Mary Terrell White, "Diagnosing PVS and Minimally Conscious State: The Role of Tacit Knowledge and Intuition," *The Journal of Clinical Ethics* 17, no. 1 (Spring 2006): 62-71.

Diagnosing PVS and Minimally Conscious State: The Role of Tacit Knowledge and Intuition

Mary Terrell White

Mary Terrell White, PhD, is an Associate Professor in the Boonshoft School of Medicine at Wright State University in Dayton, Ohio, *mary.t.white@wright.edu.*

INTRODUCTION: THE CASE OF TERRI SCHIAVO

Diagnosis of the cognitive capacity of profoundly brain-injured patients is frequently ambiguous and subject to change, potentially leading to charges of diagnostic error, patient mismanagement, and conflicts between family members, healthcare personnel, and the courts. This has been vividly illustrated in the case of Terri Schiavo, a young Florida resident who died a year ago, 15 years after the night her heart temporarily stopped beating. In 1990, Ms. Schiavo suffered cardiac arrest, possibly due to a potassium imbalance, which left her with significant brain impairment. She was diagnosed as in a persistent vegetative state and placed in a nursing home, where she received food and hydration artificially, as she could not swallow. In 1998, her husband, Michael Schiavo, first petitioned a Florida court to determine whether the tube feeding could be withdrawn. While the judge ruled in his favor, Ms. Schiavo's parents objected and appealed the judge's decision. For patients in a persistent or permanent vegetative state, withdrawal of life supports may be permitted as long as there is clear and convincing evidence that is what the patient would want, and which Mr. Schiavo claimed he had. But Ms. Schiavo's parents were not ready to give up hope, perhaps responding to the spontaneous movements she continued to make.

In the years that followed, the conflict between Mr. Schiavo and his wife's parents continued in the courts, Mr. Schiavo pressing for the right to withdraw treatment, Ms. Schiavo's parents claiming she possessed residual consciousness and with proper therapy could improve. Even though the judges consistently ruled that Ms. Schiavo was in a persistent vegetative state, the conflict eventually led to intervention by the Florida legislature and governor to maintain her life supports through a hastily written law that ordered the reinsertion of her feeding tube. The Florida Supreme Court ruled the law unconstitutional a year later. Then, in early 2005, after the U.S. Supreme Court declined to hear the case, a trial court judge ordered that the feeding tube be removed in 30 days. Two days after the tube was removed, a few U.S. senators, acting on behalf of the entire Senate, passed a law entitling a U.S. District Court in Florida to hear the case again. This legislation was approved by a majority of the House of Representatives and signed by the President of the United States. The following day, a U.S. District Court judge denied the parents' request for a restraining order that would mandate the reinsertion of the tube. Ms Schiavo died 31 March 2005.[1]

This case raises many questions, perhaps most provocatively having to do with the proper role of state and federal legislatures in medical decision making. The current political climate has also made it difficult to separate the case from the political agendas of some of the players involved. Nonetheless, Terri Schiavo's ordeal raises legitimate questions of how cognitive capacity is assessed in severely brain-injured patients and how accurate such diagnoses can be. Clearly, misdiagnoses may result in denial of appropriate care. In this discussion, I propose that an additional, if unorthodox, approach to cognitive assessment may improve diagnostic accuracy. Following a brief review of the clinical criteria for persistent vegetative state and minimally conscious state, I examine the incidence and sources of error in diagnosing cognitive capacity in brain-injured patients. I then propose that other kinds of knowledge, namely tacit knowledge and intuition, may provide valuable diagnostic evidence, and conclude by outlining steps necessary to integrate these forms of knowledge into current practices. I focus exclusively on the diagnostic process; I do not address moral questions involving the rights or interests of persons in a minimally conscious or persistent vegetative state, or whether severely brain-injured patients are owed any specific forms of treatment.

DIAGNOSIS OF PVS

At present, the diagnosis of persistent vegetative state (PVS) is made primarily by clinical observation, drawing on a number of neurological and behavioral factors. Functional neuroimaging via PET (positron emission tomography) and fMRI (functional magnetic resonance imaging) may offer confirmation of residual brain function, but at present, these technologies are too complex and their interpretation too uncertain for them to be routinely used in cognitive assessments of profoundly brain-injured patients.[2] Until these or other diagnostic technologies are better developed and understood, physicians will rely on their clinical judgment in assessing the cognitive capacity of severely brain-injured patients.

The current clinical guidelines for the diagnosis of PVS were established in 1994 by a Multi-Society Task Force comprised of a range of experts from diverse medical specialties. In these guidelines, the vegetative state is defined as,

> a clinical condition of complete unawareness of the self and the environment, accompanied by sleep-wake cycles with either complete or partial preservation of hypothalamic and brain-stem autonomic functions. The condition may be transient, marking a stage in the recovery from severe acute or chronic brain damage, or permanent, as a consequence of the failure to recover from such injuries. The vegetative state can also occur as a result of the relentless progression of degenerative or metabolic neurological diseases or from developmental malformations of the nervous system.[3]

Diagnosis is usually made after a person is in a vegetative state for a month, regardless of whether the cause of brain injury is acute traumatic or non-traumatic brain injury, neurodegenerative disease, a metabolic disorder, or congenital malformation. Diagnosis is based primarily on the following criteria.

1. No evidence of awareness of self or environment and an inability to interact with others.
2. No evidence of sustained, reproducible, purposeful, or voluntary behavioral responses to visual, auditory, tactile, or noxious stimuli.
3. No evidence of language comprehension or expression.
4. Intermittent wakefulness manifested by the presence of sleep-wake cycles.
5. Sufficiently preserved hypothalamic and brain stem autonomic functions to permit survival with medical and nursing care.
6. Bowel and bladder incontinence.
7. Variably preserved cranial-nerve reflexes (pupillary, oculocephalic, corneal, vestib-ulo-ocular, and gag) and spinal reflexes.[4]

The most distinguishing characteristic of PVS patients is the presence of sleep-wake cycles coupled with a seeming lack of any degree of self-awareness, awareness of environment, response to stimuli, or intentional behavior. Patients in this condition may move their limbs and occasionally smile, cry, or scream, but their movements and vocalizations appear to be meaningless. Some patients have startle responses; these appear to be reflexive responses to external stimuli rather than prompted by conscious awareness. Patients in this condition also do not track objects with their eyes or react to threatening gestures. An early sign of recovery from PVS is that the eyes begin to track.[5]

DIAGNOSIS OF MINIMALLY CONSCIOUS STATE

The minimally conscious state (MCS) is distinguishable from PVS by evidence that a patient possesses some degree of self-awareness, ability to act volitionally, and awareness of the environment. The presence of one or more of the following behaviors is considered evidence of minimal consciousness.

1. Following simple commands
2. Gestural or verbal yes/no responses (regardless of accuracy)
3. Intelligible verbalization
4. Purposeful behavior, including movements or affective behaviors that occur in contingent relation to relevant environmental stimuli and are not due to reflexive activity. Some examples of qualifying purposive behavior include:
    - Appropriate smiling or crying in response to the linguistic or visual content of emotional but not to neutral topics or stimuli,
    - Vocalizations or gestures that occur in direct response to the linguistic content of questions,
    - Reaching for objects that demonstrates a clear relation between object location and direction of reach,
    - Touching and holding objects in a manner that accommodates the size and shape of the object,
    - Pursuit eye movement or sustained fixation that occurs in direct response to moving or salient stimuli.[6]

These behaviors may be inconsistent but must be reproducible or sustained long enough to be considered indicative of cognition, not just random or reflexive behavior. For some minimally conscious patients, sensory deficits or motor dysfunction may limit their responsiveness such that evidence of consciousness may be overlooked or may take additional time to be observed.

DIAGNOSTIC AMBIGUITY AND RATES OF ERROR

Several studies suggest that errors may be made in diagnosis of PVS such that some patients diagnosed as vegetative may in fact possess some minimal degree of consciousness or awareness. This is not surprising, for patients for whom improvement is possible, changes may be so minimal or gradual they may not immediately be detected. In one study, 193 severely brain-injured patients admitted for in-patient neurorehabilitation in a Texas facility were reviewed for diagnostic accuracy; 49 of the patients carried a pre-admission diagnosis of PVS or coma after more than one month post injury. The patients' ages ranged from 11 to 62, with an average age of 28; gender distribution was roughly equivalent. Of these 49 patients, 18 (37 percent) received a change in diagnosis at the time of admission or shortly thereafter. Of these 18, 50 percent were recognized as possessing some degree of awareness the first day. Of the patients whose brain injuries were trauma-induced, 41 percent (14 of 34) were found to have been diagnosed inaccurately prior to admission. Misdiagnosis was more likely in patients who were over three months post-injury (48 percent, or 11 of 23), than those who were only one to three months post-injury (27 percent, or three of 11). Of patients whose brain injuries were due to non-traumatic circumstances, 27 percent (four of 15) were misdiagnosed. The time elapsed since the injury was not significant for this group.[7]

The authors of this above study suspect that part of the reason for the frequent misdiagnosis is the ambiguity of the language used to describe variations and changes in levels of consciousness that could lead to interchanging diagnoses of coma with PVS. Moreover, the various scales used to classify cognitive capacity are not consistent, and none is considered to be a "gold standard." The authors of the study also noted that discrepancies in diagnosis may be due to lack of careful, extended observation, especially as improvements in cognitive capacity can be slow in coming, erratic, and very difficult to discern.

A second study conducted at a rehabilitation center in London examined 97 adult patients admitted for severe brain damage; 40 of these patients were diagnosed as in PVS due to acute-onset brain damage. Of these, 43 percent (17) were found to be misdiagnosed on admission, including seven who had been considered vegetative for over a year. Of the remaining 23 patients, 25 percent (10) remained vegetative, and 33 percent (13) slowly gained minimal degrees of function over the course of the rehabilitation period. The main methods of assessing awareness were the ability to follow a simple command to press a buzzer switch or to look at a named object. Evidence of cognitive function was confirmed by at least two members of the medical team.[8]

Of the 17 patients who had been misdiagnosed, 10 suffered from traumatic brain damage, four from anoxia, two from vascular causes, and one from encephalitis. No limits were placed on the time elapsed since the brain damage. Of note in this study is that all of the misdiagnosed patients suffered from severe physical disabilities, 11 being blind or severely visually impaired. These deficits may well have diminished their responsiveness, further complicating the diagnostic process.[9]

Lastly, a study of patients with Alzheimer's disease sought to determine whether the diagnostic criteria for PVS could be applied to these patients;[10] 12 patients with advanced Alzheimer's disease were evaluated by three neurologists on two occasions, two months apart. Diagnostic criteria included the criteria for PVS developed by the Multi-Society Task Force, several tests of cognitive function, and an interview with a staff nurse who knew the patients well. No consistency was found between the positive findings of the three neurologists; moreover, some physicians changed their initial diagnoses at the second visit. The diagnostic discrepancies were explained as likely due to subjective factors as well as patients' fluctuating cognitive status, limited time available to neurologists, and dismissal of staff reports of responsiveness. The authors conclude that, given this disagreement, it is likely that Alzheimer's disease only rarely progresses to the point of PVS.

SOURCES OF ERROR

Changes in status are to be expected among the severely brain damaged, particularly in the first months after traumatic brain injury. Some degree of recovery is possible even after one year in PVS. In general, the younger the person is, the greater the likelihood of recovery. Recovery is also more likely if the cause of brain injury is traumatic rather than nontraumatic.[11] Thus, some changes in diagnosis should be assumed as reflecting accurate observations. However, that so many patients in these studies were found to be misdiagnosed long after their injuries suggests that diagnosis of PVS is prone to error.

Some errors may be due to confusion in terminology. As was noted in one of the studies, "the medical and legal literature does not fully adhere to the distinction between coma and PVS and frequently uses the terms interchangeably."[12] Even more problematically, we lack a consensual definition of consciousness or language with which to describe it. The terms *consciousness* and *awareness* may be used either synonymously or to refer to distinctly different states of being, while *arousal, orienting, alertness,* and *wakefulness* are frequently used interchangeably to describe various stages between sleep and wakefulness.[13]

Part of the problem may also be the kinds of tests used to establish consciousness. Many of the tests for MCS seem to assume that the patient both wishes to respond (that is, is not apathetic or depressed) and is able to hear and see. These expectations may be unrealistic, setting the bar too high. For example, the tests used in the British study — of following commands to press a switch or to look at particular objects — imply

or assume that brain injury has not affected volitional movement, hearing, or sight. Most of the patients wrongly diagnosed as PVS in this study were discovered to be blind.[14]

Errors in clinical judgment are another source of error. It is common knowledge that medical judgments are influenced by various heuristic strategies common to cognition. While these heuristic devices enable rapid decision making, they may lead to biased diagnosis. A few heuristics relevant to diagnoses of PVS include the following. *Confirmation bias*: a tendency to look for evidence that can support (or "confirm") a diagnosis, rather than evidence that refutes it. *Diagnosis momentum:* once a diagnosis is made and associated with a patient, with time, it becomes more and more difficult to change it. *Overconfidence bias*: a tendency to think we know more than we do, leading us to act on incomplete information; it can also lead us to place our faith in opinion rather than evidence. *Premature closure*: a tendency to accept a diagnosis as valid before fully verified, as in the maxim, "When the diagnosis is made, the thinking stops."[15]

Perhaps needless to say, diagnostic error may also result from the influence of unconscious emotional reactions. The physician who thinks he would rather die than have his or her life prolonged in a PVS or MSC may be more willing to establish grounds for withholding care, while the physician who believes life is a good to be preserved at all costs may be reluctant to concede that a patient is likely to be permanently vegetative. The strength of this sort of emotional influence, however, is difficult to verify. Finally, as Childs, Mercer, and Childs note, errors may result from

> a lack of extended observation for behavioral evidence of cognitive awareness by qualified personnel. Changes may be "slow and subtle, involving increasing consistency of responses which may initially appear random or coincidental." . . . Responses in these low-level patients are typically erratic, and health care providers may discount the reports of responses seen by family members or other caregivers. If untutored in assessment of consciousness, the physician examining the patient briefly on rounds may not see signs of awareness.[16]

Clearly, part of the problem in diagnosing the cognitive capacity of severely brain-injured patients is that volitional behaviors may be very subtle and sporadic. Physicians who only have time for a brief exam may not see these behaviors, and yet they alone are responsible for making diagnoses. But if some degree of consciousness remains in some patients, how can that consciousness be perceived, by whom, and how can that information be integrated into the diagnostic process?

SOURCES OF EXPERTISE: TACIT KNOWLEDGE AND INTUITION

While rarely taken seriously as medical authorities, family members and caregivers who are present with patients for continuous periods of time are obvious potential sources of patient information. Like Terri Schiavo's parents, they often claim to be able to interpret brain-injured patients' behaviors when strangers to the patient only see random activity. For example, in a study of 13 children diagnosed as in a PVS, 82 percent of parents (12 of 13 cases) felt their children could recognize their voices, and 62 percent of parents (eight cases) felt the children could make their likes and dislikes known.[17] But, as noted in this study and studies cited above, physicians tend to discount the testimony of family members and nursing staff, under the assumption that their perceptions will be distorted by their attachments to the patient.[18]

Families and caregivers may gain some standing if they are recognized as possessing valid expertise germane to the diagnosis. But in what ways can family members be considered medical experts? Physicians undergo years of study to learn to detect and interpret symptoms of diverse diseases in a broad range of patients. By contrast, the expertise family and caregivers have is at best limited to behavioral observations of a single patient. This is not generalizable knowledge, but subjective interpretations of very small gestures that may be meaningful only to persons intimate with the patient. Since these behavioral responses may be difficult to identify or describe to others who are less familiar with the patient, they are difficult to confirm and easy to dismiss. In what follows, I propose that people with intimate knowledge of a particular indi-

vidual also possess a kind of expertise that may be helpful when caring for patients who cannot speak for themselves.

This expertise is not something most of us are aware we possess; rather, it is a subconscious form of knowledge, born of experience, enabling one person to understand another, based on the smallest of cues. This kind of knowledge was described by Polanyi, a scientist and philosopher, as "subsidiary awareness" or "tacit knowledge."[19] He uses the example of a face to illustrate his point. How do we recognize a face? We can only hint at the features of the face through language, and yet we can unerringly recognize a face we know in a crowd. Similarly, we can recognize a person's mood from the expression on her or his face, but we usually cannot verbally identify or describe all the cues that lead us to our conclusions. Some features are very subtle or elude description, such that it is impossible to articulate how it is exactly that we make our judgments. Yet, without knowing how, we recognize and respond to these cues. This ability is what leads Polanyi to claim, "We know more than we can tell."[20]

Our subsidiary awareness emerges primarily from our experiences as physical beings, which is informed through our senses. What we see, hear, smell, touch, and taste, all provide information that we may not consciously assimilate, but that plays a significant role in how we respond to our circumstances or environment. The cues we pick up from someone with whom we are in conversation tell us a lot about the person and how we might most effectively respond. "Street smarts" help those who have them navigate complex neighborhoods safely. Those who are attuned to the subtleties of animal behaviors can work with them more successfully than those who are not. But we are not neutral recipients of sensory input. What we perceive and how we interpret sensory stimuli are shaped by our cultural environments. Whether and how we look into someone's eyes can mean different things, depending on the circumstances, social rank, and cultural context of the people involved. How dangerous a neighborhood is perceived to be depends on one's familiarity with its inhabitants and their customs. The degree to which a person is sensitive to animals will be dependent on the kinds of capacities they believe animals possess. In other words, how we perceive and respond to stimuli is dependent on the values we bring to our interpretation.[21]

We tend to think of knowledge as information we can communicate to others. But tacit knowledge, by definition, is knowledge we usually do not verbalize because we are not aware we have it. For example, in the medical arena, Polanyi observes that physicians cannot identify or describe many of the cues they take in when they diagnose disease. Although they can identify a disease by its typical appearance, they cannot describe it completely because they are unaware of a great deal of the subsidiary information on which they rely. As a result, these details are not included in standard descriptions of disease.[22] Undoubtedly part of the reason disease cannot be fully described is because the concept of disease is itself culturally constructed — the models, categories, and language we use to describe disease shapes and limits the kinds of questions that physicians ask, as well as the details to which they attend. Indeed, as we have seen above, the limitations of language, the difficulty of distinguishing between terms such as "consciousness" and "awareness," or "alertness" and "wakefulness," may impede accurate diagnosis of brain-injured patients. But despite their inability to fully describe it, experienced physicians draw on their tacit knowledge routinely. This level of skill and understanding is sometimes referred to as the "art" of medicine.

Polanyi cites several experiments to illustrate that tacit knowledge is both learned and influences our behaviors. In one of these, a person experienced a slight shock whenever he uttered certain words. After a time, the person subconsciously learned to avoid saying those words. However, when questioned afterwards, he could not say that he was aware that he had done so. In developing his tacit knowledge, by learning how to avoid being shocked, he was drawing on what Polanyi calls "subception," or "learning without awareness."[23] That people can learn without awareness has been supported by more-recent research in neuroscience. In one such experiment, subjects were given four decks of cards and asked to flip the cards in a way that would maximize profits of play money. The subjects were fitted with sensors that measured skin conductance responses (SCRs), while the decks of cards, unbeknownst to the subjects, were rigged. After subjects turned about 10 cards, the sensors began to register anticipatory SCRs when they reached for a losing deck. But subjects needed to turn about 50 cards before they could verbalize hunches that two of the decks

were "riskier" than the others, and they needed to flip 30 more cards before they could explain why their hunch was correct. Yet their bodies, through their senses, had registered a pattern long before the subjects were conscious of it.[24] These and related studies suggest that people are adept at perceiving patterns and at storing data in ways that permit a pattern to be recognized and behavioral responses to be elicited, even when they are unaware that this is happening. This ability to unconsciously perceive and respond to patterns of cues potentially offers a new source of diagnostic information for the severely brain-injured patients. Conceivably, some people who are very familiar with these individuals will be sensitive to any cues or patterns that are exhibited by the patient. Their intuition as to the patient's condition, based in part on their emotional responses to the patient, may constitute valid insights into the patient's condition. But how reliable can such claims be? How can such hunches be verified?

Gary Klein, a cognitive psychologist who has devoted his career to studying decision making, claims the ability to recognize patterns is what constitutes intuition. Klein has studied the role of intuition in decision making by experienced firefighters, military personnel, commercial pilots, and business executives. He has found that in the heat of battle or during a fire, experts do not analyze the risks and benefits of several options prior to making a decision; instead, they choose a single course of action that seems to them to be "good enough." They then run a mental simulation based on an assumed model of the problem, and revise the decision, if necessary. Based on this research, Klein concludes that intuitive judgments involve several steps: (1) perception of cues leads to recognition of a pattern; (2) pattern recognition signals a potential course of action or response; (3) the potential response is assessed and modified using a mental simulation based on a mental model of the problem, which is followed by an action.[25] All of this can happen so fast that sometimes decision makers are not even aware of making a choice — they just act. Even in retrospect, they may not be able to articulate why they made the decision they did.

Klein illustrates how intuition can effectively guide medical decisions with a case involving a neonate. In this case, an experienced neonatal intensive care nurse and a novice were both looking after a newborn infant. One day, the novice noticed that the infant was a bit lethargic, found her temperature a little low, and saw that a routine needlestick had left a little blood at the site. But none of these findings caused her any worry, as all were within range of normal. By contrast, when the experienced nurse arrived, she had a gut feeling the baby "looked funny," noticed that the heel stick was still bleeding, that the baby's flesh was a little mottled, and that her belly was slightly rounded. When she found that the baby's temperature had fallen constantly over the course of the previous shift, she instantly realized the baby was battling a serious infection, called the physician, and saved the baby's life. In this example, both nurses had noticed essentially the same set of symptoms, but the experienced nurse saw additional, very subtle cues, and recognized the totality as a pattern that indicated infection was probably present. Her expertise, which included her tacit knowledge of patterns, enabled her to draw the conclusion that the less experienced person missed.[26]

Klein concludes that intuition is developed through a person's accumulated experience in which similar constellations of cues are commonly associated. When one or more cues are present, an experienced person can infer that the others are likely to be also. With time and experience, it becomes possible to quickly recognize patterns of cues that suggest what to expect, what goals to anticipate, and what actions are required. In this way, Klein claims that pattern recognition, understood as intuition, is a valid and valuable source of information.[27]

TACIT KNOWLEDGE IN DIAGNOSIS OF PVS/MCS

As described by Polanyi and Klein, both tacit knowledge and intuition rely on subconscious pattern recognition, a skill that is derived through experience. While Klein focuses on professional expertise in a narrow range of decisions, Polanyi's tacit information is something we all possess and use in the most ordinary of activities. Both rely on experience in the form of stored data patterns. With regard to patients diagnosed with PVS or MCS, physicians clearly have specialized knowledge, experience, and clear mental models of the pathology of the injury, which will, in some cases, permit them to make the kind of intuitive

judgments Klein describes. But astute family members and caregivers may also be considered to be experts if they have prolonged experience with a particular patient. If they are sensitive to the patient's needs, they will have tacit knowledge of the patient's patterns: how the patient reacts when touched, when bathed, when moved, or when spoken to. They will sense if a smile or a grimace is spontaneous or made in response to an external event, or if the patient's mood shifts in the presence of certain people. They will know the patient's likes and dislikes — if there are any — and whether certain music, tastes, or types of touch are pleasurable or not. And they will know when the patient is so injured that no signs of awareness are evident.

If one accepts tacit knowledge and pattern recognition as valid sources of information, when family members and caregivers voice their belief that their loved one is responsive, one may consider that they may be correct. But how can their perceptions be incorporated into the diagnostic process? Without knowing more about the sources and validity of tacit knowledge, it is reasonable only to ask that the healthcare team recognize that when dealing with cognitively impaired patients, the perceptions of family and caregivers may be valid. Even if they do not volunteer it, caregivers should be asked for their impressions of the patient and what they think the patient is experiencing. If a patient is claimed to be in any way responsive, physicians should proceed with a more careful and refined assessment. In this process, physicians may wish to spend more time with the patient, ask the caregivers to show them what they are observing, and explore more sensitive means of assessing the patient's cognitive capacities. They may or may not change their conclusions as a result, but will have at least made an effort to use all the information at their disposal. In addition to improving diagnostic accuracy, the benefits may include greater respect and trust between the medical staff and family and a willingness on the part of the family to accept the diagnosis once it is made.

But if this sounds relatively simple, in practice it may not be. Physicians may be reluctant to accept that family members have significant information to offer or assume that caregivers' perceptions are influenced by their emotional attachments. Even if the physician is open to family input, he or she may not be present when the patient is responsive, may lack the experience to understand the patient's behaviors, or may fail to appreciate that very small signals can be behaviorally meaningful. If caregivers cannot put into words the cues that inform their intuitions or show others what they are seeing, they may have difficulty convincing others of their perceptions. Moreover, some family members may not be sufficiently attuned to the patient to have this knowledge, or their hopes and fears may indeed be shaping their perceptions. Part of the job of the healthcare team is to become sufficiently acquainted with each family to gain a sense of whether their contributions would be significant and when not.

Klein observes that the use of intuition in the workplace may also be impeded by institutional and environmental characteristics. These include organizational policies that restrict individual decision making, rapid turnover of personnel that limits the development of expertise, the pace of change in many environments, excessive reliance on procedures that reduce perceptions of more subtle cues and nuances, and increasing use of information technologies such that humans are being taken out of the decision-making process.[28] Each of these factors is a reality in modern medical practice, and may further limit opportunities for incorporating tacit knowledge in cognitive assessments of brain-injured patients.

Despite the interpersonal and institutional challenges to incorporating tacit knowledge in the diagnostic process, the anguish caused by diagnostic ambiguity and error is too great to ignore. Recognizing tacit knowledge and intuition as important sources of insight offers a possible approach toward alleviating some of the uncertainty and emotional distress that surrounds these patients and their families. When family members say, "I know she knows when I am here," "I know he is trying to communicate," or "I believe she is hungry and in pain," physicians should realize that these remarks may signal a need for further assessment, as well as the need to help the family accept that the person they knew is most likely gone forever. While many physicians may feel that attending to elusive or imperceptible cues claimed by nonmedical professionals is a waste of time, sincere attention to perceptions of family members may nonetheless contribute positively to the family's grieving process and their sense that everything possible has been done. Given the protracted legal battles that may ensue if a diagnosis cannot be satisfactorily established, this gesture alone

may be well worth the time and effort.

CONCLUSION

There is clearly a great deal to learn about how we acquire our tacit knowledge and intuition and how they may best be used in medical practice. Conceivably, this subconscious knowledge offers a new source of diagnostic and therapeutic insight that could prove beneficial across all fields of healthcare. However, because tacit knowledge appears to be subjective, nonrational, and difficult to verify, it is unlikely to be readily embraced as a valid source of information by the medical community. Moreover, with regard to brain-injured patients, critics will contend that including families in the diagnostic process will create additional problems — such as denial of the reality of the cognitive deficits, demands for futile rehabilitative services, or excessive grieving — that could lead to protracted delays and burdensome costs. This may or may not be an accurate perception. While some of these issues may arise with families, they may pose no greater difficulties than they do now, given our present diagnostic methods. And, as is evident in the Schiavo case, our current policies for resolving conflicts or lessening costs offer few constructive solutions. But it is also conceivable that, by making greater efforts to involve family members and caregivers as partners in the medical team, and by attending seriously and sincerely to their observations and concerns, they will be more willing to accept the diagnosis and treatment decisions that are eventually made. This is not an unreasonable expectation, and can only improve the quality of patient care.

NOTES

1. G.J. Annas, " 'Culture of Life' Politics at the Bedside — The Case of Terri Schiavo," *New England Journal of Medicine* 352, no. 16 (2005): 1710-5.

2. S. Laureys, A.M. Owen, and N.D. Schiff, "Brain Function in Coma, Vegetative State, and Related Disorders," *Lancet Neurology* 3, no. 9 (2004): 537-46.

3. Multi-Society Task Force, "Medical Aspects of the Persistent Vegetative State," Part 1, *New England Journal of Medicine* 330, no. 21 (1994): 1499-1508.

4. Ibid., 1500.

5. Ibid.

6. J.T. Giacino et al., "The Minimally Conscious State: Definition and Diagnostic Criteria," *Neurology* 58 (2002): 349-53.

7. N. Childs, W.N. Mercer, and H.W. Childs, "Accuracy of Persistent Vegetative State," *Neurology* 43 (1993): 1465-7.

8. K. Andrews and L. Murphy, "Misdiagnosis of the Vegetative State: Retrospective Study in a Rehabilitation Unit," *British Medical Journal* 313 (1996): 13-6.

9. Ibid., 14.

10. L. Volicer et al., "Persistent Vegetative State in Alzheimer Disease. Does it Exist?" *Archives of Neurology* 54, no. 11 (1997): 1382-4.

11. Multi-Society Task Force, "Medical Aspects of the Persistent Vegetative State," Part II, *New England Journal of Medicine* 330, no. 22 (1994): 1572-9.

12. See note 7 above, p. 1466.

13. J.T. Giacino, "Disorders of Consciousness: Differential Diagnosis and Neuropathologic Features," *Seminars in Neurology* 17, no. 2 (1997): 105-11.

14. See note 8 above, p. 12.

15. P. Croskerry, "The Importance of Cognitive Errors in Medicine in Diagnosis and Strategies to Minimize Them," *Academic Medicine* 78, no. 8 (2003): 775-81.

16. See note 7 above, p. 1466, quoting L. Sazbon, "Prolonged Coma," *Progress in Clinical Neuroscience* 2 (1985): 65-81.

17. A.I. Fields et al., "Outcomes of Children in a Persistent Vegetative State," *Critical Care Medicine* 21, no.

12 (1993): 1890-4.

18. Ibid., 1893; see note 7 above, p. 1466; see note 10 above, p. 1384.

19. M. Polanyi, "Tacit Knowing," in *The Tacit Dimension* (New York: Doubleday, 1966), 3-25.

20. Ibid., 4-5.

21. M. Polanyi, "Knowing and Being," in *Knowing and Being: Essays by Michael Polanyi* (Chicago: University of Chicago Press, 1969), 126-34.

22. Ibid., 132.

23. C.W. Eriksen, "Discrimination and Learning without Awareness: A Methodological Survey and Evaluation," *Psychological Review* 67 (1960): 270-300; M. Polanyi, "The Logic of Tacit Inference," in *Knowing and Being,* 142-3.

24. A. Bechara and H. Damasio, "Deciding Advantageously before Knowing the Advantageous Strategy," *Science* 275 (5304): 1293-4.

25. G. Klein, *Intuition at Work* (New York: Doubleday, 2003), 10-8.

26. Ibid., 5-7.

27. Ibid., 11-13.

28. Ibid., 23-25.