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MISSED DIAGNOSES AND MISDIAGNOSES OF ENVIRONMENTAL TOXICANT EXPOSURE

The Psychiatry of Toxic Exposure and Multiple Chemical Sensitivity

David E. Hartman, PhD, ABPN

Exposure to industrial, environmental, botanical, or other potentially poisonous substances pose difficult diagnostic dilemmas for psychiatrists and other mental health professionals. Many patients suffering from diffuse nervous system impairments of toxic origin do not show focal signs of neurologic impairment, and may be diagnosed on the basis of subjective complaint, without taking into account toxic exposure history. For example, lead-based depression; anxiety and *erethism* from mercury exposure and *flu* in the context of low level carbon monoxide exposure are subjective complaints that are easily missed without careful assessment. They are easily *missed diagnoses* when toxic exposure mimics more commonly seen disorders.

Alternatively, there are also the misdiagnoses of toxic exposure—cases of claimed toxic poisoning, with complaints made "legitimate" by repeated medical case note reference or a pseudodiagnosis, i.e., multiple chemical sensitivity (MCS). This article gives examples from both types of diagnostic dilemmas—those disorders that are frequently *missed* and one disorder which is just as frequently *misdiagnosed* as an organic medical, rather than a functional psychiatric disorder.

CARBON MONOXIDE

Carbon monoxide exposure is one of the leading causes of the approximately 10,000 reported cases of poisoning each year in the United States. Of

From the Rush Presbyterian St. Luke's Hospital; and Chicago Medical School, Chicago, Illinois

these, about 3800 deaths per year result from CO exposure, 40% of which are accidental and 60% the result of suicide.[29] Carbon monoxide poisonings are frequently misdiagnosed or unrecognized, as they may mimic many other psychiatric and medical disorders.[21] CO poisoning may be especially common during the Winter when patients may use alternative heating sources. In one such study, 23.6% who exhibited flu-like symptoms had COHb levels above 10%.[9] General malaise, nausea, or cough related to CO intoxication may be misdiagnosed as viral or bacterial infection. Thousands of missed cases may occur every year.[19]

Chronic, low level CO exposure may produce gradual deterioration of cognitive and emotional function without accompanying unconsciousness. More severe carbon monoxide poisoning can be associated with a wide variety of psychiatric and neurologic complaints, including many that could be misdiagnosed as conversion-type problems, including depression, delirium, Parkinsonism, visual impairments, amnesia disorder, confabulation, and psychosis.[13] Inquiries with such patients should address types of heating systems used, home or work proximity to automobile or garage exhaust, whether new heating systems have been installed (possibly incorrectly) and where there is doubt, CO levels may be obtained.

LEAD

Although children are routinely screened for lead exposure prior to or during school entry, adult exposure to lead may occur in both industrial occupational settings, as well as among individuals who would not ordinarily be assumed to be at risk. Home rehabilitation carries a known risk of lead poisoning as 52% of all US residences contain old paint with lead levels above that which the Centers for Disease Control (CDC) considers dangerous.[4] Art conservators, ceramic artisans who use leaded glazes, and even drinkers of alcohol from leaded crystal decanters are at risk for lead poisoning. Port wine stored in one such decanter showed 89 μg/L of lead per liter initially, but rose to 5331 μg/L after 4 months. Brandy stored for 5 years in a similar decanter leached 21,500 μg/L liter of lead into solution.[1] Apple juice and infant formula appear equally capable of leaching lead from crystal, contraindicating their use for those purposes. Other hobbyists at risk for lead exposure include stained glass-makers, collectors or makers of lead figures (i.e., toy soldiers), oil painters who employ lead bases and users of firearms. Blood lead levels in runners who train in populated areas with heavy automobile traffic may be almost three times the level of runners who exercise in rural areas.[24]

Lead is associated with a variety of nonspecific psychiatric symptoms, the origin of which can be overlooked by virtue of their similarity to more conventional psychiatric disorders. For example, low-lead-exposure subjects report fatigue after work, sleepiness, depression, and apathy. Cognitive symptoms tend to be reported only in the higher exposure patients, who additionally complain of forgetfulness, sensorimotor problems, in addition to restlessness, apathy, and gastrointestinal complaint.[117] Organic (covalently bonded to carbon) lead, contained in leaded gasoline, solvents, or cleaning fluids produces psychiatric symptoms that include organic hallucinosis, psychosis, restlessness, nightmares, and impotence. In higher concentrations, organic lead exposure can induce delirium, convulsion, and coma.

MERCURY

Known and notorious for its quicksilver appearance, liquid state at room temperature and ostensible origin for the erratic behavior of Lewis Caroll's *Mad Hatter,* mercury exposure can produce diffuse brain injury and subsequent neuropsychiatric complaint. Mercury penetrates and damages the blood-brain barrier,[5] and accumulates in the brain, where it can produce direct structural damage. In general, disturbances in behavior and cognition are "the earliest signs of chronic mercury intoxication,"[12] and thus may precede other neurological effects. Exposures as seemingly innocuous as a broken mercury thermometer are capable of poisoning an entire family.[22]

Mercury exposure may be an obscure but underestimated source of hidden psychiatric illness. It is not widely known, for example, that mercury compounds and elemental mercury are sold over-the-counter in folk medicine *botanicas,* or stores that provide religious artifacts and herbs used by practitioners of *Santeria,* voodoo, or African deities and Catholic saints. Mercury is easy to purchase and buyers may carry it in a sealed, but easily broken capsule, containing up to 10 times more mercury than one thermometer.[25] Buyers are advised to sprinkle mercury in home or car, and occasionally even consume it in small quantities.[33] Signs of mercury intoxication, including headache, tremor, and anxiety among low income Hispanic or African patients presenting to public health clinics or emergency rooms may have their symptoms mistaken for functional psychiatric disorder unless sufferers are questioned by knowledgeable clinicians and appropriate toxicologic testing is conducted.

MULTIPLE CHEMICAL SENSITIVITY

Just as there are neurotoxic exposure symptoms that are frequently overlooked or misattributed to functional psychiatric disorders, the reverse situation is found in a functional psychiatric disorder that is misattributed to neurotoxic disease. The most well known of the latter is the disorder that has been termed MCS or *environmental illness.* Symptoms were outlined by Cullen[7] as being

1. Acquired in relation to documented environmental exposures, insults, or illnesses
2. Involving more than one organ system
3. Having symptoms that recur and abate in response to predictable stimuli
4. With symptoms are elicited by chemicals of diverse structure and toxicologic action
5. Symptoms elicited by demonstrable, albeit ultra-low-level exposure
6. Exposures are far below levels known to cause damage elicit symptoms
7. No single test explains symptoms

Although considered by its proponents to be of recent origin, and the understandable byproduct of an increasingly toxic environment, symptoms resembling MCS have been catalogued under different nomenclatures for at least a century, with equally mysterious explanations proposed for the symptoms. Consider, for example, the patients whose

> manifest illness [included] paraphasia . . . convergent squint, severe disturbances of vision, paralyses in the right upper and both lower

> extremities, or the patient who "would complain of the profound darkness in her head, of not being able to think, of becoming blind and deaf, later she lost her command of grammar and syntax . . . and became almost unintelligible."[11]

Many present-day clinicians, including the author, have seen claimed MCS patients reporting similar complaints, attributing their symptoms to a combination of a toxic environment and their own extreme sensitivity to that environment. The original patients described in the paragraph above did not have the benefit of MCS to describe their symptoms—they were Freud and Breuer's patients whose functional complaints laid the groundwork for *Studies on Hysteria*,[11] and who are described in those pages.

Somewhat later, Glenard attempted to place a more physiologic explanation on the phenomenon when he termed it *neuresthenia* in 1886.[14] Bouchard diagnosed the same symptom complex in 1894 as *autointoxication* because he believed that the disorder was caused by intestinal toxins that were produced at a faster rate than they could be detoxified by the liver and kidneys.[14] More recently proposed physiologic explanations for MCS have likewise failed to be supported, including claims of olfactory hypersensitivity[10] and toxin-induced limbic kindling. Both odors and imagined perception of odors have similar effects on EEG.[20] Therefore, EEG changes seen during odor perception may be emotionally or cognitively mediated, rather than neurotoxic.

Instead, most evidence points to psychologic rather than organic causation as the correct explanatory construct for MCS. First, the clear majority of MCS cases have no abnormal laboratory findings in any physical sphere. In Terr's[31] review of 50 litigating cases, 31 had no physical or laboratory abnormalities. Patients with MCS scored higher than controls on Symptom Checklist 90-Revised acute experience of somatization, obsessive–compulsiveness, depression, anxiety, phobic anxiety, and psychoticism, and produced higher scores on the Barsky Somatic Symptom Amplification Scale.[2] One sample found 75% of MCS patients met criteria for personality disorder, based on structured interview.[3]

Probably the most conclusive evidence for the ephemeral influence of actual toxic exposure on claimed MCS is the study conducted by Staudenmayer, Selner, and Buhr[30] who subjected claimed MCS patients to multiple double-blind chemical exposures, using substances to which patients reported sensitivity at concentrations and durations reported to induce symptoms (from 15 min to 2 h). Distinctive odors of certain substances were masked by a tolerated masking agent (i.e., peppermint, cinnamon, or anise). MCS patients distinguished actual chemical exposures at a pure chance level. No patient was discovered to have general chemical sensitivity. Moreover, when patients were confronted with their results and encouraged to enter psychotherapy, 75% gave up their MCS beliefs.[14]

Similar MCS symptoms also appear to be triggered by widely differing substances and belief systems. For example in Scandinavian countries, patients present to their physicians with the exact same symptoms, but believe they are caused by exposure to wires carrying electric current. Attribution of symptoms to MCS is virtually unknown but *electrical allergy* is widespread. Because of the failure to find hard physiologic correlates of MCS, the weight of evidence appears has persuaded "many traditional allergists and psychiatrists, [that] the onset of MCS is due almost entirely to psychological factors."[18]

There has been very little medical, psychiatric, or legal support for the inclusion of so-called MCS disorder as a scientifically legitimate injury sustained from toxic exposure. Psychiatrists and other mental health professional who might endorse or validate the syndrome as an organically based psychosomatic

syndrome should be aware that they will cast their professional reputations against well-regarded scientific studies and most reputable scientific organizations that have issued position papers that reject MCS as a scientifically valid disease state. The symptom complex is not considered to be a medical disorder by the National Research Council[23] and symptoms lack specificity as a clear medical syndrome.[6]

Nevertheless, MCS has active and vociferous proponents, including so-called *clinical ecologists* who have proposed certain ad hoc postulates that influence cause of MCS. William J. Rea, MD, a thoracic and cardiovascular surgeon, has been one of the leading proponents of MCS as an organic disease entity. He is author of a projected four volume treatise on the subject, the first book attempted to define disease parameters of MCS. Rea's postulates include a variety of statements that have not been subject to scientific scrutiny, including the belief that if "the sum of all pollutants in the body overloads the system" (then) chemical sensitivity can occur." Other hypotheses include the belief that low-level environmental pollutants can produce synergistic effects; that somatic adaptation and even *masking* of exposure symptoms are caused by "an induction of the immune and detoxification systems" and that the immune system is subject to *"stimulatory/withdrawal* reactions and depressive reactions *(bipolarity)* and *spreading* may occur, in which sensitivity may generalize both to new substances and new target end organs.[26]

A case study cited by Rea in *Volume 1*[26] of his treatise as demonstrating these phenomena is particularly disturbing in its superficial evaluation of case data and failure to consider explanations much more obvious and reasonable than *ad hoc* MCS-related symptoms. He outlines a case of a 24-year-old woman of whom little is known except that she was claimed to be "totally well" until her symptom development after leaving home for college.[26] As can be seen in Table 1, each of the obscure and unverified hypotheses propounded by Rea has a mundane and unremarkable (but more likely) rule-out, which was never subjected to scrutiny.

LITIGATION

Having their complaints validated by the litigation and financial compensation has a been a frequent concomitant of multiple chemical sensitivity claims and it is not infrequent for an MCS patient to present for evaluation expressly for the purpose of furthering litigation. Although MCS plaintiffs made initial inroads into court and worker's compensation systems, increased scientific scrutiny of the disorder has apparently turned the tide against MCS claimants. Currently most judges rule in favor of the defendants (i.e., against the MCS patient) because of failure of MCS plaintiffs and practitioners to establish a scientific claim that would meet *Daubert* criteria.[8]

DIAGNOSIS OF MCS

How can psychiatrists and other mental health professionals categorize patients with MCS complaints? Underlying nosology may be complex and may differ among individual patients, but there are clear mechanisms that explain most of the symptoms. Despite the claims of adherents, MCS appears to be a complex, multifactorial disorder, with significant influence of premorbid psychiatric make-up and somatization. Clinicians who evaluate such patients should

Table 1. REA'S EXAMPLE OF AN MCS CASE: WHY BELIEVE THE OBVIOUS WHEN THE OBSCURE WILL SUFFICE?

Symptom	Rea's Claim or Explanation	More Likely
	Totally well until left for university	Unverified
Weakness, diarrhea, rhinitis	Pollution overload	College overload, living in a dormitory environment
Energy vacillates during menstrual cycles	Bipolarity	Normal or PMS
Cystitis	Switch phenomenon	Having sex; honeymoon cystitis
Given tranquilizers and symptoms mostly disappear	Masking	Appropriately medicated for anxiety symptoms
Odor sensitivity	Pollution overload	Stress response; depression; panic attack
Goes to MCS Clinic with decrease in symptoms	Pollution load reduced	Much lower stress
Returns home to family who build her a special nontoxic room. Gets well.	Pollution load reduced	Return to family; lower stress; increased isolation from college and personal stressors

consider a full set of rule-out criteria for such disorders (Fig. 1). Categories of chemically sensitive patients include the following.

Hysterical or Somatoform Disorders

Patients in whom psychological symptoms are expressed as physical equivalents. Self-report (which notoriously underestimates past history variables) in one study suggested that 25% of MCS patients would have satisfied the criteria for somatization disorder prior to the development of their chemical sensitivity syndrome.[28]

Conditioning and Generalization

Conditioning and generalization of panic/arousal to certain odors or belief that toxicants are in the vicinity. Such patients often have histories of panic and anxiety disorder that predate alleged exposures. Bolla-Wilson et al[3a] describe several case studies where were exerienced in response to common environmental odorants, such as hair spray, perfume, gasoline, and cigarette smoke. Noting that MCS does not develop with odorless neurotoxins, the authors suggest that MCS symptoms develop as part of a Pavlovian conditioning paradigm. MCS develops when a chemical odor becomes a conditioned stimulus for the unconditioned stimulus (toxicant) after being paired with it. Subsequently, symptoms are produced by the odor alone. Symptoms are than generalized according to the same conditioning principles.

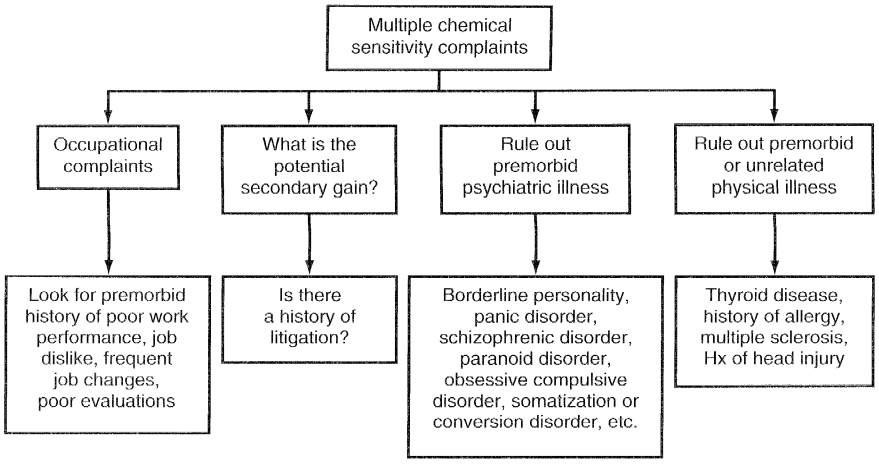

Figure 1. Common rule-out considerations for a patient with multiple chemical sensitivity complaints.

Iatrogenic

Symptoms are elicited, encouraged and supported by clinical ecologists, support groups and the *cult* of MCS. In this author's experience, patients who self-identify as being members of a group of chemically sensitive individuals show a "profound aversion to psychiatry"[14] and are rarely open, if not actually hostile, to psychosomatic explanations, psychiatric treatment, or behavioral "de-conditioning" of their responses. A recent Internet discussion was held about a patient making a claim to workers compensation. He had a normal physical examination but claimed to have sick building syndrome and refused to return to work. This author suggested that psychiatric examination and psychological testing should be considered to rule out influence of premorbid psychiatric history, present somatization and secondary gain, and that behavioral desensitization of phobic responses be considered if indicated. The same day, the author received an e-mail response from an individual who clearly felt threatened by the possibility that her own multiple and questionable diagnoses could have alternative causation:

> Your response may have created a new phobia: Fear of people like you who need to educate yourself *[sic]* on the dangers of pesticide exposure. After a bug spray exposure in 1985, I am totally disabled. I react to all petro-chemicals. I have sick building syndrome, chemical asthma, reactive airway disease, multiple chemical sensitivity, vocal cord dysfunction, etc. Your lack of understanding of the difficulties of living with these health problems is difficult for me to understand. This is 1997, not 1897.

Acceptors

Patients with a mixed group of psychiatric disorders who are told they have MCS and accept the diagnosis, often viewing it as less stigmatizing than a

psychiatric label. This author has seen patients with pre-MCS diagnoses or history of borderline personality disorder, chronic physical and sexual abuse, drug and alcohol abuse, and other significant psychopathology who have their symptoms newly attributed to MCS by a well-meaning or ideologically predisposed clinician. Having been so diagnosed, patients are either told or conclude by themselves that their premorbid symptoms (often inadequately described to clinicians) themselves demonstrate undiagnosed MCS.

PTSD equivalent

Some patients with predisposition to anxiety disorder may fear consequences of toxic poisoning (whether or not there is legitimate reason for such fear) and develop nightmares and associated panic reactions.

Secondary Gain

The prospect of emotional or financial benefit from the claim of multiple chemical sensitivity is formidable, especially compared with more prosaic or conventional psychiatric, allergic or medical illnesses. Just a few aspects of secondary gain are catalogued.

- MCS patients describe themselves in terms that emphasize their unique and sensitive nature (i.e., as a "canary in the coal mine" or as a Princess (or prince) detecting the pea).
- Other individuals must adjust their environments to suit the *disabled* MCS sufferer.
- MCS patients may cease work for *illness-related* reasons.
- Symptoms can be attributed to factors other than stress and psychologic maladjustment. MCS sufferers can (and frequently do) litigate to force financial compensation from government and from worksites they allege to have caused their "illness."
- MCS symptoms are temporarily relieved (but never cured) by expensive, spa-like environments that regressively cater to symptoms and administer placebo treatment.
- MCS is assumed to be incurable and the sufferer must demand special environmental conditions for the rest of the patients' life.
- If the sufferer simply had a "mental" illness, he or she would receive psychiatric treatment that would not be eligible for special status: either legally, morally, monetarily, and occupationally.

Case Examples

This author has seen many patients for evaluation with claims of MCS development. Diagnosis varied but no case of true multiple chemical sensitivity was found. Conditions that initiated and sustained symptoms differed, and actual toxic exposure likelihood ranged from impossible to credible. In one notable case, a 43-year-old woman who had already successfully litigated a workers compensation claim for MCS had initiated a lawsuit against the owner of a small framing shop, where she had been employed many years ago, for a period of 3 months. The patient claimed to have developed symptoms after assembling picture frames with solvent-based glues.

In the process of placing her mental state at issue in the lawsuit, the patient's psychiatric records became available, and showed an initial psychotic

break with hallucinations, delusions, and inpatient hospitalization that occurred several years before working at the frame shop. Since that initial break, the patient had experienced unrelated psychotic episodes both before and since working at the frame shop. Neuropsychologic test results were normal.

Interestingly, the patient also claimed to be chemically sensitive to perfume, so, with her permission, various perfumes were brought to an additional screening session, in an attempt to elicit abnormal behavior or cognitive function. Chemical sensitivity could not be elicited experimentally, even when a cotton ball saturated with perfume was held under the patient's nose. The patient's diagnosis after review was considered consistent with schizophrenia, paranoid subtype. It was not clear, however, whether the patient was litigating based on a delusional belief system, or if her motivation was related to the more mundane prospect of damage awards and increased financial compensation.

A very different type of case involved that of a 65-year-old woman who had documented toxic exposure effects as a result of likely exposure carbon monoxide from a faulty heater. Neuropsychologic examination was abnormal and considered consistent with CO-related brain injury. The patient also claimed what she was told was multiple chemical sensitivity, but which appeared to be panic-based aversion to hydrocarbon-based odors, similar to that described by Ryan, Morrow & Hodgson[27] as *cacosmia.* Panic-based symptoms were clearly evident as the patient also developed similar symptoms if she viewed a pesticide truck on the highway.

The patient was not litigating her injury and had not become affiliated with other self-identified MCS individuals or support groups. She expressed a clear wish to get well. Working diagnosis was panic attack and the patient was treated with biofeedback and desensitization. Her husband was independently counseled as he had responded to her fears by immediately removing his wife from feared situations, thus unwittingly reinforcing the validity of those fears. As a result, the patient's "chemical sensitivity" remitted within 3 months with no recurrence. Recovery from cognitive effects of carbon monoxide proved slower and eventually incomplete.

TREATMENT OF MCS

Clinicians who have applied physical "treatments" to MCS patients typically use a variety of physical, dietary, and drug-related approaches. Individuals who visit a chemical sensitivity treatment clinic, for example, may be subjected to complex blood screening measures, as well as dietary and environmental restrictions that limit stress and promote both relaxation and regression. The efficacy of these treatments comes at the service of the placebo effect and misattribution and this author has seen several individuals who, having spent a week in a such a pristine, spa-like chemical sensitivity clinic, are thrown back into a noisy, odorous, chaotic airport, only to have their symptoms return. They are then encouraged to attribute symptom exacerbation, not to stress response, but as a result of their return to a "toxic world."

Physical treatment may have a powerful placebo effect but little validity from the standpoint of eliminating psychiatric symptoms as a function of toxic body burden. In a recent study, for example, patients claiming a variety of symptoms as a result of dental amalgam exposure, were subjected to a double blind, randomized and placebo-controlled trial of chelation (Chemet, succimer [McNeill PPC, Fort Washington, PA]) treatment.[15] Placebo capsules were indistinguishable from active ingredient pills. While chelation was effective in enhancing

urinary excretion of mercury and lead, there was no difference between degree of rated psychologic improvement among patients who had received chelation treatment versus those who had been administered the placebo. The authors suggest the possibility that "certain patients with environmental illness are particularly likely to exhibit a substantial placebo effect."

In patients who are not already convinced that their disorder is owing solely to toxic damage from a physical agent, behavioral deconditioning of symptoms can be effective and successful. Often deconditioning is paired with an explanation that encompasses some aspects of the patient's world view. In several recent cases treated by this author, for example, the patient's symptoms were likened to a nervous system "alarm" of high sensitivity but little specificity. The analogy to an overly sensitive smoke detector was made—with an alarm that went off for real fires, but also for a single cigarette, a burning match, a cooking odor, or other conditions that would not pose immediate danger. The patient was then asked whether they would benefit from the possibility of fine-tuning that alarm system to respond more accurately—with a danger signal to true risk situations, while remaining silent when there was no actual risk of toxic damage. Patients who agreed that such a condition would be beneficial were found to be receptive candidates for subsequent behavioral approaches.[16] The use of biofeedback, which clearly depicts autonomic arousal sequelae (i.e., peripheral temperature drop, muscle activity), can provide significant motivation in patients who wish to reset their internal "alarm."

CONCLUSION

There are diagnostic dilemmas in psychiatry that cannot be easily resolved by a trip to the pages of DSM–IV. Exposure to a variety of neurotoxicants at work or in the home environment can elicit a nonspecific symptom profile that is frequently mistaken for primary psychiatric illness. Alternatively, there are functional psychiatric states where patients resolutely insist on strict unifactorial organic causation but that are either functional or else deliberately manufactured for secondary gain. Diagnostic work-up of either group requires a thorough psychiatric history, knowledge of home and work exposure conditions, a familiarity with subtle effects of common neurotoxicants as well as experience handling cases of somatization and secondary gain. Accurate diagnosis in the case of neurotoxic exposure may prevent lasting brain injury and save lives. Sensitive handling of claimed MCS cases may allow such patients to receive useful treatment and resume normal productive existence; rescuing them from the dustbin of pseudoscience, iatrogenic illness, and ineffective or harmful placebo treatment.

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Address reprint requests to
David Hartman, PhD, ABPN
401 E. Illinois Street, Suite 320
Chicago, IL 60611