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SPECIAL ELEMENT: TASK FORCE REPORT

Neuropsychiatry and Neuroscience Milestones for General Psychiatry Trainees

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For nearly 50 years, psychiatric thought leaders have suggested that advances in our understanding of the brain should lead psychiatry training to include more clinical neuroscience [1–13]. The importance to psychiatric training of a foundation in neurology has been acknowledged since at least 1939, when the predecessor of the Accreditation Council on Graduate Medical Education (ACGME), the American Medical Association (AMA) Council on Medical Education and Hospitals, established the requirement that "a program of graduate studies should run concurrently with clinical instruction, covering the fundamentals of neuroanatomy, neuropathology, neurophysiology, psychobiology, and psychopathology [14]." In 1987, the ACGME and American Board of Psychiatry and Neurology (ABPN) initiated the current two-month neurology experience requirement. The 2007 ACGME Program Requirements in Psychiatry included little guidance as to the content or goals of this experience beyond "supervised clinical experience in the diagnosis and treatment of patients with neurological disorders/conditions" and the competencies and didactic components listed in Table 1. A number of trends in recent years argue strongly for increased attention to clinical neuroscience in psychiatric training:

1. Clinical psychiatric evaluation increasingly involves neurodiagnostic modalities including knowing when to utilize and how to understand the results of imaging, electrophysiological testing, and cognitive assessment. With the proliferation of novel diagnostic techniques purported to offer additional neurological data, it is also important for trainees to be able to discriminate among evidence-based and nonevidence-based modalities.
2. As healthcare reform causes care systems to focus on disorders that are most complex and costly to the system, the house of medicine looks to psychiatry to recognize and treat psychiatric comorbidities that tend to increase the cost of care [15–18]. Similarly, psychiatrists must utilize neurodiagnostic resources carefully in an area of accountable, value-oriented care. Diagnostic precision and tailored treatment ultimately lead to more efficient medicine. Recognition of neurologic comorbidities of psychiatric disorders leads to earlier treatment for these disorders and better quality of life.
3. Neuroscience research dominates investigations into the biology of psychiatric disorders and may yield new therapeutics development. Sufficient literacy in neuroscience research will allow psychiatry graduates to appreciate opportunities for targeted diagnosis and treatment, thus conserving scarce resources and offering their patients more personalized care. Further, research literacy is increasingly necessary for physicians to discriminate and reject spurious claims and unhelpful interventions.
4. Recent national surveys of training directors and other psychiatrists demonstrate widespread support for increased training in neuropsychiatry and neuroscience [19–23]. Training resources were not felt to be an obstacle by the majority of program directors [19].

Despite the widely accepted need, there has been little substantive change in training or expectations over the past decade. This derived in part from uncertainty and lack of specificity in the ACGME requirements but also from the fact that neuroscience is vast, and it is difficult for many program directors to readily decide what to teach. This paper will clarify the core neuroscience knowledge and neuropsychiatry skills specified in the recently promulgated Psychiatry Milestones.

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Table 1 Most recent ACGME neurology knowledge requirements for psychiatry residents

Residents should develop competence in neurological and mental status examination, including appropriate diagnostic studies [IV.A.5.a).(3).(a)]
The required geriatric psychiatry competencies should include an understanding of neuropsychological testing as it relates to cognitive functioning in the elderly [IV.A.5.a).(5).(e)]
The didactic curriculum must include the following specific components:
comprehensive discussions of the diagnosis and treatment of neurologic disorders commonly encountered in psychiatric practice, such as neoplasm, dementia, headaches, traumatic brain injury, infectious diseases, movement disorders, multiple sclerosis, seizure disorders, stroke, intractable pain, and other related disorders [IV.A.5.b).(3).(d)]
the use, reliability, and validity of the generally accepted diagnostic techniques, including physical examination of the patient, laboratory testing, imaging, neurophysiologic and neuropsychological testing, and psychological testing [IV.A.5.b).(3).(e)]
use of case formulation that includes neurobiological, phenomenological, psychological, and sociocultural issues involved in the diagnosis and management of cases [IV.A.5.b).(3).(i).(i)]
Residents are expected to monitor clinical records on major rotations to assess resident competency to document an adequate history and perform mental status, physical, and neurological examinations [IV.A.5.f).(14).(a)]
Numbers in brackets refer to the paragraph numbers in the 2007 ACGME Program Requirements in Psychiatry [41]

A version of this table appeared in Benjamin [34]

Methods

The Psychiatry Milestone Working Group, convened by the ACGME and the ABPN, was charged with creating a group of milestones that would define a framework for assessment of the development of competency in general psychiatry trainees. Milestones were created for each of the 22 subcompetencies, specifying the knowledge, skills, and attitudes a resident is expected to acquire by the time of graduation. They provide trainees an unambiguous metric against which to gauge their progress. The Milestones Project represents the next step in the specification of the correlates of competence and the development of reliable measures to assess trainee progress toward competence, as part of the Next Accreditation System [24].

The Milestone Working Group was composed of psychiatrists from a broad spectrum of practice orientations, interests, department size, and geographic location. All milestones were the result of a consensus among this diverse group. The working group constantly reviewed milestone expectations to make certain that they were achievable in any accredited program. Additional changes were made in response to feedback received in national surveys by the ACGME Psychiatry Review Committee, the American Association of Directors of Psychiatry Residency Training (AADPRT), and a milestone implementation pilot project.

In developing the clinical neuroscience milestones, emphasis was placed both on neuropsychiatric clinical skills and neuroscience research literacy, with the goal of graduating psychiatrists prepared to adapt their practices to a rapidly evolving field. In developing the clinical neuroscience milestones, the working group used as its guide the knowledge that is already expected and required of a general psychiatry graduate under the existing ACGME Psychiatry Program Requirements.

The Clinical Neuroscience Milestones

Table 2 lists the topic areas related to clinical neuroscience found in the MK3 clinical neuroscience subcompetency as well as in other psychiatry subcompetencies. In addition to the milestones that specifically mention neuropsychiatry or clinical neuroscience skills, trainees are expected to demonstrate integration of neuroscience in areas such as patient care (evaluation, differential diagnosis, formulation, and treatment planning), professionalism (through provision of compassionate, informed, and evidence-based care), interpersonal and communication skills (effective verbal and written communication with patients, families, and colleagues), practice-based learning and improvement (seeking out relevant reviews of evidence for decisions about care, ongoing critical appraisal of research literature, teaching);, and systems-based practice (consultation to non-psychiatric providers, resource management, and cost-effective practices). Critical aspects of clinical neuroscience knowledge are reflected in these other psychiatric milestones. For example, the MK1 subcompetency requires a trainee to be able to describe neural development across the life cycle. The PC2 subcompetency requires the trainee to incorporate into their formulation comprehensive models that take etiology into account, such as neurobiological formulation [35].The MK5 somatic therapy subcompetency requires the trainee to describe ECT techniques and understand the use of neuromodulation therapies such as deep brain stimulation

and transcranial magnetic stimulation [25]. The PC2 and MK5 level 5 milestones (the stretch goals) include the integration of studies of these emerging somatic treatments into their clinical knowledge base.

The subcompetencies are structured so that achieving the milestones associated with a score of 4 on the 5-point scale represents the skill level expected of a graduating resident. A given resident might be eligible for graduation without demonstrating achievement of every level 4 milestone, based on the program director's assessment of global competency in clinical neuroscience.

Knowledge Expectations and Teaching

Patient Evaluation (Neurological Examination, Cognitive Status Examination, Laboratory Evaluation, Structural Imaging, Clinical Neurophysiology)

Content

The elemental neurological examination serves not only to gather evidence of potential neurological disorders in the differential diagnosis of the patient's psychiatric symptoms but also to seek evidence of an abnormal neurological substrate that might explain why a psychiatric disorder has atypical features. Abnormal substrates include neurodevelopmental abnormalities, which range from genetic disorders with dysmorphic features to more subtle developmental cognitive syndromes that may include evidence of hemispheric or prefrontal dysfunction. Either could color the psychiatric phenomenology.

Hypothesis-driven cognitive status assessment requires the trainee to develop skill beyond the administration of standardized rating scales. For example, when a patient complains of memory problems, the trainee should be able to extend beyond the basic three-object recall for memory or digit span, serial 7's, and reversed spelling for attention, to develop an hypothesis as to whether the problem is one of attention or instead one of storage or retrieval. If neuropsychological consultation is available, the trainee should be able to ask a specific question of the neuropsychologist so that the testing will address the appropriate hypothesis. In addition, the psychiatrist should have sufficient knowledge of the major neuropsychological batteries and tests to know whether the right questions are being addressed by the consultant and whether there is a sufficient understanding of the findings in the neuropsychological report to use them in clinical decision making.

Psychiatrists should know the indications for structural brain imaging (Computed Tomographic and Magnetic Resonance Imaging), the circumstances in which one or the other technology is preferred, the indications for using contrast, and be sufficiently familiar with procedures to pre-counsel the patient. As with any clinical testing, the physician should know the specific types of abnormality being sought when the test is ordered. This means psychiatrists should be familiar with the common pathologies that may be detected with structural neuroimaging for indications such as severe headache, partial seizures, traumatic brain injury, dementia, neurodevelopmental disorders, movement disorders, and white matter disease, as well as acute personality change, first psychotic break, late-onset mental illness, catatonic behavior, and focal findings on neurologic examination.

Knowledge of indications for and how to order clinical neurophysiological testing, including EEG, evoked potentials, and sleep studies, should also be accompanied by familiarity with findings in common indications such as delirium, seizures, white matter disease, and sleep disorders, so that the psychiatrist can use the findings in differential diagnosis and explain the significance of any findings to the patient and family.

Pedagogy

In summarizing a case, the medical and neurological findings as well as the psychiatric phenomenology are listed, and the trainee should be able to construct a differential diagnosis that includes likely medical and neurological causes of symptoms. This skill could be modeled in morning report, intake meetings, case conferences, and especially by senior residents on call or on clinical services with junior residents. Case conferences with invited behavioral neurology or neuropsychiatry discussants are useful to broaden the perspective of psychiatry trainees. Senior residents often have this skill but may need to be cued to produce the appropriate information.

When referring a patient for neuropsychological testing, the resident should be expected to formulate a specific question to be addressed. A neuropsychologist occasionally joining rounds with residents can be helpful in teaching this skill. Neuropsychologists participating in didactic seminars should be asked to include teaching on how to best explain patterns of cognitive deficits to patients and families.

Familiarity with the use of structural neuroimaging and clinical neurophysiologic testing in differential diagnosis is expected, so neuroimaging and neurophysiological testing must be presented in routine case conferences, with radiologists or neurologists present to demonstrate findings as needed. When ordering neurodiagnostic laboratory testing, the trainee should be expected to specify the suspected abnormality, both to facilitate meeting the clinical neuroscience milestones and to promote cost-effective care.

If neurodiagnostic data are discussed only during the PGY-1 neurology rotation and neuropsychiatric content is

Table 2 Clinical neuroscience-related milestones

Subcompetency	Thread	Milestone	Expectations of graduates
PC1 psychiatric evaluation	General interview skills	2.2/A	Performs a targeted examination, including neurological examination, relevant to the patient's complaints
		4.1/A	Routinely identifies subtle and unusual findings
PC1 psychiatric evaluation	Collateral information gathering and use	3.3/B	Selects laboratory and diagnostic tests appropriate to the clinical presentation
PC2 psychiatric formulation and differential diagnosis	Organizes and summarizes findings and generates differential diagnosis	4.1/A	Incorporates subtle, unusual, or conflicting findings into hypotheses and formulations
PC2 psychiatric formulation and differential diagnosis	Identifies contributing factors and contextual features and creates a formulation	4.2/B	Efficiently synthesizes all information into a concise but comprehensive formulation
PC3 treatment planning and management	Creates treatment plan	3.2/A	Applies understanding of psychiatric, neurologic, and medical comorbidities to treatment selection
PC5 somatic therapies	Education of patient about medications	2.2/B	Incorporates basic knowledge of proposed mechanisms of action and metabolism of commonly prescribed psychopharmacologic agents in treatment selection and explains rationale to patients/families
PC5 somatic therapies	Monitoring of patient response to treatment and adjusting accordingly	4.2/C	Appropriately selects evidence-based somatic treatment options (including second and third line agents and other somatic treatments) or patients whose symptoms are partially responsive or not responsive to treatment
MK1 development through the life cycle	Knowledge of human development	4.1/A	Describes neural development across the life cycle
MK1 development through the life cycle	Knowledge of pathological and environmental influences on development	4.1/B	Describes the influence of acquisition and loss of specific capacities in the expression of psychopathology across the life cycle
		4.2/B	Gives examples of gene-environment interaction influences on development and psychopathology
MK2 psychopathology	Knowledge at the interface of psychiatry and the rest of medicine	3.3/C	Shows sufficient knowledge to identify and treat common psychiatric manifestations of medical illness
		3.4/C	Demonstrates sufficient knowledge to include relevant medical and neurological conditions in the differential diagnosis of psychiatric patients
		4.4/C	Demonstrates sufficient knowledge to systematically screen for, evaluate, and diagnose common medical conditions in psychiatric patients and to ensure appropriate further evaluation and treatment of these conditions in collaboration with other medical providers
MK3 clinical neuroscience	Neurodiagnostic testing	4.1/A	Explains significance of routine neurodiagnostic abnormalities to patients
		4.2/A	Knows clinical indications and limitations of functional neuroimaging
MK3 clinical neuroscience	Neuropsychological testing	3.2/B	Knows indications for specific neuropsychological tests and understands meaning of common abnormal findings
MK3 clinical neuroscience	Neuropsychiatric comorbidity	4.3/C	Describes psychiatric comorbidities of less common neurologic disorders and less common neurologic comorbidities of psychiatric disorders

Table 2 (continued)

Subcompetency	Thread	Milestone	Expectations of graduates
MK3 clinical neuroscience	Neurobiology	3.3/D	Describes neurobiological and genetic hypotheses of common psychiatric disorders and their limitations
		4.4/D	Explains neurobiological hypotheses and genetic risks of common psychiatric disorders to patients
MK3 clinical neuroscience	Applied neuroscience	2.4/E	Identifies the brain areas thought to be important in social and emotional behavior
		4.5/E	Demonstrates sufficient knowledge to incorporate leading neuroscientific hypotheses of emotions and social behaviors into case formulation
MK5 somatic therapies	Knowledge of ECT and other emerging somatic treatments	3.4/B	Lists emerging neuromodulation therapies
SBP2 resource management	Cost of care and resource management	4.1/A	Practices cost-effective, high-value clinical care, using evidence-based tools and information technologies to support decision making
		4.2/A	Balances the best interests of the patient with the availability of resources
SBP4 consultation to nonpsychiatric medical providers and nonmedical systems	Specific consultative activities	4.2/C	Manages complicated and challenging consultation requests

reserved for board preparation at the end of residency training, it will be difficult for psychiatrists to incorporate clinical neuroscience into their daily thought process. Psychiatry training programs will have to seek ways to continue neuropsychiatric education throughout residency training to normalize the expectation.

Neuropsychiatric Comorbidities (Psychiatric Comorbidities of Neurological Disease, Neurological Comorbidities of Psychiatric Disorders)

Content

Generally, psychiatrists should be able to diagnose and treat the mood and anxiety disorders, psychosis, personality changes, and aggressive behavior that may occur in the setting of dementia, delirium, stroke, traumatic brain injury, infection, autoimmune disease, demyelinating disease, seizure disorders, extrapyramidal disorders, and brain tumor. Specific examples of common and less common neurological comorbidities of psychiatric disorders and psychiatric comorbidities of neurological disorders are provided in Table 3. In many cases, these comorbidities are so common that the disorders may be regarded as a complex in which the comorbidities are the expected concomitants of the primary disorders. In some cases, it is the neurological comorbidity that may cause a psychiatric disorder to appear atypical.

Pedagogy

Psychiatric comorbidities of neurological disorders are likely to be seen on psychosomatic medicine services and should be well represented in case conferences. To the degree possible, the required neurological rotations for psychiatry residents should include experiences in clinics or consultation services that routinely see these comorbid neurological conditions in psychiatric patients. The expectation that psychiatry evaluation notes contain explicit neuropsychiatric differential diagnoses will reinforce knowledge of neuropsychiatric comorbidities, especially in the presence of atypical psychiatric symptoms. A number of neuropsychiatry references covering these comorbidities in detail are available for use in psychiatry curricula [26–30].

Neurobiology of Psychiatric Disorders (Neurobiological Theories of Mental Illness, Social Neuroscience, Functional Imaging, Genetics)

Content

Whether or not one agrees with the assertion that psychiatry is a clinical neuroscience [31], the centrality of neuroscience to understanding psychiatric disorders is well established. The importance of neuroscience to interpersonal relationships and especially psychotherapy was eloquently argued by Kandel [32, 33]. Recent neuromodulation therapies have emerged

Table 3 Examples of neuropsychiatric comorbidity expectations of graduating residents in the MK3 subcompetency

Thread	Milestone	Examples of expectations
Neuropsychiatric comorbidity	4.3/C	Examples of neurologic comorbidities of psychiatric disorders Acute drug-induced hypokinetic and hyperkinetic movement disorders Neuroleptic malignant syndrome Tardive syndromes Serotonin syndrome Drug-induced seizures Neurological findings in delirium Seizures Movement disorders Autonomic syndromes Increased and decreased movements in manic and depressed mood Tics in obsessive-compulsive disorder Motor hyperactivity in ADHD Lethal catatonia (likely overlap with autoimmune encephalitis) Examples of psychiatric comorbidities of neurologic disorders Depression, frustration, catastrophic reactions in anterior aphasia Paranoia, agitation, impulsivity in posterior aphasia Decreased insight in right hemisphere pathology Manic behavior in orbitofrontal and right hemisphere pathology Apathy in dorsolateral prefrontal dysfunction and expansive pituitary lesions Irritability, disinhibition, limited insight in orbitofrontal dysfunction Delirium in acute neurological disorders Aggressive behavior in neurological disorders Subcortical cognitive dysfunction and depression in basal ganglia and white matter disorders Visual hallucinations, delusions, and REM behavior disorder in dementia with Lewy bodies

directly from psychiatric neuroscience [25]. The probability that many of our current neurobiological theories of mental illness will be supplanted by others, as advances in neuroscience research occur, does not negate the need for psychiatric trainees to critically read and understand the major neurobiological theories of mental illness. Heightened public awareness and curiosity about brain disorders, reflected in Internet and media focus, have raised the level of dialogue that an educated public demands of psychiatry. Graduating residents will be increasingly called upon to answer questions about evolving knowledge of neurobiology of psychiatric disorders and the biological basis of somatic treatments. Examples of the neuroscience knowledge expectations for general psychiatry graduates are given in Table 4.

Pedagogy

The majority of learning about psychiatric neuroscience will occur in seminars and journal clubs. In addition to discussing clinical trials of biological and psychotherapeutic interventions, journal clubs focusing on the clinical neuroscience of psychiatric disorders should be included [34]. If programs have difficulty identifying faculty to serve as discussants for these topics, consideration should be given to utilizing postdocs or researchers at area schools

Table 4 Examples of neuroscience expectations of graduating residents in the MK3 subcompetency

Thread	Milestone	Examples of expectations
Neurodiagnostic testing	4.2/A	General understanding of methods and meaning of images in SPECT, PET, fMRI, MRS Knowledge of limitations of functional imaging paradigms Clinical (Medicare-reimbursable) indications of PET/SPECT (e.g., Alzheimer's disease)
Neurobiology	4.4/D	Sufficient knowledge to explain current major neurobiological hypotheses to patients in terms relevant to them Sufficient knowledge to explain relative familial risk to patients with common disorders (e.g., bipolar disorder, schizophrenia, ADHD, panic disorder, familial Alzheimer disease)
Applied neuroscience	4.5/E	Knowledge of some cognitive and social functions of areas such as amygdala, hippocampus, hypothalamus, nucleus accumbens, dorsolateral prefrontal cortex, anterior cingulate cortex, and orbitofrontal cortex Knowledge of potential mechanisms such as inflammation, immunity, hormonal involvement, excitotoxicity, epigenetic control, cognitive deficits, etc. Knowledge of postulated theories of attachment, memory and learning, aggressive behavior, neurovegetative excess, mood dysregulation, etc.

with neuroscience programs, employing internet conferencing to involve distant discussants, trading psychiatry for neurology discussants with local neurology departments, or using online modules [35]. Dual-boarded or fellowship-trained neuropsychiatrists, when available, will be excellent educational resources in assisting departments with milestone implementation. Case-load supervision during outpatient rotations creates opportunities for attending psychiatrists to hear trainees explain (to both peers and patients, in person or through video) the relevant theoretical understanding of a diagnosis or treatment. Inclusion of neurobiological formulation in case conferences will give trainees additional opportunities to demonstrate their understanding [34, 36]. Both concise and detailed references are readily available for use in psychiatric curricula [29, 37–39]. The NIMH Research Domain Criteria (RDoC) also provide a robust resource for organizing applicable neuroscience findings and a framework that residents may find useful to link basic findings to their clinical cases [40].

Conclusions

The MK3 clinical neuroscience subcompetency clarifies the neuropsychiatry and neuroscience knowledge expectations of general psychiatry graduates. Reliance on the two-month PGY-1 neurology rotation to achieve these milestones will be insufficient. Instead, it is suggested that following the minimum two-month PGY-1 neurology experience, clinical neuroscience should be integrated into most areas of the general curriculum across all years of training affording multiple venues in which to practice these skills. This may require a change in mindset of academic psychiatry leaders but will result in psychiatry graduates equipped to do thorough neuropsychiatric evaluations of their patients and take advantage of diagnostic and treatment improvements resulting from advances in psychiatric neuroscience.

Implications for Educators

- The clinical neuroscience milestones are a clarification of the knowledge and skills already expected of general psychiatrists
- Clinical neuroscience should be integrated into all aspects of the psychiatry curriculum across all years of training
- A combination of seminars, journal clubs, case conferences, and observed patient interactions along with a review of the goals of the program's 2-month neurology rotation will best address these milestones

Implications for Academic Leaders

- Neuropsychiatric skills, neuroscience knowledge, and their integration into formulation will need to become part of the fabric of psychiatric training
- Resource exchanges and strategic relationships with area neuroscience and neurology departments will facilitate milestone achievement
- Teaching faculty with skills in neuropsychiatry and clinical neuroscience will be a strategic advantage for psychiatry training programs

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