Potential Applications of the National Institute of Mental Health's Research Domain Criteria (RDoC) to Clinical Psychiatric Practice: How RDoC Might Be Used in Assessment, Diagnostic Processes, Case Formulation, Treatment Planning, and Clinical Notes

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ABSTRACT

Offering a new framework for understanding and studying basic dimensions of normal and abnormal human functioning and mental disorders, the National Institute of Mental Health (NIMH) has initiated the Research Domain Criteria (RDoC) project in which a series of higher order domains, representing major systems of emotion, cognition, motivation, and social behavior, and their constituent operationally defined constructs serve as organizing templates for further research and inquiry, eg, to discover validated biomarkers and endophenotypes. Cutting across traditional *DSM* diagnoses, the domains are defined as *Negative Valence Systems, Positive Valence Systems, Cognitive Systems, Systems for Social Processes,* and *Arousal/Regulatory Systems*. To inform educators, trainees, and practitioners about RDoC, alert them to potential practical applications, and encourage their broad exploration in clinical settings, this article reviews the RDoC domains and their subsystem constructs with regard to potential current clinical considerations and applications. We describe ways in which the RDoC domains and constructs offer transdiagnostic frameworks for complementing traditional practice; suggest clinical questions to help elucidate salient information; and, translating RDoC domains and constructs headings into clinically friendly language, offer a template for the psychiatric review of systems that can serve in clinical notes.

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Psychiatric assessments are designed to assure that clinically pertinent historical data, processes, and phenomenological features are comprehensively appraised so that accurate diagnoses, case formulations, and treatment plans result. What constitutes "pertinent" and "accurate," in these instances, is pragmatically and iteratively defined and shaped by contemporary nosology, theoretical models, and available evidence-based and evidence-informed treatments.[1] Psychiatric assessments and case formulations are customarily structured around fusions of traditional *DSM* categories (or, less commonly, psychoanalytic or other alternative terminologies) morphed with broad biopsychosocial cultural models of pathogenesis.

Concerned that *DSM* diagnostic categories lack scientific rigor and validity, the National Institute of Mental Health (NIMH) has proposed alternative systems for conceptualizing and studying psychiatric disorders via the Research Domain Criteria (RDoC) project,[2,3] in which a series of higher order domains, representing major systems of emotion, cognition, motivation, and social behavior, composed of various sets of operationally defined constructs, serve as organizing templates for further inquiry, eg, for research to discover validated biomarkers studied via different units of analysis, ranging from genes, molecules, and neurocircuitry networks through paradigms of much larger scope.[3] Starting with a strategic plan nearly a decade ago and posting its first draft in 2010, the NIMH has increasingly encouraged investigators to incorporate RDoC into their projects; the next few years will tell how fruitful this initiative will prove to be or whether it may need to be scaled back due to lack of meaningful contributions.

Briefly, the proposed domains and their related constructs are as follow:

- **Negative Valence Systems** including the constructs *Responses to Acute Threat, Responses to Potential Harm, Responses to Sustained Threat, Frustrative Nonreward,* and *Loss*;
- **Positive Valence Systems** including the constructs *Approach Motivation* (and its subconstructs *reward valuation, effort valuation/willingness to work, expectancy/reward prediction error, and action selection/preference-based decision making*), *Initial Responsiveness to Reward Attainment, Sustained/Longer-Term Responsiveness to Reward Attainment, Reward Learning,* and *Habit;*
- **Cognitive Systems** including the constructs *Attention, Perception, Declarative Memory, Language, Cognitive Control,* and *Working Memory*;
- **Systems for Social Processes** including the constructs *Affiliation and Attachment, Social Communication* (and its subconstructs *reception of facial communication, production of facial communication, reception of nonfacial communication,* and *production of nonfacial communication*), *Perception and Understanding of Self* (and its subconstructs *agency* and *self-knowledge*), and *Perception and*

Understanding of Others, including *animacy perception*; and
- **Arousal/Regulatory Systems** including the constructs *Arousal, Circadian Rhythms,* and *Sleep and Wakefulness.*

RDoC domains and constructs, fully defined on the NIMH's RDoC webpage,[4] are more completely described in Tables 1–5. At the same time, RDoC should be considered a work in progress since suggestions for adding a "motor" domain and an "alcohol addiction" domain have been proposed,[5–7] and other suggestions for modification are likely to be forthcoming as well.

Each domain has been variably associated with increasingly well-defined neurocircuits, many of which have been associated with specific psychopathological conditions. For example, key cortical nodes in frontal, cingulate, and temporal cortex have been associated with externalizing behaviors in children along a continuum and across healthy and clinical samples regardless of the presence or absence of specific *DSM* diagnoses.[8] None of the domains or circuitry have, as yet, been translated into assessment tools for routine clinical practice, worthy tasks well beyond the scope of this article that remain for future development. Nevertheless, although these domains and their constructs were primarily developed to provide organizing themes for predominately biological research and might appear to be reductionistic, they certainly invite clinical consideration. Reflections on how RDoC's themes might apply to major clinical syndromes have already been described for adolescent depression,[9] maltreatment and resilience in children and adolescents,[10] binge eating disorder,[11] and the study of hallucinations,[12] among others.

To briefly illustrate early applications for adolescent depression, Henje Blom et al[9] developed an RDoC-aligned 12-week group-based semimanualized Training for Awareness, Resilience, and Action (TARA) program based on current understanding of developmental and depression neurobiology in which RDoC domains are prioritized according to their involvement in adolescent depression (eg, predominantly negative valence and arousal/regulatory systems). Taking into consideration developmental limitations in top-down cognitive control in adolescence and promoting bottom-up strategies such as vagal afference to decrease limbic hyperactivation and its secondary effects, the program has been informed by mindfulness-based therapy and yoga, as well as modern psychotherapeutic evidence-based techniques and training strategies.

RDoC has also served as the framework for a recently described neuroscience course for psychiatry residents.[13] Research has linked circuitry abnormalities to a wide array of disorders across the diagnostic spectrum.[14–19] In a clinical application using natural language extraction applied to electronic health records, McCoy et al[20] have demonstrated how measures of cognitive and arousal domains were related to length of hospital stay and how measures based on negative valence and social communication domains were significantly associated with readmission risk beyond predictions made by *ICD-9* diagnostic codes alone.

Clinical Points

- The National Institute of Mental Health's Research Domain Criteria (RDoC), designed to serve as templates for research, invite potential clinical applications.
- RDoC broadly translate into clinical systems addressing *Threat Appraisal and Response, Drives and Effort Allocation, Cognitive Systems, Interpersonal and Reflective Systems,* and *Vegetative Systems*.
- Routine appraisal of these systems can potentially augment conventional psychiatric histories, formulations, diagnoses, and treatment planning.

Given these contexts, the aim of this article is to alert educators, trainees, and practitioners to potential practical applications of RDoC's themes and to encourage their broad exploration in clinical settings. The RDoC project was never intended to offer a template for clinical practice and is still in early stages of development and translation. Without overreaching or getting too far ahead of the as yet skimpy data, we attempted to glean clinically pertinent elements from RDoC's overriding concepts that might usefully augment, but in no way currently replace, usual practice. We also consider how RDoC domains and constructs, cutting across the major diagnostic categories of the *DSM*, might complement conventional diagnostic schemes in clinical practice. We propose concise templates for bundling these themes as a psychiatric review of systems and for their documentation in clinical notes, but many details concerning RDoC's potentials for implementation in clinical settings are beyond the scope of this article and remain to be worked out.

TRANSLATING RDOC DOMAINS AND CONSTRUCTS INTO CLINICAL TERMS

For the most part, RDoC repackages many topics of concern into new organizing bundles in ways that might lead clinicians to think more productively about assessment, diagnoses, case formulation, and associated treatment planning. Furthermore, for practitioners who tend to focus primarily on *DSM* diagnoses, RDoC highlights certain highly relevant cross-cutting features that can be considered dimensionally and that often receive insufficient attention across disorders.

To lay out the major themes of this article, Tables 1–5 depict each of the NIMH's descriptions of the 5 domains and their constructs and roughly translate those constructs into clinically useful frames.

Terms that we have nominated for psychiatric systems representing clinical translations for the 5 major domains are as follow:

- *Negative Valence Systems = Threat Appraisal and Response*;
- *Positive Valence Systems = Drives and Effort Allocation;*

Table 1. Negative Valence Systems Domain Applied Into Clinical Psychiatric System: Threat Appraisal and Response (including Frustrations and Losses)[a]

Negative Valence Systems: Systems Primarily Responsible for Responses to Aversive Situations or Context, Such as Fear, Anxiety, and Loss	Clinical Psychiatric System: Threat Appraisal and Response
Responses to acute threat (Fear): Activation of the brain's defensive motivational system to promote behaviors that protect the organism from perceived danger. Normal fear involves a pattern of adaptive responses to conditioned or unconditioned threat stimuli (exteroceptive or interoceptive). Fear can involve internal representations and cognitive processing and can be modulated by a variety of factors.	Managing responses to aversive situations such as acute, sustained, imagined, and potential sources of fear, anxiety, loss, and failure, these constructs can be bundled as clinical systems for threat perception, appraisal, reaction, and response. They include internal and external factors contributing to vulnerability and breakdown, as well as to adaptive and maladaptive coping and resilience.
Responses to potential harm (Anxiety): Activation of a brain system in which harm may potentially occur but is distant, ambiguous, or low/uncertain in probability, characterized by a pattern of responses such as enhanced risk assessment (vigilance). These responses to low imminence threats are qualitatively different than the high imminence threat behaviors that characterize fear.	Regarding clinical application, these functions constitute a psychiatric "system" of Threat Appraisal and Response. Assessment of its constructs is likely to enhance and refine the clinician's ability to estimate the patient's total stress and vulnerability burdens/coping capacities. Manifestations of clinical strengths include accurate, discerning, and realistic threat appraisal and effective instrumental and effective coping with actual threats.
Responses to sustained threat: An aversive emotional state caused by prolonged (ie, weeks to months) exposure to internal and/or external condition(s), state(s), or stimuli that are adaptive to escape or avoid. The exposure may be actual or anticipated; the changes in affect, cognition, physiology, and behavior caused by sustained threat persist in the absence of the threat and can be differentiated from those changes evoked by acute threat.	**Potential overlap with *DSM-5* syndromes:** Attention to these themes can refine diagnostic understanding particularly for patients with various internalizing and externalizing response patterns and complaints concerning anxiety, phobias, trauma, depression, suicidality, violence, paranoia, and other diagnostic categories including personality disorders that most closely reflect these problem areas. However, these cross-cutting issues, clearly pertinent for all psychiatric patients, will provide clinicians with information about background concerns, stresses and vulnerabilities, coping strategies, and coping reserve.
Frustrative nonreward: Reactions elicited in response to withdrawal/prevention of reward, ie, by the inability to obtain positive rewards following repeated or sustained efforts.	
Loss: A state of deprivation of a motivationally significant conspecific, object, or situation. Loss may be social or nonsocial and may include permanent or sustained loss of shelter, behavioral control, status, loved ones, or relationships. The response to loss may be episodic (eg, grief) or sustained.	

Clinical Inquiry

Assessment of this domain can be introduced by informing patients that the clinician would like to learn about their current and ongoing threats, fears, and challenges and how (and how successfully) they're coping. As with all symptoms and signs, inquiry attends to their frequency, intensity, and characteristics, as well as antecedents, precipitants, and consequences.

Regarding threat appraisal:

- What current and long-term sources of internal and external fears, threats, and stresses do you see in your life?
  - Internal fears: Failure, death, social rejection, being alone, phobias, public speaking
  - External fears: Nuclear, terrorist, domestic violence, climate change, arrests, financial collapse
- What do you find yourself most concerned and worrying about? What internal or external fears or threats preoccupy your thoughts? What do you dread? What do you prefer not to think about? How would you estimate their risks of actually happening?
- What are the most frustrating situations you currently encounter?

Regarding responses to threat:

- How do you ordinarily react to and cope with internal and external threats and stresses? How do you usually defend yourself against these threats and stresses?
- What's your assessment of how well you handle these stresses? Where do you think you run into difficulties?

Regarding frustrations:

- How do you usually respond to frustrations? Examples?

Regarding losses/traumas:

- What major losses/traumas have you experienced, and how have you dealt with them?

[a]Adapted from the National Institute of Mental Health.[4]

- *Cognitive Systems* = *Cognitive Systems* (no need to change what is clear);
- *Systems for Social Processes* = *Interpersonal and Reflective Systems;* and
- *Arousal/Regulatory Systems* = *Vegetative Systems*.

IMPLICATIONS FOR ASSESSMENT

Understanding that experienced practitioners skillfully question patients on many of these subjects, in Tables 1–5 we suggest how clinical inquiry might be approached for each psychiatric system defined by the domains and offer illustrative screening and follow-up questions to address the various constructs. Clinicians should survey clinical strengths as well as psychopathological concerns. In our view, systematic appraisal of RDoC paradigms, already inconsistently conducted by clinicians, will quite likely add value to routine comprehensive assessments. We envision that RDoC-associated domains might suggest revised conventional psychiatric systems reviews currently incorporated in standard assessment templates. Table 6 illustrates how an RDoC-oriented review of systems might appear following a traditional History of Present Illness.

We also foresee these systems prompting development of validated, brief screeners and rating scales for measurement-based care. Our own search of the literature for clinical assessment measures that are aligned with the various RDoC domains and constructs revealed a disappointing

Table 2. Positive Valence Systems Domain Applied Into Clinical Psychiatric System: Drives and Effort Allocation (Motivations, Values, Efforts, Decision-Making and Evaluation, Addictions, Impulses, and Habits)[a]

Positive Valence Systems: Systems Primarily Responsible for Responses to Positive Motivational Situations or Contexts, Such as Reward Seeking, Consummatory Behavior, and Reward/Habit Learning	Clinical Psychiatric System: Drives and Effort Allocation (Motivations, Values, Efforts, Decision-Making and Evaluation, Addictions, Impulses, and Habits)
Approach motivation: A multifaceted construct involving mechanisms/processes that regulate the direction and maintenance of approach behavior influenced by preexisting tendencies, learning, memory, stimulus characteristics, and deprivation states. Approach behavior can be directed toward innate or acquired cues (ie, unconditioned vs learned stimuli), implicit or explicit goals; it can consist of goal-directed or Pavlovian conditioned responses. Component processes include reward valuation, effort valuation/willingness to work, expectancy/reward prediction error, and action selection/decision making.	Regarding clinical application, these functions constitute a psychiatric "system" of Drives and Effort Allocation, covering drives, motivations, and values; efforts; and substance-related and behavioral dependencies and addictions, impulses, and habits. Their assessment concerns issues of will and willpower; mechanisms for developing, initiating, and sustaining drive and goal-directed behaviors; cues affecting implicit or explicit goals; how goals are differentially evaluated (what are they worth) and valued (eg, degrees of satisfaction vs pleasure; pain vs gain); allocation of effort and resources in their attainment (how, and how vigorously, they are pursued); goal flexibility; capabilities for decision-making and evaluation of outcomes; responses when these goals are achieved or frustrated; and effective habits as healthy adaptive functions.
Initial responsiveness to reward attainment: Mechanisms/processes associated with hedonic responses—as reflected in subjective experiences, behavioral responses, and/or engagement of the neural systems to a positive reinforcer—and culmination of reward seeking.	Manifestations of clinical strengths include the capacity for productive work, play, and relationships; physical and psychological satisfactions; and, in general, finding productive meaning and fulfillment in life. Conversely, maladaptive issues include distorted or misguided motivations and values; paralyzing goal/drive conflicts; misdirected or deficient desire, drive, ambition, motivation, will-power, stick-to-itiveness, and self-control; poor planning and decision-making; difficulties in estimating realistic outcomes of efforts; low frustration tolerance; easy discouragement; chronic dissatisfactions; pathological attachments; substance or behavioral dependencies and addictions (pending such time as a new Research Domain Criteria [RDoC] domain specific to these topics might be added); pathological impulsivities; and bad (maladaptive) habits.
Sustained/Longer-term responsiveness to reward attainment: Mechanisms/processes associated with the termination of reward seeking, eg, satisfaction, satiation, and regulation of consummatory behavior.	**Potential overlap with *DSM-5* syndromes:** Systematic assessment can assist in better delineating a broad range of diagnostic conditions including those marked by brain deficits, psychotic conditions, and obsessive-compulsive, smoking, eating, gambling, substance use, and personality disorders, to name the most obvious. While some of these issues are likely to be touched upon in traditional reviews of social, developmental, legal, and substance use areas and in mental status examination, systematic assessment using the RDoC framework can enhance understanding of factors shaping physiological, behavioral, social, and vocational impairments, including difficulties with setting and achieving both short- and long-term goals.
Reward learning: A process by which organisms acquire information about stimuli, actions, and contexts that predict positive outcomes and by which behavior is modified when a novel reward occurs or outcomes are better than expected. Reward learning is a type of reinforcement learning, and similar processes may be involved in learning related to negative reinforcement.	
Habit: Sequential, repetitive, motor, or cognitive behaviors elicited by external or internal triggers that, once initiated, can go to completion without constant conscious oversight. Habits can be adaptive by virtue of freeing up cognitive resources. Habit formation is a frequent consequence of reward learning, but its expression can become resistant to changes in outcome value. Related behaviors could be pathological expression of a process that under normal circumstances subserves adaptive goals.	

Clinical Inquiry

Assessment of this domain can be introduced by informing patients that the clinician would like to learn about their helpful and harmful current and ongoing motivations, drives, values, goals, rewards, turn-ons, capacities for stick-to-itiveness, satisfactions, impulses, addictions, and habits.

Regarding motivations, values, and efforts:

- What drives, motivates, and inspires you? What are you passionate about? What are your aspirations?
- What values do you hold sacred?
- What values are essential to your self-esteem?
- How far into the future do you imagine, fantasize, and plan? What do you see yourself doing in 2, 5, and 10 years?
- Which of your motivations do you see as positive? What motivations do you or others see as potentially harmful or self-destructive (note: substance and behavioral addictions can be implicated here)?
- How energetic and persistent are you in pursuit of your goals? Which goals get your full attention and persistent hard effort? For which goals do you give up too easily?
- Once you start working toward a goal, how good are you at switching directions if that's called for, either in the way you approach that goal or switch midstream to other goals entirely? To what extent are you adaptively flexible? To what activities and substances would you or others consider you to be addicted?

Regarding decision-making and evaluation:

- How would you and others close to you describe your judgment regarding choices, decision-making, and abilities to realistically estimate likely outcomes of your efforts in school, work, relationships, and other activities?
- What drives most of your decisions? Reason and logic (making lists of pros and cons)? Emotions (how a decision will make you feel)? Impulsivity (do you react on the spur of the moment)?
- To what extent do you tend to be unrealistically optimistic, idealistic, or pessimistic?
- How capable are you of selecting and carrying out wise plans of actions? How often do you impulsively make unwise choices for important decisions?

Regarding addictions, impulses, and habits:

- To what substances, things, or activities would you or those close to you consider you to be overdependent or addicted?
- In what ways would you or others close to you consider you to be impulsive? What types of impulses do you find yourself trying to fight off? How successful or unsuccessful are you in these efforts? What are the consequences of giving in to your impulses?
- In what ways are you a creature of habit? What would you count as your good habits? Bad habits? Terrible habits? What do your habits do for you? How much, and in what ways, do your habits "cost" you?

[a]Adapted from the National Institute of Mental Health.[4]

Table 3. Cognitive Systems Domain Applied Into Clinical Psychiatric System: Cognitive Systems[a]

Cognitive Systems: Systems Responsible for Various Cognitive Processes	Clinical Psychiatric System: Cognitive Systems
Attention: Attention refers to a range of processes that regulate access to capacity-limited systems, such as awareness, higher perceptual processes, and motor action. The concepts of capacity limitation and competition are inherent to the concepts of selective and divided attention.	These systems are responsible for the entire range of cognitive processes such as attention (including awareness, selective and divided attention), perception, declarative memory, and associated processes underlying episodic memory and semantic memory, language, and executive functions such as cognitive control, working memory, and decision-making.
Perception: Perception refers to the process(es) that perform computations on sensory data to construct and transform representations of the external environment, acquire information from, and make predictions about, the external world, and guide action.	Regarding clinical application, these functions obviously constitute the well-trodden psychiatric Cognitive Systems. Manifestations of clinical strengths include competent attentional focus, superior memory, high general intelligence, and creativity.
Declarative memory: Declarative memory is the acquisition or encoding, storage and consolidation, and retrieval of representations of facts and events. Declarative memory provides the critical substrate for relational representations—ie, for spatial, temporal, and other contextual relations among items, contributing to representations of events (episodic memory) and the integration and organization of factual knowledge (semantic memory). These representations facilitate the inferential and flexible extraction of new information from these relationships.	**Potential overlap with *DSM-5* syndromes:** These constructs directly impact every single psychiatric disorder, not only the obvious ones with gross brain dysfunctions and psychoses, amnestic syndromes, attention-deficit/hyperactivity disorder, delirium, and mild and severe neurocognitive disorders.
Language: Language is a system of shared symbolic representations of the world, the self, and abstract concepts that supports thought and communication.	
Cognitive control: A system that modulates the operation of other cognitive and emotional systems, in the service of goal-directed behavior, when prepotent modes of responding are not adequate to meet the demands of the current context. Additionally, control processes are engaged in the case of novel contexts, where appropriate responses need to be selected from among competing alternatives.	
Working memory: Working memory is the active maintenance and flexible updating of goal/task relevant information (items, goals, strategies, etc) in a form that has limited capacity and resists interference. These representations may involve flexible binding of representations; may be characterized by the absence of external support for the internally maintained representations; and are frequently temporary, although this may be due to ongoing interference. It involves active maintenance, flexible updating, limited capacity, and interference control.	

Clinical Inquiry
Assessment of this domain can be introduced by informing patients that the clinician would like to learn about their abilities and difficulties in attention, concentration, and memory. Most of these constructs are generally well covered in traditional histories and mental status assessments.

[a]Adapted from the National Institute of Mental Health.[4]

void; at present, nothing specifically addresses RDoC questions for clinical practice (but, beyond the scope of this article, think of the opportunities for test developers). Before such instruments are available, clinicians interested in measurement-based assessment will still have to rely on available scales. Numerous freely available validated screening measures are available for overall mental health and for anxiety, depression, mania, eating disorders, personality disorders, trauma, suicidality, disruptive behavior disorders, attention-deficits, and cognitive functioning[21,22]; to our knowledge, none of these has yet been specifically aligned with RDoC constructs, but some of their features might variably lend themselves to RDoC-associated purposes.

In routine practice, we appreciate that the time required to survey all RDoC domains and constructs far exceeds that available to clinicians in single intake visits. At the very least, several sessions might be necessary for taking additional history. Information collected via patient-completed history forms and questionnaires can assist these processes.

APPLYING RDOC INFORMATION TO CLINICAL DIAGNOSES

While RDoC cannot and, in the foreseeable future, is unlikely to fully replace the *DSM* as a diagnostic scheme, its designers hope that these initiatives will produce valid biomarkers and endophenotypes, ultimately yielding not only useful therapeutic targets, but also more precisely and validly defined disorders from more meaningful groupings of signs, symptoms, historical data, and laboratory findings.[23] The extent to which future findings will primarily strengthen existing *DSM* diagnostic categories such as major depressive disorder, bipolar disorder, schizophrenia, and borderline personality disorder or alternatively call for radical overhaul, redefinition of major disorders and syndromes, and redelineation of the diagnostic meta-taxonomy is unclear. Broader transdiagnostic behavioral dispositions to threat response such as internalizing versus externalizing tendencies might be usefully considered from the perspective of RDoC domains such as negative valence. Critics recognize that RDoC is incomplete, that it currently focuses on biological factors to a much greater extent than psychological or social factors, and that its ability to fulfill its promises remains to be proven.[24–26]

Nevertheless, RDoC can prompt educators and practitioners to rethink clinical psychiatry's traditional diagnostic templates and models. Systematic attention to clinical manifestations related to the RDoC constructs might, for example, add individualized nuance to *DSM* diagnoses by highlighting cross-cutting moderating and mediating

Table 4. Systems for Social Processes Domain Applied Into Clinical Psychiatric System: Social Processes (Affiliation and Attachment Styles, Social Communication, and Capacity to Understand Others and Oneself)[a]

Systems for Social Processes: Systems That Mediate Responses to Interpersonal Settings of Various Types, Including Perception and Interpretation of Others' Actions	Clinical Psychiatric System: Interpersonal and Reflective Processes (Affiliation and Attachment Styles, Social Communication, and Capacity to Understand Others and Oneself)
Affiliation and attachment: Affiliation is engagement in positive social interactions with other individuals. Attachment is selective affiliation as a consequence of the development of a social bond. Affiliation and attachment are moderated by social information processing (processing of social cues) and social motivation. Affiliation is a behavioral consequence of social motivation and can manifest itself in social approach behaviors. Affiliation and attachment require detection of and attention to social cues, as well as social learning and memory associated with the formation of relationships. Affiliation and attachment include both the positive physiological consequences of social interactions and the behavioral and physiological consequences of disruptions to social relationships. Clinical manifestations of disruptions in affiliation and attachment include social withdrawal, social indifference and anhedonia, and overattachment.	These systems involve perception and interpretation of others' actions and mediate responses to interpersonal settings. They include mechanisms concerned with affiliation-attachment and social communication functions including expressive and receptive (eg, recognizing and interpreting) affect, intention, vocal intonation, facial communication, gestures, aromas, and other forms of social signaling. Also included in these systems are mechanisms for perceiving, understanding, and making judgments about others (eg, people-reading, mentalization, empathic capacities) as well as about the self (eg, regarding psychological and physical self-awareness, self-monitoring, and self-knowledge and recognizing oneself as an active agent governing these processes).
Social communication: A dynamic process that includes both receptive and productive aspects used for exchange of socially relevant information. Social communication is essential for the integration and maintenance of the individual in the social environment. This construct is reciprocal and interactive, and social communication abilities may appear very early in life. Social communication is distinguishable from other cognitive systems (eg, perception, cognitive control, memory, attention) in that it particularly involves interactions with conspecifics. The underlying neural substrates of social communication evolved to support both automatic/reflexive and volitional control, including the motivation and ability to engage in social communication. Receptive aspects may be implicit or explicit; examples include affect recognition, facial recognition, and characterization. Productive aspects include eye contact, expressive reciprocation, and gaze following. Although facial communication was set aside as a separate subconstruct for the purposes of identifying matrix elements, social communication typically utilizes information from several modalities, including facial, vocal, gestural, postural, and olfactory processing.	Regarding clinical application, these functions constitute a psychiatric "system" composed of Interpersonal and Reflective Processes, including affiliation and attachment styles, social communication, and capacity to understand others and oneself. Manifestations of clinical strengths include mature attachment and communication styles and high interpersonal intelligence.
Perception and understanding of self: The processes and/or representations involved in being aware of, accessing knowledge about, and/or making judgments about the self. These processes/representations can include current cognitive or emotional internal states, traits, and/or abilities, either in isolation or in relationship to others, as well as the mechanisms that support self-awareness, self-monitoring, and self-knowledge.	**Potential overlap with *DSM-5* syndromes:** Although standout pathological findings are central to a wide array of diagnostic categories including childhood attachment disorders and other forms of pathological attachment, autism spectrum disorders, trauma and neglect, borderline, schizoid, schizotypal and other personality disorders, and psychotic disorders, these issues are clearly salient for every patient and influence all psychiatric outcomes and personal relationships, including those with caregiving clinicians. Some of these issues might be considered in traditional review of developmental and social issues and in mental status examination, but Research Domain Criteria (RDoC) offers a useful list for additional consideration.
Perception and understanding of others: The processes and/or representations involved in being aware of, accessing knowledge about, reasoning about, and/or making judgments about other animate entities, including information about cognitive or emotional states, traits, or abilities.	

Clinical Inquiry

Assessment of this domain can be introduced by informing patients that the clinician would like to learn about their abilities and difficulties in getting along with others; in clearly communicating their needs and intentions with words, gestures, and emotional signals; in reading and understanding other people; and in understanding and knowing themselves.

Regarding affiliation and attachment:

- Who are (and who have been) the important people in your life, in and outside the family? How enduring, consistent, deep, personal, and intimate have your close relationships been? Please describe the ongoing frequency, intensity, quality, and duration of your relationships with family and friends. Who initiates contact?
- How have your relationships been with coworkers and colleagues?
- How well do your family and friends know you? How would various family and friends describe your relationships? To what extent would your family and friends consider you to be easy to get along with versus "high maintenance"? Over what sorts of issues have you disagreed with family and friends? Have you experienced any significant estrangements?

Regarding social communication:

- How would you assess your ability to communicate in words and gestures? Do others have difficulty in understanding what you mean? How well do you read other people? Have you ever been accused of not understanding others' words, feelings, or emotions? Of being "clueless"?

Regarding perception and understanding of others:

- To what extent are you able to understand, imagine, and anticipate what others are thinking? How are you at reading other people's needs, emotions, and unspoken thoughts? What difficulties have you encountered in this area? Have you ever been accused of being insensitive to other people's thoughts and feelings? How often and in what circumstances have you been fooled, deceived, and blind-sided because you've missed important hints and clues in how others are thinking?
- How are you likely to be described by your...[mother, father, spouse, partner, employer, best friend]?
- How do you imagine that you come across to strangers when you first meet them?

Regarding perception and understanding of self:

- How and in what ways would you say you best understand yourself? Least understand yourself?
- In what aspects of your life do you consistently trip yourself up or surprise yourself? How do you account for these problems and events?
- What aspects of how you think or behave do you find perplexing? To what extent are you likely to hold yourself responsible versus tend to blame others for bad things that happen to you?

[a]Adapted from the National Institute of Mental Health.[4]

Table 5. Arousal/Regulatory Systems Domain Applied Into Clinical Psychiatric System: Vegetative Systems[a]

Arousal/Regulatory Systems: Systems Responsible for Generating Activation of Neural Systems as Appropriate for Various Contexts and Providing Appropriate Homeostatic Regulation of Such Systems as Energy Balance and Sleep	Clinical Psychiatric System: Vegetative Systems
Arousal: Arousal is a continuum of sensitivity of the organism to stimuli, both external and internal.	These systems activate and regulate mechanisms governing homeostatic regulation of energy balance, arousal, alertness, vigilance, energy, sleep, appetite, biorhythms, and associated processes.
Circadian rhythms: Circadian rhythms are endogenous self-sustaining oscillations that organize the timing of biological systems to optimize physiology and behavior and health.	Regarding clinical application, these functions constitute a psychiatric "system" of vegetative regulation. Assessing these systems includes questions regarding arousal and vigilance (hypo and hyper), sleep and its pathologies, and broader biological cycles affecting energy, feeding, sexual function, and other basic physiological systems. Manifestations of clinical strengths include good physiological health, balance, and capacity for endurance.
Sleep and wakefulness: Sleep and wakefulness are endogenous, recurring, behavioral states that reflect coordinated changes in the dynamic functional organization of the brain and that optimize physiology, behavior, and health. Homeostatic and circadian processes regulate the propensity for wakefulness and sleep.	**Potential overlap with *DSM-5* syndromes:** In addition to well-known primary disorders of sleep and arousal, diagnostic categories particularly affected by these processes range from dementias and primary brain disorders through mood (notably bipolar, seasonal affective, and premenstrual dysphoric disorders), anxiety, substance use, eating and weight-related, sexual, somatoform, and pain disorders. Also affected are patients with medical comorbidities, those receiving conventional and complementary medical therapies, and individuals impacted by a variety of environmentally dysregulating influences. In practice, although these issues are ubiquitous and many are likely to be touched upon in histories of present illness and general medical reviews, the Research Domain Criteria (RDoC) framework offers a useful checklist.
Clinical Inquiry	
This area can be introduced by informing patients that the clinician would like to learn about their abilities and difficulties with sleep and energy, keeping awake and alert, being inattentive or hypervigilant, and in maintaining normal biological rhythms of sleep, eating, and energy throughout the day and night.	
Regarding arousal, vigilance, and alertness • Do you have difficulties keeping awake at times? Please describe the circumstances, intensity, duration, and quality of your difficulties in staying alert. • Do you ever find yourself excessively jumpy and prone to startle? Please describe.	
Regarding chronobiology • Have you experienced difficulties in your daily or weekly or monthly or yearly rhythms affecting menses, sleep, energy, hunger, sex, or mood? To what extent are you usually able to sleep, work, and do other things on a regular schedule?	
Regarding sleep • Since sleep concerns are such common complaints in psychiatric practice, clinicians are generally attentive to both screening for and obtaining details about disrupted, deficient, and excessive sleep including patterns of diverse primary and secondary insomnias, nightmares, hypersomnias, and parasomnias; typical screening and follow-up questions need not be repeated here.	
Regarding appetite, eating, and weight • What concerns do you or anyone close to you have about your eating habits or weight?	
Regarding sexual functioning • What concerns do you or anyone close to you have about your sexual functioning?	
Regarding somatic symptoms and pain • What concerns do you or anyone close to you have about your experiencing pain? • What concerns do you or anyone close to you have about your physical functioning?	

[a]Adapted from the National Institute of Mental Health.[4]

factors that impact clinical presentations, clinical course, and responses to treatment. Such factors include strengths as well as deficits.

Initially, enriching *DSM* diagnoses by means of RDoC might be most easily accomplished by using a hybridized "multi-axial" clinical portrait appended to traditional *DSM* diagnostic criteria. The extent to which such modifications to usual diagnostic practices could impact how treatments might be individualized can be empirically determined. Illustrating this approach, in the analyses of adolescent depression by Henje Blom et al,[9] prominence is given to sustained threat and loss within the domain of negative valence, to physiological dysfunctions in the domain of arousal and regulatory systems, and to attention in the domain of cognitive systems. For these conditions, they also underscore the importance of processes for social system, in particular social communication and perception and understanding of self and others.[9]

Many aspects of RDoC address features directly reflected in conventional diagnoses based on the *DSM*. Characteristics of Negative Valence Systems constructs addressing fear, anxiety, responses to threat, loss, and the like are subsumed within usual diagnostic criteria. RDoC offers a more inclusive set of considerations, all of which might contribute to overall impairment and functioning in any given patient. Although we are mindful of not wishing to overburden already taxed clinicians, identifying these potentially contributing, modifying, and salient contextual factors adds a great deal of important information to unadorned *DSM* diagnoses. Simply identifying a patient as having "recurrent major depressive disorder (MDDR)" or "generalized anxiety disorder" conveys much less information than is required to formulate optimum treatment.

Accordingly, we see potential value in considering a "hybrid" diagnostic scheme, in which *DSM* diagnoses might be augmented in multiaxial fashion, each axis representing

Table 6. Clinical Application: Case Illustration of How Assessment Using a Clinical Psychiatric Systems Review Based on Research Domain Criteria (RDoC) Constructs Might Enrich Conventional Assessment, *DSM* Diagnoses, and Clinical Notes[a]

Case Description: A 55-year-old married, employed male patient assessed using conventional *DSM* diagnoses meets criteria for major depressive disorder, recurrent; posttraumatic stress disorder (PTSD) secondary to a significant motor vehicle accident; and concurrent alcohol use disorder (AUD), moderate, a not uncommon set of co-occurring conditions. Family history reveals mood and alcohol use disorder in various first-degree relatives. Social and developmental history reveals unremarkable childhood, graduation from high school with mediocre grades ("not a great student"), onset of depressive episodes and AUD in midteens, mostly steady work in construction, and 1 driving under the influence (DUI) charge. Married for 25 years with 3 children, he is described by his family as usually grumpy and grouchy, with a self-demeaning style, darkly blaming himself for his failures and seeing no chance of things getting better—but he just as easily finds others to blame including his parents, people in his family, his bosses, and larger social forces. In addition, he's described as holding grudges, a little "paranoid," rage-filled, bigoted, grumbling about everything, often threatening to hurt others or himself—particularly when he's been drinking. He has a few superficial work and drinking buddies but no deep, long-lasting relationships outside of his family. According to his family, he insists that he could stop drinking any time he wanted to but reiterates that he isn't really interested. He also worries a great deal about money, keeping his job, his health, and his family's well-being and safety. Mental status examination shows depressed mood without current suicidal thought, generally well-controlled anger with occasional loss of temper (no physical violence), hypervigilance regarding driving, preoccupations with nightmares related to the accident with generally poor sleep, difficulty with sustained attention, and spotty recent and remote memory, which he describes as chronic problems.

Case formulation to account for these findings includes biological dispositions for mood and AUD, chronically negative perspective, limited social supports, ongoing realistic life stressors and hassles, and the effects of acute motor vehicle accident while intoxicated.

Treatment planning for such a patient might ordinarily include attention to PTSD, mood, sleep, and AUD. To first moderate any potential impact of AUD on mood and anxiety, interventions to address AUD might be initiated, including alcohol counseling with referrals to Alcoholics Anonymous and the use of naltrexone if needed. To address PTSD, prazosin and a selective serotonin reuptake inhibitor might be initiated, with the patient also invited to participate in cognitive-behavioral therapy (CBT). To assist with sleep, sleep hygiene would be addressed, CBT-Insomnia might be offered, and, if necessary, adjunctive trazodone might be prescribed. These interventions would also be intended to benefit the patient's depressive condition.

How might systematic attention to RDoC domains and constructs add to this assessment, enhance diagnoses and case formulation, modify treatment planning, and translate into clinical documentation?

Although a thorough history and mental status examination might have previously uncovered all the information that follows, systematic assessment using RDoC constructs can help assure that certain clinical features are explicitly appraised that might otherwise be overlooked or underappreciated. In the table that follows, we illustrate what such a "review of systems" showing an expanded scheme to delineate each of the construct areas associated with each RDoC domain might look like in an electronic medical record.

Besides adding to the list of identified problems to be addressed in case formulation and treatment plan, RDoC-identified findings might augment the formulation by noting other elements contributing to this patient's vulnerability to mood, alcohol use, and sleep disorders and PTSD. Among others, for example, from the Threat Appraisal and Response system: chronic worries, unaddressed losses, low frustration tolerance, chronic consideration of suicide as a "way out," and failure to grieve; from the Drive and Effort system: multiple poor decisions, unrealistic about what he can accomplish, and intermittent gambling; from the Interpersonal and Reflective system: poor ability to trust, easily disturbed relationships, difficulties in communicating with and understanding others, and little introspective ability; and from the Vegetative system: chronic pain.

(continued)

an RDoC psychiatric system, with details provided by a series of brief narrative sentences, each concisely describing patient-specific salient information that might not have been captured in the *DSM* diagnoses, as well as by data from pertinent standardized measures. Specific issues can be characterized with regard to frequency, duration, and intensity. While we realize that narratives do not readily lend themselves to easy quantitative analyses, we can envision increasingly capable versions of natural language approaches to searching medical records such as those applied by McCoy et al,[20] mining big data systems in ways that could be usefully quantified.

An evolving hybrid diagnostic matrix might, for example, look something like this:

- *DSM-5* Diagnoses: MDDR, posttraumatic stress disorder, alcohol use disorders;
- Threat Appraisal and Response;
- Drives and Effort Allocation;
- Cognitive Systems;
- Interpersonal and Reflective Systems; and
- Vegetative Systems

The "psychiatric systems for clinical notes" section displayed in Table 6 illustrates one way in which collecting information for this approach might be operationalized and offers a very preliminary example of a hybrid diagnostic matrix. Ultimately, whether morphing *DSM* criteria with additional information derived from RDoC constructs will result in diagnostic entities best considered to be simple variations of original *DSM* diagnoses or better thought of as new "kinds" or "types" of diagnostic categories remains for future taxonomists to decide. These efforts will require large data sets containing information pertinent to antecedent, concurrent, and predictive validators to evaluate how various factors and clusters derived from traditional diagnostic criteria and RDoC constructs might combine to yield more powerful prognostic capacities regarding course, treatment responses, and outcomes.

IMPLICATIONS FOR CASE FORMULATION

Case formulations are intended to help account for how each major problem has evolved, with biological, developmental, psychological, and social roots, and how strengths can be mobilized, for example, all coming together to produce current findings and prospects for change. Systematic assessment of domain-associated psychiatric systems can expand conceptualization not only for diagnoses per se, but also for individualized problem lists.

Table 6 (continued). Clinical Application: Case Illustration of How Assessment Using a Clinical Psychiatric Systems Review Based on Research Domain Criteria (RDoC) Constructs Might Enrich Conventional Assessment, *DSM* Diagnoses, and Clinical Notes[a]

Psychiatric System	Constructs—Expanded	Issues
Threat Appraisal and Response	Threat appraisal (past/present/future, trauma)	Lifelong worrier; can't rely on himself, sees little support from others, reality-based chronic apprehension about medical, financial, housing, transportation status
	Responses to threat	Tends to both externalize and self-demean; chronically considers suicide as a "way out"
	Frustrations	Low frustration tolerance; hold grudges, chronically irritable
	Losses	Feels like a failure; numerous close family deaths never grieved
Drives and Effort Allocation	Motivations, values, and effort	He strongly values his family and, in theory, aspires to be a productive member of society; during periods of sobriety, good worker who wants to be able to support family; usually takes medications as instructed
	Decision-making and evaluation	Although he tries to be rational, he realizes that many of his reactions are emotional and impulsive, particularly when he's been drinking. Multiple poor decisions; unrealistic sense of how easy it would be to stop drinking
	Addictions, impulses, and habits	Alcoholic relapses, especially when depressed; intermittent gambling; pornography addiction
Cognitive Systems	• Attention • Perception • Declarative memory • Language • Cognitive control • Working memory	Even when sober, poor recent and spotty remote memory; has had ongoing difficulty with sustained attention (to which he attributes mediocre grades in school)
Interpersonal and Reflective Processes	Affiliation and attachment styles	Poor ability to trust; easily disturbed relationships; insecure avoidant attachments
	Social communication	Poor communicator; difficulty expressing himself verbally; tends to build up feelings and then explode
	Perception and understanding of others	Lacks empathy, clueless about other people's feelings; poor ability to mentalize
	Perception and understanding of self	Poor self-understanding; little ability to reflect
Vegetative Systems	Arousal, vigilance, and alertness	Often sluggish, daytime fatigue
	Rhythms and chronobiology	Irregular sleep pattern
	Sleep	Difficulties falling and staying asleep, intermittent nightmares
	Appetite, eating, and weight	Generally poor appetite and low weight, especially when drinking heavily
	Sexual functioning	Rarely has sex, but watches pornography
	Somatic functioning and pain	Multiple aches and chronic back pain

A hybrid *DSM-5*–RDoC psychiatric systems diagnostic matrix might more concisely summarize those issues that clinicians appraise to be most clinically pertinent. The abbreviated narrative statements below are provided simply as preliminary placeholders; with further experience, we anticipate that the field could develop more precise conventions for notating RDoC-related dimensional phenomena for each axis. Clinicians reviewing this diagnostic menu will find multiple ways of approaching the various symptoms and problem sets from biological, psychotherapeutic, and psychosocial vantage points.

- *DSM-5* Diagnoses: MDDR, PTSD, AUD (an extended list might include mild cognitive impairment, insomnia disorder, gambling disorder, pain disorder, and relationship difficulties and detail personality trait difficulties).
- Threat Appraisal and Response: Chronic worrier with significant internal and external stressors; low-grade suicidal thinking; low frustration tolerance; externalizer; unattended losses.
- Drives and Effort Allocation: Impulsive/emotional poor decision-making; alcohol relapses frequent; intermittent impulsive gambling.
- Cognitive Systems: Distracted, inattentive; poor recent memory, spotty remote memory.
- Interpersonal and Reflective Systems: Insecure avoidant attachment style, difficult relationships; little capacity to mentalize or reflect.
- Vegetative Systems: Chaotic sleep, nightmares; chronic pain.

[a]RDoC domains and constructs are based on the National Institute of Mental Health framework.[4]
Abbreviation: MDDR = major depressive disorder, recurrent.

APPLICATIONS FOR TREATMENT PLANNING

An RDoC-oriented review of systems might add to the problem list of possible therapeutic targets by including an array of developmental, psychological, and interpersonal processes and by highlighting potential patient strengths that might help in treatment and recovery. In turn, matrices of problem lists (derived from diagnoses and domains); clinicians' understanding of their genesis, prioritization, interrelations, and modifiability; and access to and feasibility of various options for intervention should guide treatment planning. In this fashion, in their work with adolescent depression, Henje Blom et al[9] offer a detailed treatment manual that employs RDoC-based matrices to organize and prioritize domain-associated pathogenic processes in hierarchical fashion, aligning each one with its respective treatment approaches in ways that maximize time efficiency, effort, and feasibility.[8]

At the least, attending to RDoC can help dispel any lingering illusions that we treat categorically isolated disorders. RDoC-enriched problem lists might enhance clinicians' abilities to conceptualize and precisely address the modifiable processes and mechanisms underlying and generating the arrays of signs, symptoms, problems, and impairments that bring patients to seek assistance. These perspectives highlight that risk, vulnerability, coping, resilience, and recovery are all dynamic processes, each approachable through various systems by means of biological treatments; psychological interventions to strengthen capacities for attachments, tolerating distress, and facing and coming to terms with traumas and losses; social supports; and wellness programs, promoting positive goals

and habits, and the like.[9] By contributing to patient-centered collaborative treatment discussions, systematic appraisal of RDoC systems could expand the array of potential targets for intervention. Who knows—in the future, we might anticipate treatment plans that are able to consider biological factors (eg, 5-HTTPR polymorphisms) to determine optimum psychotherapeutic interventions.[16] In addition, heralded by the preliminary work of McCoy et al,[20] as they are further refined and validated, biological and behavioral measures derived from assessment of RDoC constructs might serve as the basis of quality process and outcome measures.

IMPLICATION FOR CLINICAL NOTES

In a hybrid model that combines traditional documentation, *DSM-5* diagnoses, and RDoC, as described above and as illustrated in Table 6, we can envision routinely adding 5 RDoC "psychiatric systems" to the usual history of present illness, past psychiatric history, medical history, family history, and social history (development, finances, housing, relationships, education, occupation, and legal concerns). In clinical notes, the contracted form would address characteristics along these 5 themes.

Although considerable information addressing all the domains and constructs will be available, we appreciate that clinicians are likely to take the time to record only the most clinically salient features. We are mindful of the work burden on clinicians and the need to streamline systems for notation in real world practice. In practice, an electronic medical record section might list only the major systems, with each major system subheading appearing as a series of drop-down menus, with free text boxes permitting clinicians to describe pertinent findings. Check-boxes might note problems of particular concern requiring priority attention. Such problems might, in turn, automatically populate a treatment plan section.

CONCLUSIONS

The NIMH's RDoC project has stimulated considerable thinking regarding research approaches to important mental health concerns and has started to generate discussion regarding implications for clinical activities. We believe that the domains and constructs offer educators, trainees, and practitioners opportunities to freshly rethink several aspects of clinical assessment, diagnosis, case formulation, and treatment planning. Whereas the information obtained from RDoC-focused research might ultimately greatly refine diagnostic soundness via validated biomarkers, individually tailored treatment targets, and improved arrays of quality measures, translating RDoC constructs for clinical practice into psychiatric review of systems templates might enrich conventional assessment and contribute to more nuanced problem lists, diagnoses, formulations, and treatment plans.

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