

The Integration and Application of Neuropsychology into the Treatment and Care of Patients with Brain Conditions



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Introduction

Neurological conditions include diseases caused by faulty genes, degenerative diseases, diseases of blood vessels that supply the brain, injuries to the brain, seizure disorders, brain tumors, and brain infections, as well as developmental disorders. All of these conditions have a huge neuropsychological, psychosocial, and quality-of-life impact and represent a global public health challenge [1].

Neurosurgical options for diseases of the nervous system continue to expand in breadth and scope. These advances have been related in large part to progress in technology, translational application of molecular biology, and increased understanding of the physiological processes associated with neurological disease. Unfortunately, interventional surgical brain procedures can result in unavoidable secondary acute and delayed neurocognitive and neurological deficits.

Management of long-term neurosurgical and neurological disorders requires the provision of a seamless continuum of care. Due to its close relationship with neurosurgery, neurology and psychiatry, the success of such approaches is critically dependent on the integration of neuropsychology. Indeed, incorporating neuropsychological care as part of a multidisciplinary rehabilitation approach has proved to be beneficial in the recovery of neurosurgical brain diagnoses, strokes, traumatic brain injuries, and the evolving neurological conditions of neurodegenerative dementia variants. The empirical role of neuropsychology in this process cannot be overstated.

Neuropsychology is the study of brain-behavior relationships that are evaluated by neuropsychological examination (NPE). Thus, the NPE can help elucidate a clinical diagnosis, particularly

in patients suffering from different dementias. Moreover, adequate formal neuropsychological assessment is a critical prerequisite for the formulation of effective neuropsychological rehabilitation programs.

Here, I discuss the role of neuropsychology as an integral aspect of the multidisciplinary continuum of healthcare services provided for brain disorder patients. In addition, I focus on the significance of neuropsychology and the empirical basis of procedural adequacy in predicting the impact of such brain disorders on daily functioning. I also review the foundation of the NPE its application in determining neuropsychological rehabilitation strategies.

Neurosurgical and Neurological Residuals of Cognitive/Behavioral Deficits

Although remarkable neurosurgical advances have been achieved in the management of brain tumors [2], movement disorders [3], and neurologic injury [4], these procedures can result in unavoidable secondary trauma to the adjacent, non-diseased brain structures. Studies have demonstrated that physical insults to the brain can initiate a cascade of neurocognitive changes that result in long-term neurodegeneration and brain atrophy [5]. However, the cause-and-effect association of such acute and delayed cognitive and/or neurological deficits is often obscured by the substantial potential of the brain for compensatory changes, the long human lifespan, and aging-related phenomena.

The increased national and global burden of brain and other central nervous system diagnoses has highlighted the necessity for continuity of care to improve function and the quality-of-

life of patients. Neuropsychology services represent a critical component of the seamless continuum of multidisciplinary care required to manage the long-term residuals of neurosurgical brain procedures and degrading neurological conditions. The success of the care provided to medical patients with a brain condition requires a comprehensive understanding of the empirical basis of neuropsychology in its approach and the critical importance of procedural adequacy.

The Concept of Prediction of Cognition and Behavior as It Relates to Neuropsychology

In his treatise on "The Nature of Scientific Thought" published in 1963, Walker [6] stated that the purpose of science is to accurately predict events in nature. The degree of scientific predictability ranges from extremely accurate (e.g., the time of an eclipse of the sun) to a statement of probability (e.g., the presence of brain damage in mild head injury). The role of the scientific method in neuropsychology is to predict or diagnose the neuropsychological profile in an objective and unbiased manner. Additionally, the primary purpose of the neuropsychological conceptual model is to capture and describe the workings of natural phenomena. Predictions based on the model are compared to observations or measurements of events that actually reflect the patient. The effectiveness of the model is represented by the correspondence between the model itself and predictions of behavior and as it relates to neuropsychological rehabilitation in the care of the brain-impaired patient [7].

Clinical Neuropsychology: The Discipline of Predicting the Functional Expression of Cognitive Integrity in Daily Behavior

Clinical neuropsychology focuses on brain-behavior relationships and the application of this knowledge to clinical problems associated with brain lesions in terms of patient deficits. These associations are evaluated by measuring intellectual, sensory-motor, and personality deficits that relate to brain lesions and are applied to the rehabilitation of the brain-damaged patient [8].

The concept of the behavioral effects of brain changes as it relates to clinical neuropsychology is not merely in differentiating brain damage from other diagnostic possibilities, but also in making refined descriptions of clinical conditions. Although there have been remarkable developments in radiological techniques that have further elucidated the complexity of the brain anatomy, advances in clinical neuropsychology have provided an important and less invasive approach to infer the location and extent of brain damage. Nevertheless, the medical and psychological residuals accounting for abnormal neurocognitive behavior are primary in defining the issues. To determine the prognosis of recovery, rehabilitation potentials, and management alternatives for the patient, the clinical neuropsychologist requires comprehensive

and systematic measurement of the major adaptive function of the patient, which is dependent on the organic integrity of the brain.

The discipline of clinical neuropsychology allows differentiation of similar behavioral deficits and adaptive consequences due to widely differing causative sources and, therefore, require entirely different therapeutic approaches. For example, a reading disability may be the result of an abnormal learning history in an otherwise normal patient, or the result of a structural, or biochemical anomaly of the brain. A psychotic behavior, including delusions, may be the result of treatable brain damage or, more seriously, a dementia-related psychosis due to a neurocognitive degrading condition.

Thus, effective treatment is critically dependent on determining the cause of the adaptive deficits observed. Careful specification of adaptive deficits due to brain changes is important for disposition, management, and treatment, even when the diagnosis is already known (the diagnosis is not in this sense a problem). Indeed, despite a comprehensive knowledge of the neurological facts, the neurosurgeon, neurologist, or psychiatrist, is still faced with the challenge of extrapolating these facts to predictions about the patient's behavior in their individual environment, so as to provide the most appropriate advice on how to maximize their well-being and adaptive function [9].

The NPE is a procedural adequacy measurement used to define adaptively significant behaviors. In contrast to other methods of appraising the patient's adaptive capacity, the NPE is less prone to omission of critically important behaviors. In general, other methods of appraisal tend to rely too heavily on a patient's spontaneous verbal communication, and on non-systematically elicited cognitive and perceptual motor behavior. For instance, spatial praxis, and other functions of the right cerebral hemisphere, are insufficiently scrutinized in such appraisals. Even more importantly, the patient's highest cortical functions, involving the categorization of stimuli and formation of new logical relationships (analysis and synthesis) are not sufficiently made manifest. Without a systematic and comprehensive examination of the patient's adaptively significant behaviors and careful comparison of their pattern of functioning in the context of the demands of the work, home environment, or school to which they will return following hospitalization, the stage is frequently set for needless tragedies of adaptive failure. With precise knowledge of a patient's pattern of functioning, specific neuropsychological rehabilitation and compensatory measures can be applied. To phrase this in the vernacular, the remarkable radiological techniques available today illustrate the "real estate" of the brain anatomy, while the NPE elucidates brain function in terms of the person "living in this real estate".

The NPE provides a basis for understanding the patient's cognition both neuropsychologically and psychologically [10]. In the absence of this objective procedural adequacy approach

via the NPE, organic and prognostic conclusions will be reduced to nothing more than clinical impressions, leading to incorrect rehabilitation treatment systems. As a parallel example to illustrate this scenario, no neurosurgeon would proceed with an intracranial procedure without access to blood biomarker analyses and a variety of radiological studies.

In addition, the diagnosis of neurocognitive brain changes can be important in assessing adaptive capacity and establishing legal responsibility. In such cases, the NPE is extremely valuable in objectifying the presence, quality, and extremity of adaptive deficits.

Furthermore, the NPE is a valuable technique used in numerous research applications for quantifying adaptive function as a dependent variable in the evaluation of experimental interventions that affect the nervous system such as neurosurgical, chemotherapeutic or antibiotic treatments, in addition to agents such as nervous system stimulants or depressants and anesthetics.

Finally, an improved understanding of the psychological effects of brain damage and, more generally, brain-behavior relations requires the systematic study of patients with brain damage of different etiologies, locations, extents, etc., since the neuropsychological profiles alone show remarkable variation. Furthermore, traumatic brain injury, cerebrovascular, and neoplastic diagnoses are all associated with different patterns of neuropsychological findings [11]. Neuropsychology is distinct from other related disciplines, such as clinical psychology and psychiatry, in its emphasis on correlating the neurological bases of behavior with brain structure and function, and the clinical significance of cerebral damage and behavioral adjustment. So how do the medical specialties of neurology, neurosurgery, and psychiatry interact with neuropsychology as the primary referral sources?

Relationships Between Neuropsychology and Its Primary Referral Sources: Neurology, Neurosurgery, and Psychiatry

In current practice, the neuropsychologist examines patients referred from a range of disciplines, but primarily by medical specialists in neurology, neurosurgery, and psychiatry. Each of these fields has particular characteristics that importantly affect their interactions with neuropsychologists, with the referral source as the most generally important of these influences. There are relatively few clinical neuropsychologists, with the consequence that the clinical neuropsychological approach is not well-known in these referring fields. Most medical disciplines have become accustomed to the tests and types of inferences used by conventional clinical psychologists. They tend to expect familiar references to such information and sometimes do not know how to receive the unfamiliar data and inferences provided by the neuropsychologist [12].

As would be expected for any type of cross-disciplinary information, great variation exists among neurologists and neurosurgeons in terms of their familiarity with both the scientific/clinical and technical aspects of neuropsychology. Some neurologists and neurosurgeons are frontline contributors to this field, while others know very little. However, many neurologists and neurosurgeons are familiar with behavioral neurology, and will possess a differentiated perception of the behavioral effects of brain damage. Thus, when the neuropsychologist refers to the effects on specific functions, such as spatial praxis, and makes inferences based on the pattern of such deficits to the distribution of damage in the brain, the neurologist and neurosurgeon will be familiar with similar concepts. Nevertheless, despite this overlap, the neurologist and neurosurgeon will sometimes encounter certain difficulties in utilizing the services of the neuropsychologist for a number of reasons. First, there remain important conceptual differences about the behavioral effects of brain damage. The neuropsychologist's view of brain behavioral relationships is more differentiated than that of the neurologist or the neurosurgeon. For instance, the concept of dementia, which is still popular in neurology, remains an important constituent in the diagnosis of many syndromes. In this situation, the neuropsychologist will differentiate the presentation of preserved and impaired adaptive functions, while the neurologist merely questions whether or not the patient has dementia; these differences in approach can be confusing and frustrating to both sets of professionals. Furthermore, neurologists and neurosurgeons are not typically acquainted with the validity of neuropsychological batteries and may be equally unfamiliar with the meaning of various scores derived from such procedures. Thus, these specialists may be both unable to evaluate the raw data and doubt the conclusions derived. Obviously, these are problems of education that are being corrected presently. Neurologists and neurosurgeons tend to seek and welcome objectification of adaptive function related to the physical integrity of the brain. However, the obstacles to understanding the perspective of the neuropsychologist are overcome as they become better acquainted with the achievements in clinical neuropsychology [12].

Neuropsychologists deal in quantified data concerning functions that are measured in a less quantitative manner by neurologists. Consequently, compared with the neurosurgeon, the neurologist is more likely to encounter difficulties in interpreting this type of quantified functional data and the conclusions drawn from the two sets of data may not be consistent. Traditionally, the neurologist has depended on global merit measures of adaptive functioning such as the IQ test, but more recently, a more standardized analysis of intellectual functions has been adopted by using the mini-mental status examination [13]. The neurologist may view the neuropsychologist's quantified data on sensory suppression effects, finger agnosia, motor strength, and finger tapping speed as an uninvited territorial intrusion. Equally, the

neuropsychologist may have insufficient respect for the diagnostic power of a well-conducted neurological examination.

In practical application, the neuropsychologist may encounter other difficulties in their interactions with the neurologist/neurosurgeon. Presently, the administration of a comprehensive neuropsychological battery requires a number of hours, which can conflict with the patient's physical condition. Other concurrent diagnostic radiological procedures may also limit the patient's availability to participate in the NPE. Some of the most time-consuming tests may be among the most valuable to the neuropsychologist, who may also want to include the entire battery in the interest of research and to obtain the most comprehensive basis from which to make clinical inferences.

These are problems that must be met through close collaboration between the neurologist, neurosurgeon and clinical neuropsychologist on the one hand, and further refinement of the neuropsychological batteries on the other. In the best circumstances, the neuropsychologist will be consulted during the case/admission planning phase so that the neuropsychological battery can be performed in proper synchrony with other procedures. Given the pressured and complicated situation of patient care of a large teaching hospital, such synchrony is difficult to achieve. Moreover, the frequent turnover of treating personnel in such settings further complicates collaborative planning and communication of results. Thus, effective interaction between the neuropsychologist and medical specialties within a hospital setting requires a systematic step-wise screening procedure leading to the comprehensive neuropsychological battery. Combined with our current state of knowledge, abbreviated procedures applied in the hospital setting are likely to lead to the omission of a source of information that could be decisive in a particular case [14].

Finally, neuropsychology offers knowledge and techniques that can contribute substantially to the diagnostic efforts of a psychiatrist when brain damage is suspected. However, even more than the neurologist and the neurosurgeon, the psychiatrist may be uneasy with neuropsychology and its findings, which may conflict with, or fall outside the perspective from which they view the behavioral effects of brain damage. The longstanding popular theories of behavior and psychiatry do not allow the differentiation facilitated by neuropsychological data. The global and imprecise concepts of the unitary concept of "organicity" continue to be a popular and relevant source of thinking in psychiatry. Psychiatrists have little opportunity in their training to become familiar with clinical neuropsychology, although this is rapidly changing. I am pleased to report that curricula and didactic coursework have been introduced for the residents and fellows in the program at the hospital facility to which I am affiliated. In the past, the psychiatrist learned about NPEs from a clinical psychologist, most of whom were not trained in clinical neuropsychology; however, this too is changing for the better. So what is this NPE all about?

The Neuropsychological Examination as the "Blueprint" For Treatment

The principal focus of neuropsychological rehabilitation is the mitigation of cognitive impairment and recovery from secondary brain conditions. However, with respect to methodological organization, the measurements employed require an understanding of a legitimate, comprehensive NPE. The current approach to this process in the profession is commonly represented only by the administration of a series of unrelated tests. These tests are interpreted according to the level of performance of the patient and an analysis based on comparisons with normative data. In this respect, the most common approach is to compare performances on neuropsychological tests with results on general intelligence measures and conclude that the patient is impaired if certain test scores are lower than others. These tests, in turn, serve as the focus of attention and the basis for interpretation of neuropsychological deficits. Unfortunately though, the range of variability that occurs among normal subjects creates a significant problem in using this particular methodology, which does not consider the fact that every patient will perform poorly in some of an extensive series of tests [15].

The solution to this problem is provided not only by using an interpretive framework based on the level of performance (how well the subject has performed), but also the incorporation of additional methodological approaches to the examination of the data [16]. The results can then be evaluated in four successive steps: #1 Level of performance, #2 Patterns and relationships among the test results that reflect the biological status of various areas within the cerebral hemispheres, #3 Specific deficits that occur most exclusively in patients with cerebral damage, and #4 Comparative performances on the two sides of the body as they relate to the differential status of the contralateral cerebral hemisphere. This integrated interpretation of the results from a standard "fixed" battery of tests represents a fundamental advantage over a series of unrelated or "flexible" tests.

Although the reported benefits of "flexible" batteries include the freedom to select certain tests to evaluate specific areas of function that are consistent with the patient's complaints, such an approach is limited by the circularity of documenting only the patient's own initial self-examination (self-diagnosis). Also, if the complaints are not sufficiently comprehensive, or if the patient is not able to offer an adequate and complete self-diagnosis, the resulting test battery will fail to recognize and evaluate significant areas of dysfunction.

In contrast, the Halstead-Reitan Neuropsychological Battery (HRNB) and the Meyers Neuropsychological Battery (MNB) are identified as "fixed" batteries [17], which require explicit criteria to be met within an organized methodological framework to draw conclusions about cerebral damage in the patient [18]. The fixed battery is necessary in order to achieve a balanced interpretation

of brain-behavior relationships in an individual patient using a panel of tests that have been validated in combination. Thus, the term fixed battery as it applies to the aforementioned neuropsychological batteries, implies a standardized, validated, and clinically tested approach. In contrast, the term flexible battery implies a series of tests that may not have even been validated individually for their sensitivity to brain damage and have never been tested as a battery for validity in relating to type, location, or a process of cerebral pathology. Consequently, the flexible battery is subject to a permissive clinical interpretation with few, if any published standards available for reference or comparison purposes. Indeed, a flexible battery is adopted by clinicians inclined to impose a personal imprint on their clinical evaluations. However, this approach does not achieve the level of clinical competence required by a system of clinical evaluation that demands knowledge of the research findings and adherence to a body of knowledge representing appropriate procedural adequacy and testing. The choice is based on whether the clinical neuropsychologist favors an approach that is personal, impressionistic and akin to an art or one that is objective, scientific and disciplined [18].

Neuropsychological Rehabilitation

Many specific procedures for rehabilitating children and adults have been developed over the years; however, these programs have not been organized around a meaningful conceptualization of brain-behavior relationships. The NPE provides a solution to this problem by identifying the patient's impaired neuropsychological functions in the framework of a model of brain-behavior relationships [19].

Verbal and language functions are generally related to the integrity of the left cerebral hemisphere, while visual-spatial and manipulatory skills are dependent on the status of the right cerebral hemisphere. In contrast to the specialized capabilities of specific brain regions, the non-specialized functions cover the broad range of abstraction abilities and represent cerebral cortical functioning generally in terms of its representation in the brain; therefore, it can be implied that abstraction, reasoning, and logical analysis abilities may be more fundamentally important than the specialized skills.

Thus, neuropsychological rehabilitation based on the NPE rests on its capacity to: #1 Delineate cognitive strengths and weaknesses as a result of brain impairment, #2 Predict the extent to which cognition will influence the potential for recovery and improvement, #3 Determine the management implications of a patient's cognitive profile, and #4 Provide the appropriate rehabilitative treatment directed specifically toward improving the areas of neuropsychological behavior and cognitive impairment [20].

The NPE can be used to monitor a patient's progress regardless of the program of rehabilitation. The greatest positive

reinforcement is provided intrinsically when the patient realizes that they have learned to do something that was previously impossible. Thus, informed feedback is a vital aspect of these training procedures that provides support beyond the kind and encouraging words of the rehabilitation therapist. Moreover, it is imperative that the patient makes some actual and noticeable progress as a result of the training strategies [17].

The value of the NPE cannot be overstated as the first step in rehabilitation because of the importance of characterizing the brain-related strengths and weaknesses of the patient as a basis for designing a program of rehabilitation, encompassing medical adjustment counseling (MAC®), cognitive remediation, biofeedback, and family therapy. This examination serves to identify areas of strengths and weaknesses across the entire range of neuropsychological functioning and permits the development of an understanding of the particular needs of the individual patient. This is in contrast to conventional procedures that engage in a routine implementation of a standard set of techniques designed to address a variety of cognitive deficits presumed to be characteristic of, or present in, all cases of brain damage. Unfortunately, this approach is adopted all too often in hospital rehabilitation departments.

In conventional rehabilitation, there is a tendency to emphasize only the training materials rather than an interaction of training materials and the patient, presuming that these materials would be advantageous and effective for each and every brain-damaged person. This approach stems from a presumption that brain damage is relatively constant and invariable in its effects on higher-level functioning from patient to patient, while in fact, brain damage results in highly varied combinations of deficits for the individual [21].

Finally, in isolation, the NPE is not sufficient to provide an adequate understanding of the brain-behavior relationships of the patient; equal or greater significance must be attached to the neuropsychological competence and knowledge of the neuropsychologist and rehabilitation specialist who analyzes and interprets the results. A review of brain-behavior relationships may be provided by the test results, but the adequacy of the rehabilitation program prescribed for the patient, even when organized, depends on the understanding of the neuropsychologist who interprets the data [22].

The negative effect of confronting areas of deficit directly represents an additional reason for emphasizing neuropsychological competence in a rehabilitation program. Anyone who conducted delivered cognitive therapy with a significantly impaired patient has experienced the stress and frustration felt by the patient who is required to continually work with tasks designed to test their weakest area of ability. It is much more pleasant to select tasks that the patient can perform satisfactorily, will be enjoyable to perform, and provide a feeling of personal satisfaction and accomplishment. In fact, the frustration

that arises from finding a simple task to be impossible is sufficient in many cases to cause the patient to break down in tears. One has to wonder why it is necessary to inflict such emotional trauma on brain-damaged patients.

MAC® is applied concurrently with remediation as an alternative approach in the counseling process, but with different emphasis. It is a psycho-biological approach focusing on neuropsychological impairment illustrated in the NPE and discussed in ordinary conversation between the neuropsychologist and the patient, paying particular attention to their deficits and psychological reactions to them. MAC® does not involve systematic use of the patient-physician relationship or transfer to an exploration of the dynamics of the patient's behavior. The neuropsychologist seeks to explain the sequelae undermining the patient's ability to engage in their daily activities without disturbing their relationships with others or creating anxiety. In addition to the application of a number of adjustment strategies, the neuropsychologist's fundamental aim is to assist the patient in establishing a more rational and constructive understanding of their situation, with a focus on actual situations and circumstances rather than attitudes, internal "scripts" and mechanisms [17].

MAC® is designed with a specific awareness of the patient's cognitive and behavioral changes, and the adjustment strategies necessary to achieve effective treatment. Limited understanding of our deficits, thoughts, actions, and perceptions minimizes the control we have over our daily lives and results in adherence to detrimental patterns of behavior. MAC® is distinct from other psychological treatment systems in its dependence on cognitive brain functions defined by the initial administration of the NPE. Most importantly, the MAC® and related interventions are founded on neuropsychological knowledge of brain-behavior relationships represented by the NPE "blueprint", which encompasses the nature of neurological diagnoses and recovery, cognitive remediation, and crisis counseling theory. This approach is not adopted for conventional mental health patients, but for patients who have incurred an acute or chronic medical condition. An understanding of the nature of the patient's neuropsychodiagnostics and consequential changes is a prerequisite for selecting appropriate treatment in the context of organic changes in the patient's behavior and cognition since this can limit their ability to participate in therapy and effect change [23]. Brain disorders often result in physical, psychological, and neuropsychological phenomena that can be misinterpreted as psychological problems. Therefore, effective treatment requires an integration of various interventions that go beyond conventional psychotherapy systems; these include environmental manipulation, individual/family therapy systems, group/support groups, legal advocacy, community integration, and educational mainstreaming. MAC® differs from traditional psychotherapy in its crisis perspective and comprehensive emphasis on the diagnostic issues, the necessary adaptive strategies to be applied, and how to restore the patient

to their area of daily functioning. Thus MAC® represents the coordination of a more comprehensive integrated approach, known as neuropsychological care [24].

In terms of its application, MAC® is delivered in four stages: validation, education/explanation, accommodation, and reintegration. First, the patient needs to understand the nature of their crisis, and that in spite of the emotional and behavioral changes, this does not represent psychopathology. The patient is supported in coming to terms with anxiety and depression as normal psychological responses to their situation. It is important to note that these psychological reactions do not warrant the same treatment approach adopted for patients experiencing the same symptoms independent of a medical diagnosis.

The second stage of MAC® consists of education/explanation, which is the most basic element in the treatment of brain conditions. This stage involves an explanation of the patient's NPE deficits, which forms the basis for their treatment through MAC®, biofeedback, and cognitive remediation.

As the third phase of MAC®, accommodation is the most complex stage in achieving successful adjustment to a medical brain condition. Conventional psychotherapy may not only be ineffective, but also counterproductive. This phase of remediation is focused on assisting the patient in developing alternative strategies to compensate for the limitations in a process that involves conditioning of new automatic behaviors and the implementation of environmental changes.

The final reintegration stage of MAC® consists of successful adaptation to daily function as a result of psychological transformation achieved during the prior stages in the recognition, compensation, and adjustment to a new set of limitations. To achieve the goals of MAC® and neuropsychological care in general, the neuropsychologist can choose from an array of intervention strategies and techniques, including individual/family biofeedback, videotaping, crisis intervention, stress management, cognitive rehabilitation, and medical options [17].

Finally, medical patients tend to be more interested in short-term, focused interventions that can facilitate their recovery than in long-term insight-oriented therapies. The NPE provides this gateway for the application of these interventional strategies through the transformation of theory into appropriate methods applied in clinical practice.

Summary and Closing Points

The role of neuropsychology in the continuum of healthcare model, particularly its status post-neurosurgical intervention and in neurological degrading conditions, requires a commitment to follow these patients through the hospital system and into outpatient care. The integration of neuropsychology into this model focuses on care delivery, particularly in the long-term.

The preventative aspects should include careful identification of the problem by conducting epidemiological research and by identifying stages affected by the problems. For example, providing holistic, neuropsychological care to patients discharged from hospital after neurosurgical intervention, or to outpatients with degrading neurological conditions in the form of dementia, fulfills a true psychosocial model in dealing with the idiosyncrasies of each of these medical patients. This includes neuropsychological care standards applied as core aspects with the treatment of post-neurosurgical patients, dementia, stroke, traumatic brain injury, epilepsy, and movement-related disorders [24].

As society and healthcare policymakers become more familiar with the biopsychosocial perspective on health and injury, the application of neuropsychology in medical settings becomes more effective, and the opportunities in other areas of healthcare services will also grow. Neuropsychologists are now an integral part of healthcare provision, and more importantly, patients will benefit from its knowledge base and service. However, to achieve successful integration, doctors must be properly educated in the field of neuropsychology. This represents a challenge for training programs in neuropsychology to satisfy emerging needs and implement the necessary changes in our conceptual delivery of services. With continuing education and increased advocacy for integrated healthcare services, neuropsychology will meet its goals of providing improved services [25].

In summary, besides the existing opportunities and difficulties, clinical neuropsychology is a field with a great future. Although healthcare will be faced with a number of challenges in the near future, important changes in education and training now provided in neuropsychology have already started to take place. Within this context, clinical neuropsychology has a lot to offer the medical patient and profession in general [26].

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