, body-image impairment or proprioceptive impairment.
3	Any two of the following: mild body-image impairment, motor apraxia or agnosia (spatial); with or without moderate impairment of peripheral sensation.
4	Moderate constructional apraxia and/or astereognosis, with mild impairment of peripheral sensation.
5	Mild constructional apraxia, astereognosis or impairment of peripheral sensation, or hemianopia.
6	No deficits in these areas.

Communication (Table IV)

Aphasia (or dysphasia) and auditory agnosia are evaluated by means of the Porch Index of Communicative Ability[6] and the Minnesota Test for the Differential Diagnosis of Aphasia.[7] The degree of dysarthria and oral apraxia is judged from the proportion of time that the patient's speech is not intelligible, as follows: severe, 90%; mod-

Table IV—Communication

Score	Description
0	Not applicable.
1	Not applicable.
2	Global aphasia; or severe mixed aphasia or severe apraxia with or without dysarthria; or severe auditory agnosia.
3	Moderate mixed aphasia with mild dysarthria or apraxia or auditory agnosia; or moderate to severe apraxia; or severe dysarthria; or moderate to severe auditory agnosia.
4	Moderate mixed aphasia; or moderate to severe apraxia; or moderate to severe dysarthria; or moderate auditory agnosia.
5	Mild mixed aphasia with mild dysarthria or mild apraxia; moderate dysarthria or moderate apraxia; or acalculia; or mild auditory agnosia.
6	Any single mild impairment that does not prevent patient's returning to former lifestyle.

erate to severe, 65 to 90%; moderate, 45 to 60%; mild to moderate, 20 to 45%; and mild, less than 20%.

Motor ability (Table V)

Total motor function rather than recovery of isolated movements is evaluated. The gait pattern is less important than independence and safety of gait. Therefore, balance, ability to transfer and independence of ambulation are the indicators of motor recovery.

Case reports

The following two cases illustrate the importance of complete evaluation of stroke disability.

Patient 1

A 64-year-old woman was admitted to our rehabilitation program 1 month after having a cerebrovascular accident (CVA) affecting the right cerebral hemisphere. She had severe distractibility and reduction of attention span, and moderate impairment of short-term memory (mental status score, 3); severe body-image impairment, constructional apraxia and spatial agnosia with moderate perseveration, but normal peripheral sensation (perceptual score, 1); no impairment of communication (communication score, 6); and no motor deficit (motor score, 6). She required supervision and assistance in dressing, was not reliable and could not find her way in the department (score for overall functional ability, 1).

After 4 months of treatment her mental status had improved and the only deficit was mild reduction of attention span (mental status score, 5), but she still had moderate body-image impairment, spacial agnosia and apraxia, and mild perseveration (perceptual score, 2) and needed assistance in all self-care activities (score for overall functional ability, 2).

Patient 2

A 63-year-old man was admitted to the rehabilitation program 1 month after having a CVA affecting the left cerebral hemisphere. He had moderate distractibility and impairment of short-term memory and reasoning (mental status score, 3); moderate body-image impairment and constructional apraxia, and mild perseveration (perceptual score, 2); moderate to severe auditory agnosia and moderate mixed aphasia (communication score, 3); and no motor deficit (motor score, 6). He was dependent in all self-care activities, requiring continuous supervision (score for overall functional ability, 2).

After 6 months of treatment he had mild impairment of short-term memory, reasoning and attention span (mental status score, 4); mild body-image impairment and constructional apraxia (perceptual score, 5); and minimal improvement in communication (communication score, 3). He was independent as regards self-care but was unable to use public transportation and therefore was considered socially dependent (score for overall functional ability, 3). Although he had made gains, the residual impairment in perception and communication prevented his performing at a higher level of independence. He was discharged home and arrangements were made for him to go to a sheltered workshop. Reports during the next 12 months indicated that his activity in the workshop was limited to social interaction.

Table V—Motor ability

Score	Description
0	Bilateral hemiplegia with complete paralysis.
1	Poor to fair sitting balance, no standing balance, no functional recovery of affected extremities.
2	Poor to fair standing balance; wheelchair activities require assistance.
3	Wheelchair independent; limited ambulation with external aids and assistance.
4	Independent ambulation with external aids but no assistance. May have painful complication of affected arm.
5	Independent ambulation with or without external aids. Degree of function of arm is important factor for modified employment.
6	Independent ambulation with or without external aids. Function of arm does not hinder return to former lifestyle and occupation.

Discussion

Lack of systematic evaluation of stroke disability makes it difficult to analyse the results of rehabilitation programs. The value of rehabilitative treatment of the person who has had a stroke has been challenged by Waylonis and colleagues,[8,9] but in their functional evaluation they did not consider the functional progress of the whole person, but primarily the recovery, or lack of recovery, of muscle function. Others have shown that functional improvement in the patient who has had a stroke is not consistent with motor recovery.[10] Furthermore, Adams and Hurwitz[11] in 1963 reported that mental barriers rather than motor disability were often the major factors preventing functional recovery. More recently Anderson and colleagues[12] have found that some variables, such as perceptual losses, previous CVAs and extended periods of unconsciousness, have a negative influence on functional recovery; similar conclusions were reached by Isaacs and Marks.[4]

It is unfortunate that the motor deficit is still considered by many to be the primary reason for the functional disability, for, because of this, patients continue to be referred for further exercise therapy. This view, in our opinion, has contributed to the unmerited emphasis given to the motor deficit in the total functional evaluation, thus prejudicing the expectations of any rehabilitation program. The stroke may produce deficits in mental status, sensation, perception, communication and motor ability, and these deficits, separately or combined, will determine the total disability. Complete functional evaluation of the patient must therefore include determination of the degree of impairment in each of these areas and how this impairment is affecting overall function; what the patient can and cannot do should be clearly stated.

The approach of Moskowitz and McCann in evaluating disabilities[13] is not suitable for assessing stroke disability because the rating for perceptual function is not included in the total score, and the ratings for communication and sensation abilities are combined. The classification by Shafer and colleagues[14] of 587 patients, done to evaluate early functional recovery, did not include assessment of speech impairment, and the overall functional ability of the patient was not correlated with the various impairments.

Conclusion

Complete evaluation of the various impairments caused by a stroke should be carried out in each patient for a better understanding of what his or her disability represents, both medically and socially. Our approach is a comprehensive method that correlates impairment ratings with a patient's overall functional disability.

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