Introduction

Central nervous system (CNS) conditions, including psychiatric, neurological and substance abuse disorders, account for 13 percent of the global burden of disease, surpassing both cardiovascular disease and cancer. While CNS disorders represent a significant opportunity for therapeutic innovation, recent years have seen decreased worldwide research investment into neuropsychiatric diseases. Among the larger pharmaceutical companies, Pfizer, Merck and Sanofi-Aventis have scaled back their investments and GlaxoSmithKline, Novartis and AstraZeneca have exited this therapeutic area completely, as the risk involved in developing drugs for complex or poorly-understood psychiatric conditions is often too great to allow for profitable drug development.
Currently, the majority of central nervous system (CNS) clinical trials rely on neuropsychological endpoints for establishing efficacy, safety, and tolerability. Unfortunately, the available instruments for neuropsychological testing are sometimes subjective and may be limited by variability from a number of sources. In addition to being time-intensive, the administration of neuropsychological testing may also require special equipment, training, and testing areas, all of which contribute to the cost of a clinical trial. In many cases, sponsors of neuropsychiatric clinical trials are faced with the challenge of identifying behavioral, cognitive, and functional endpoints that are relevant for both clinical and regulatory purposes based on limited guidance and an inadequately-developed evidence base.

Sponsors and investigators need to understand the existing regulatory guidance relevant to the clinical evaluation of neuropsychiatric drugs in order to employ or develop accurate, specific, and cost-effective neuropsychological assessments or alternative methods for measuring the efficacy, safety, and tolerability of these much-needed drugs.

### Challenges of CNS Trials

Nearly 60 million American adults – or, one in four American adults – currently suffer from some type of CNS condition, from anxiety, depression or dementia to schizophrenia, attention deficit hyperactivity disorder or addiction. According to the National Institutes for Mental Health, serious psychiatric and neurological illnesses cost the U.S. more than $317 billion in health care expenditures, lost wages and disability benefits each year.

Therapies for psychiatric and neurological disorders comprised approximately 21 percent of the pharmaceutical market in 2007, accounting for more than $95 billion a year in drug sales. The decline in the value of the overall CNS drug market to an estimated $78 billion in 2010 reflects both generic competition to the top neuropsychiatric drugs and decreased investment due to the length, cost and uncertainty of drug development. The time and expense involved in bringing a CNS drug to market is longer than other therapeutic areas, requiring an average of 8.1 years and $850 million in direct costs for phase II and III development. In addition, only 8.2 percent of CNS clinical drug candidates are eventually approved for use in patients, compared to 15 percent for drugs overall.

Although regulatory guidance is available, CNS drug development is complicated by the relative lack of established proof-of-concept models or biomarkers for CNS diseases, which stems from the inherent challenge of demonstrating treatment efficacy and safety in psychiatric or neurological conditions where underlying disease pathophysiology is poorly understood. For example, it is difficult to determine whether an improvement in cognitive function in Alzheimer’s disease or a reduction in hyperactivity in attention deficit hyperactivity disorder (ADHD) is the result of a drug, or simply a fluctuation in the natural course of the condition. As a result, many of the drugs currently used to treat CNS disorders were initially derived from empirical research and their utility in informing the discovery of new treatments is limited to the actions of the drugs themselves, rather than a clear understanding of disease mechanisms.

For the many CNS diseases that lack physical examination findings or established biochemical surrogate markers to serve as primary endpoints, clinical trials rely largely on neuropsychological testing for measuring outcomes. Although they are widely used in research and clinical practice, the existing instruments for neuropsychological testing are often subjective and prone to multiple sources of variability. To effectively leverage neuropsychological assessments in CNS clinical trials, sponsors and investigators need to be aware of the value, limitations and future potential of these tests.

Neuropsychological testing is the current standard for measuring the effect of CNS drugs on cognitive, motor, behavioral, linguistic and executive functioning in clinical trials. Neuropsychological tests can be useful for assessing multiple domains of neuropsychological functioning, including:

### Background on Neuropsychological Testing

- Intellectual functioning
- Academic achievement
- Language processing
- Visuospatial processing
- Attention and concentration
- Verbal learning and memory
- Visual learning and memory
- Executive functions
- Processing speed
- Sensory-perceptual functions
- Motor speed and strength
- Motivation and symptom validity
- Personality and mood
# MEASURING HOW WELL SUBJECTS KNOW AND DO IN CNS TRIALS:
Challenges and Opportunities for Neuropsychological Testing

## Table 1. Commonly Used Neuropsychological Tests

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>NEUROPSYCHOLOGICAL TEST</th>
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<tr>
<td><strong>INTELLECTUAL FUNCTIONING</strong></td>
<td>Wechsler Adult Intelligence Scale-IV (WAIS-IV)</td>
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<td>Wechsler Intelligence Scale for Children-IV (WISC-IV)</td>
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<td><strong>LANGUAGE PROCESSING</strong></td>
<td>Boston Naming Test</td>
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<td>Multilingual Aphasia Examination</td>
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<td></td>
<td>Boston Diagnostic Aphasia Examination</td>
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<td>Token Test</td>
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<tr>
<td><strong>VISUOSPATIAL PROCESSING</strong></td>
<td>Rey-Osterrieth Complex Figure Test</td>
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<td>WAIS Block Design Subtest</td>
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<td>Hooper Visual Organization Test</td>
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<td><strong>ATTENTION AND CONCENTRATION</strong></td>
<td>Behavior Assessment System for Children (BASC)</td>
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<td>Trail Making Tests</td>
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<td>Digit Span Forward and Reversed</td>
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<td>Paced Auditory Serial Addition Test (PASAT)</td>
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<td><strong>VERBAL LEARNING AND MEMORY</strong></td>
<td>Wechsler Memory Scale (WMS)</td>
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<td>WMS-III Verbal Memory Index</td>
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<td></td>
<td>Rey Auditory Verbal Learning Test – Rote list learning</td>
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<td></td>
<td>Verbal Selective Reminding Test – Selective reminding</td>
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<td></td>
<td>Hopkins Verbal Learning Test</td>
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<td>Continuous Recognition Memory Test</td>
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<td><strong>EXECUTIVE FUNCTION</strong></td>
<td>Mini-Mental Status Exam</td>
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<td>Multiple Errands Test (MET)</td>
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<td><strong>PROCESSING SPEED</strong></td>
<td>Simple and Choice Reaction Time</td>
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<td>Symbol Digit Modalities Test – Written and oral</td>
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<td><strong>SENSORY-PERCEPTUAL FUNCTIONS</strong></td>
<td>Halstead-Reitan Neuropsychological Battery (HRNB) Tactual Performance Test and Sensory Perceptual Examination</td>
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<td><strong>MOTOR SPEED AND STRENGTH</strong></td>
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<td>Grooved Pegboard Task</td>
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<td>Hand Grip Strength</td>
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<td><strong>MOTIVATION AND SYMPTOM VALIDITY</strong></td>
<td>Rey 15 Item Test</td>
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<td>Dot Counting</td>
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<td>Forced-Choice Symptom Validity Testing</td>
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<tr>
<td><strong>PERSONALITY AND MOOD</strong></td>
<td>Minnesota Multiphasic Personality Inventory (MMPI)</td>
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<td>Beck Depression Inventory (BDI)</td>
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<td></td>
<td>Myers-Briggs Type Indicator (MBTI)</td>
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Often, neuropsychological tests are administered in combination as standardized test batteries to assess multiple neuropsychological functions. Neuropsychological tests are also used in conjunction with information from clinical examinations and reports made by patients or their relatives.

**Neuropsychological Batteries for Specific Patient Populations**
In addition to traditional neuropsychological test batteries used to assess overall cognitive function, test batteries have been developed to screen for specific CNS conditions, including:

- Alzheimer's dementia (CERAD)
- Multiple sclerosis
- Parkinson's disease
- Epilepsy (EpiTRAX)
- Schizophrenia (MATRICS)
- HIV dementia
- Sports concussion (SAC)
- Multiple sclerosis
- Epilepsy (EpiTRAX)

These disease-specific neuropsychological test batteries may help to clarify the cognitive measures needed to define a pathway to FDA approval.16

**Standardized Neuropsychological Testing**
In an effort to facilitate comparison of results across studies and more effectively aggregate information into significant meta-analyses, the National Institute of Neurological Disorders and Stroke (NINDS) initiated a Common Data Element (CDE) Project to develop data standards for clinical research. The CDE Project includes standard neuropsychological tests and may be a useful resource for sponsors and investigators in the design, implementation and interpretation of CNS clinical trial data.

**Limitations of Neuropsychological Testing**
While neuropsychological testing provides insight into psychological functioning beyond what can be obtained from neuroimaging, most of these tests require interpretation by an experienced neuropsychologist. Results of certain neuropsychological tests need to be interpreted in the context of a patient’s age, gender, education level and cultural background, all of which have the potential to influence test performance and the conclusions that can be drawn from testing. The results of neuropsychological testing may also be impacted by a patient’s mental or functional status. In severely compromised patients, such as those with advanced dementia, early traumatic brain injury or serious psychiatric disorders, the value of neuropsychological testing may be limited. To further compound the problem, relatively few of the existing neuropsychological tests are supported by population-based norms as a standard for comparison, so outcomes reporting in CNS trials requires experienced neuropsychologists and trained investigators who understand the nuances in rating subjective outcomes.11

Each neuropsychological test has relative strengths and weaknesses with regard to reliability, validity, sensitivity and specificity:

**Reliability**
Reliability refers to the consistency with which the same information is obtained via a test or a series of tests.11 Many traditional neuropsychological tests are paper-and-pencil tests administered and interpreted by trained neuropsychologists (raters) and, as such, they are subject to variability and issues of reliability, including:

- Inter-rater reliability – Administration of the test by different examiners
- Intra-rater reliability – Administration of the test by the same examiner on different occasions
- Test-retest reliability – Administration of the test to the same patient on different occasions
Validity

Validity refers to how well a test measures what it is intended to measure. There are different types of validity, including:

- Construct validity – Does the test measure what it is supposed to measure?
- Concurrent validity – Does the test correlate with existing tests or independent measures of that psychological construct or symptom?
- Ecologic validity – Does the test predict real-world ability?

Most neuropsychological tests were developed as indicators of brain function or dysfunction, and were validated against neurosurgical, neurologic and neuroradiologic data rather than real-world behavior. Nevertheless, performance on tests of motor function, processing speed, complex attention and memory has generally been found to correlate with real-life ability.

In some cases, however, the validity of neuropsychological testing may be influenced, or called into question, by a patient’s motivation, the testing environment or even the test itself. For example, in ADHD, the testing procedure may temporarily “treat” the disorder because it is a new experience taking place in a quiet, one-on-one setting. This novelty may sufficiently capture a patient’s attention so that underlying attentive or hyperactive/impulsive deficits are temporarily masked.

Sensitivity and Specificity

Sensitivity reflects the ability of a test to identify individuals who have a disorder, while specificity refers to the ability of a test to differentiate patients with a particular abnormality from those with other abnormalities or with no abnormality. Some neuropsychological tests, such as the Stroop Test, show a high level of specificity, but a low level of sensitivity, or vice versa. As a result, when choosing neuropsychological tests for use in CNS trials, sponsors and investigators need to balance the relative sensitivity and specificity of neuropsychological tests in order to meet their primary endpoints. Review of the existing literature may help sponsors and investigators determine which tests are the most sensitive and specific for the CNS condition and psychological construct or symptom they are studying.

Regulatory Guidance Relevant to CNS Trials

In order to establish a favorable risk-benefit profile for CNS drugs, sponsors need to understand the regulatory requirements for clinical trial endpoints and adverse effect profiles. Both the U.S. Food and Drug Administration (FDA) and European Medicines Agency (EMA) have issued extensive guidance relevant to the clinical investigation of drugs for the treatment of CNS disorders. These guidance documents include specific guidelines for CNS drug categories and disease conditions, as well as general guidelines on risk assessment and adverse event reporting:

Examples of Guidance Regarding Drug Categories

- FDA Guidance for Industry – Guidelines for the Clinical Evaluation of Hypnotic Drugs
- FDA Guidance for Industry – Guidelines for the Clinical Evaluation of Antidepressant Drugs
- FDA Guidance for Industry – Guidelines for the Clinical Evaluation of Antianxiety Drugs
- FDA Guidance for Industry – Guidelines for the Clinical Evaluation of Psychoactive Drugs in Infants and Children

Note: In these guidelines, the FDA acknowledges the dearth of objective laboratory measures for determining efficacy and encourages sponsors to develop new, potentially useful approaches to drug evaluation.
Examples of Guidance Regarding Specific Disease Conditions

- FDA Guidance for Industry – Alzheimer’s Disease: Developing Drugs for the Treatment of Early Stage Disease
- EMA Guideline on medicinal products for the treatment of Alzheimer’s disease and other dementias
- EMA Guideline on the clinical investigation of medicinal products for the treatment of attention deficit hyperactivity disorder

Examples of Guidance Regarding Risk Assessment & Adverse Events

- FDA Guidance for Industry – Premarketing Risk Assessment
- FDA Guidance for Industry – Suicidal Ideation and Behavior: Prospective Assessment of Occurrence in Clinical Trials

Determining the types of metrics and evidence necessary for gaining approval requires sponsors to navigate among these guidelines, and sponsors may not always be aware of which guidelines are applicable to the CNS disease conditions and patient populations they intend to study. In addition, psychoactive substances may be subject to local or regional regulations that vary from country to country. Performing a review of the pivotal phase II and III studies supporting already-approved CNS drugs may help sponsors gain insight into the types of neuropsychological tests and analyses that regulatory agencies expect for demonstrating efficacy, safety and tolerability.

Centrally-acting drugs may also be associated with special safety risks, such as suicidality, abuse liability or physical dependence, cognitive and motor impairment or sexual dysfunction, which must be accounted for in the clinical development plan. These safety concerns have led to increased regulatory expectations around the risk-benefit profiles of new CNS drugs. Early and continuous monitoring of safety indicators throughout drug development can help sponsors avoid delays in regulatory review and market approval.

The withdrawal of triazolam in the UK in 1991 following its association with amnesia or adverse psychiatric reactions linked to violent acts and the recent FDA Drug Safety Communications regarding the risk of next-morning impairment following use of eszopiclone and zolpidem underscores the need for improved guidance and/or understanding of appropriate safety and tolerability endpoints, as well as drug pathophysiology.

Case Study: Assessing Mild Cognitive Impairment in Early Alzheimer’s Disease

The challenge of assessing cognitive changes in early-stage Alzheimer’s disease (AD) can be used as an illustrative example of the unmet need for disease-modifying neurotherapeutic drugs, as well as the limitations of both neuropsychological testing and existing regulatory guidance in CNS clinical trials. Currently available therapies for AD may lead to improvements in some of the core symptoms of AD, but as yet, there are no pharmacologic treatments that prevent, cure or alter the course of the underlying pathophysiology of AD. Consequently, many dementia trials focus on patients with the prodromal phase of mild cognitive impairment, where pharmacologic intervention may be more useful.

Limitations of Neuropsychological Testing in Early-Stage AD

Early identification of mild cognitive impairment facilitates diagnosis of patients with prodromal disease and enables follow-up of patients in both the clinical care context and in intervention trials where cognitive change is a primary outcome for assessing the effects of drugs in early-stage AD. However, mild cognitive impairment is not unique to AD and may be the consequence of different diseases with distinct etiologies. To date, there is no clear recommendation regarding which neuropsychological tests should be used to...
differentiate mild cognitive impairment due to AD from cognitive decline due to other causes at any given point in time. However, multiple studies have found that the Free and Cued Selective Reminding test (FCSRT) is a highly sensitive neuropsychological test for detecting cognitive changes in prodromal or early-stage AD and for distinguishing AD from other dementias, even among subjects with high levels of cognition.32,33 This may be because, unlike most other memory tests, the FCSRT begins with a study phase of controlled learning that remediates the mild retrieval deficits which occur in many healthy elderly individuals, but has little effect on the cognitive effects associated with dementia.32

Limitations of Existing Regulatory Guidance

In February 2013, the FDA published Guidance for Industry on developing drugs for the treatment of early-stage Alzheimer’s disease. For clinical trials of AD dementia, both the FDA and EMA require co-primary endpoints of efficacy for both cognitive and functional or global impairment and the FDA recommends that sponsors utilize the Clinical Dementia Rating – Sum of Boxes test to measure both of these domains. However, functional impairment is often minimal or difficult to assess in earliest clinical stages of AD. As a result, the current FDA guidance indicates that demonstrating delay of cognitive impairment may be sufficient, but does not provide concrete recommendations on which neuropsychological test(s) would be considered a reliable and valid cognitive assessment for use as a primary efficacy endpoint to support marketing approval.22

Opportunities for Optimizing the Use of Neuropsychological Testing in CNS Trials

Despite the challenges associated with neuropsychological testing in the current regulatory environment, there are strategies sponsors can use to minimize the variability or improve the utility of neuropsychological assessments in CNS trials.

Rater Training

The neuropsychological tests used to collect data in CNS trials leave room for interpretation by both study patients and investigators. The success or failure of a CNS clinical trial may depend on how well investigators and other study personnel are trained to collect data, particularly in global studies where language and cultural differences may influence testing. Rater training, including tutorials on scoring conventions and applied clinical training where raters conduct interviews under the observation of an expert trainer, can help to improve and maintain optimal rater training and rater consistency.34 Studies have shown that rater training improves rater competency at all levels of clinical experience, which can contribute to the rater consistency and rating accuracy needed to document the efficacy of drug interventions in CNS trials.35

Combining Neuropsychological Testing with Other Biomarkers

Advances in neuroimaging and ongoing research into the predictive or discriminative utility of molecular biomarkers are creating the potential for utilizing structural and functional imaging modalities and/or molecular biomarkers to augment or validate the results of neuropsychological testing. In addition to contributing to improved understanding of the underlying pathophysiology of psychiatric and neurological diseases, advanced neuroimaging techniques have enabled researchers to examine the effects of investigative compounds on the central nervous system, including impact on patterns of brain activity or rate of distribution into target tissues. The CNS biomarker market niche is currently the fastest-growing biomarker sector, and identification and validation of anatomical and molecular biomarkers that could be used alongside neuropsychological test results would lead to synergies that enhance the value of all three modalities for diagnosing or predicting CNS disease, and for following disease progression.10,36

In its guidance on the development of drugs for early AD, the FDA indicates that it would consider the use of biomarkers as a single primary surrogate efficacy measure or supportive secondary outcome measure, provided there were widespread evidence-based agreement that the chosen biomarker reflected a pathophysiologic entity that was fundamental to the underlying process of AD.22 To date, structural MRI and neuropsychological assessment remain the diagnostic methods of first choice for AD, but there is early evidence that CSF biomarkers may be useful in predicting evolution to AD in patients with clinically ambiguous dementia.37,38
Computerized Neuropsychological Testing

Beyond the limitations imposed by their relative reliability, validity, sensitivity and specificity, traditional neuropsychological testing may be time intensive for both patients and test administrators/raters. Administration of traditional neuropsychological testing also requires special equipment, dedicated testing areas and experienced professionals, which contribute to cost and may limit accessibility. Computerized neuropsychological tests have the potential to improve the accuracy and reproducibility of performance measures and minimize the environmental and interpersonal factors that contribute to variability.

In 2012, the American Academy of Clinical Neuropsychology and the National Academy of Neuropsychology issued a joint position paper on appropriate standards and conventions for computerized neuropsychological assessment devices to promote the accurate and appropriate use of computerized tests to maximize clinical utility. While some of the available computerized neuropsychological tests are adaptations of traditional paper-and-pencil tests, other computer-administered tests have been developed de novo to measure specific domains of neuropsychological functioning. Current computerized neuropsychological test batteries include:

- Automated Neuropsychological Assessment Metrics® (ANAM)
- CNS Vital Signs®
- Computer Administered Neuropsychological Screen (CANS-MCI)
- Cambridge Neuropsychological Test Automated Battery® (CANTAB)
- ImPACT® Test

Computerized neuropsychological tests are readily available and easy to administer and score, but test results still require interpretation by a qualified physician or psychologist. While important aspects of measurement validity in comparison to traditional neuropsychological testing in clinical trials still need to be widely established, clinical studies of individual tests such as the Hamilton depression and Hamilton anxiety rating scales have demonstrated equivalence between assessments delivered either by clinicians or by computer. Of note, the FDA has already demonstrated its willingness to approve CNS drugs based on computerized cognitive tests with its approval of Lunesta® (eszopiclone) in 2004. After the FDA requested additional analyses of adverse events related to memory and psychomotor impairment in its original approvable letter on February 27, 2004, the safety of Lunesta was evaluated in two cross-over studies using a battery of computerized cognitive tests, which showed numerous decrements in functioning compared to placebo, though few reached statistical significance. These studies resulted in revisions to the labeling for Lunesta and eventual approval on December 15, 2004.

Conclusion

With continued advances in the treatment and prevention of infectious diseases, cardiovascular disorders and cancer, the global population is aging and novel CNS drug development is poised to become a societal priority. By 2030, severe neurological and psychiatric disorders are estimated to cost society $6 trillion a year. In today’s competitive and regulatory environment, the process of developing CNS drugs that demonstrate clear patient benefit and value is more challenging than ever. However, clear understanding of the existing regulatory guidance and effective employment of validated neuropsychological instruments – including computerized tests – in conjunction with neuroimaging and, eventually, molecular or genetic biomarkers are paving the way for more concrete endpoints in the evaluation of novel therapies that answer critical unmet needs in the CNS therapeutic area.
MEASURING HOW WELL SUBJECTS KNOW AND DO IN CNS TRIALS: Challenges and Opportunities for Neuropsychological Testing

References

About Premier Research

Premier Research is a leading contract research organization serving the needs of biotechnology, pharmaceutical, and medical device companies worldwide. The company has a wealth of experience in the execution of global, regional, and local clinical development programs with a special focus on addressing unmet needs in such areas as analgesia, CNS, rare diseases, medical device and diagnostics, and pediatric research. Premier Research operates in 50 countries and employs more than 1,000 professionals, including a strong international network of clinical monitors and project managers, regulatory, data management, statistical, scientific, and medical experts. With its mission to improve productivity in clinical development, the company aligns itself with the mission of its customers to bring new medical treatments to patients promptly, accurately, and cost-effectively.

Thomas Laage, MD, MPH

Director, Product Development Consulting and Regulatory Medical Writing Support, Premier Research

Dr. Thomas Laage is an experienced psychiatrist who helps design effective clinical trials and develops sound protocols for our customers. Specifically, he has written several ADHD protocols over the course of his career. He completed residencies in internal medicine and psychiatry and earned Board certification in both specialties (internal medicine and psychiatry and neurology). He has had clinical experience from his training and practice in internal medicine and psychiatry and also worked in emergency room settings for four years. For many years, he conducted a private practice in psychiatry with an academic appointment as Instructor in Psychiatry at the Harvard Medical School. He has treated many adult and adolescent patients with ADHD with the usual medications over the course of his career. In 2011, Dr. Laage completed a Master's degree in Public Health (Quantitative Methods) at the Harvard School of Public Health in Boston, MA. He recently completed courses in Good Clinical Practice (Sept, 2011) and in Medical Device Submission and Compliance Strategies for the US Market (June, 2011) through the Regulatory Affairs Professional Society (RAPS), as well as in Drug Safety and Adverse Event Reporting (Sept, 2011) through the Drug Information Association (DIA).

Prior to joining Premier Research, he worked as an independent contractor for the consulting firm John Lehmann, LLC in medical writing and safety reporting for clinical trials and as an independent medical writer and editor for Edanz Group Ltd in China and Japan, for CE Outcomes LLC in Birmingham, AL, and for the American Physician Institute in Chicago, IL. He is a member of Phi Beta Kappa, Alpha Omega Alpha, the Massachusetts Medical Society, the Regulatory Affairs Professionals Society, the Society for Clinical Trials, and the Drug Information Association.

Matthew T. Healy

Senior Manager, Clinical Management, Premier Research

Matthew Healy is currently a Senior Manager in the Clinical Management department at Premier Research. Mr. Healy is responsible for all aspects of functional management supervision to the clinical management staff including, but not limited to, performance management, guidance on corporate policy, training and support.

Mr. Healy has over eighteen years of clinical research experience including; site coordination and management, clinical monitoring, clinical team management and clinical operations management. His experience includes, six years of coordinating and project management experience at the University of Pittsburgh Medical Center, Department of Psychiatry; clinically focused on Alzheimer’s disease, Geriatric Schizophrenia, Traumatic Brain Injury, and Late Life Depression studies. He has extensive training in Neuropsychological concepts from the Western Psychiatric Institute and Clinic, for the administration and interpretation of numerous Neuropsychological assessment instruments. Mr. Healy also has more than two years of experience coordinating Hepatology and Gastroenterology clinical trials. Within the CRO environment he has over ten years’ experience working in the capacity of a clinical research associate, clinical team manager, and clinical operations manager covering various CNS, GI, Hematology, and Oncology trials.

Mr. Healy holds a Masters of Education in Counseling Psychology from the University of Pittsburgh.