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Cognitive Predictors of Understanding Treatment Decisions in Patients with Newly Diagnosed Brain Metastases

Adam Gerstenecker, PhD[1], **Karen Meneses, PhD**[2,4], **Kevin Duff, PhD**[3], **John B. Fiveash, MD**[2,5], **Daniel C. Marson, JD, PhD**[1], and **Kristen L. Triebel, PsyD**[1,2]

[1]Department of Neurology, Division of Neuropsychology, UAB, Birmingham, AL

[2]Comprehensive Cancer Center, UAB, Birmingham, AL

[3]Department of Neurology, University of Utah, Salt Lake City, UT

[4]School of Nursing, UAB, Birmingham, AL

[5]Department of Radiation Oncology, UAB, Birmingham, AL

Abstract

Background—Medical decision-making capacity is a higher-order functional skill that refers to a patient's ability to make informed, sound decisions related to care and treatment. In a medical context, understanding is the most cognitively demanding consent standard and refers to a patient's ability to comprehend information to the extent that informed decisions can be made.

Methods—The association between reasoning and cognition was examined using data from 41 patients with diagnosed brain metastasis. All diagnoses were made by a board-certified radiation oncologist and were verified histologically. In total, 41 demographically-matched, cognitively healthy controls were also included to aid in classifying patients with brain metastasis according to reasoning status (i.e., intact or impaired).

Results—Results indicate that measures of simple attention, verbal fluency, verbal memory, processing speed, and executive functioning were all associated with understanding, and that verbal memory and phonemic fluency were the primary cognitive predictors. Using these two primary predictors, equations can be constructed to predict the ability to understand treatment decisions in patients with brain metastasis.

Conclusions—Although preliminary, these data demonstrate how cognitive measures can estimate understanding as it relates to medical decision-making capacities in these patients. Clinically, these findings suggest that poor verbal memory and expressive language function could serve as "red flags" for reduced consent capacity in this patient population, and, thus, signal that a more comprehensive medical decision-making capacity evaluation is warranted.

Corresponding Author: Kristen L. Triebel, Psy.D., Department of Neurology, University of Alabama at Birmingham, Sparks Center 650, 1720 7th Avenue South, Birmingham, Alabama 35294-0017. Phone: (205) 934-2334, Fax: (205) 975-3094. ktriebel@uab.edu.

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Keywords

treatment consent capacity; cognition; neuropsychology; decisional capacity; malignant brain tumor; medical ethics

INTRODUCTION

Medical decision-making capacity, also known as treatment consent capacity, is a higher-order functional skill that refers to a patient's ability to make informed, sound decisions related to care and treatment. Five core standards of medical decision-making capacity derived from the medical and legal literature have been identified [1,2]: expressing choice, appreciation, reasoning, understanding, and making a choice. Of these standards, understanding appears to be the most cognitively demanding [1,3–5]. In a medical context, understanding reflects comprehension of information by a patient that allows him/her to make flexible generalizations about diagnosis, prognosis, and treatment options. Consider, for instance, a patient with brain cancer attempting to choose between whole-brain radiation therapy and stereotactic radiation, each of which has its own pros and cons. Understanding allows the patient to comprehend and recall factual information regarding the two treatment options and make informed medical decisions.

Little has been done to examine the cognitive abilities underlying understanding in medical decision making capacity in patients with serious neurological illness. In patients with mild cognitive impairment and mild Alzheimer's disease, measures of short term verbal memory, executive functioning, and processing speed were predictors of understanding [6]. Multiple cognitive abilities, including verbal memory, semantic fluency, and working memory, were associated with understanding in patients with moderate-severe traumatic brain injury at baseline and 6-month follow up [7]. In patients with malignant glioma, verbal memory and verbal fluency have been shown to be associated with understanding [8]. Given that we have previously noted that associations between cognition and understanding can be affected by brain pathology, there is clearly a need to further examine the cognitive determinants of understanding in other brain diseases.

Brain metastasis refers to cancer that has spread to the brain from another location in the body. Cognitive dysfunction secondary to brain metastases can vary depending on tumor volume and location and the presence of paraneoplastic process. Although corticosteroids can sometimes improve cognitive functioning by reducing edema, many treatments of brain metastases (e.g., corticosteroids, anticonvulsants, and radiotherapy), can cause impairments in executive functioning, memory, sustained attention, and other cognitive abilities [9]. Patients with brain metastases have also shown significantly poorer understanding compared to demographically matched healthy controls, with nearly 50% classified as impaired in their understanding of medical decisions in one study [10]. Given the complexities of treating brain metastases in combination with the high likelihood of cognitive dysfunction, medical decision-making capacity has significant implications for these patients and their healthcare providers.

To our knowledge, studies investigating the cognitive abilities needed for understanding in patients with brain metastases have not been performed. To address this gap in the research literature, cognition and its effects on understanding in a medical context in patients with brain metastases was examined. The following hypotheses were made: 1) understanding of medical decisions will be positively correlated with scores on measures of attention, language, memory, and executive functioning and 2) performance on measures of verbal memory and verbal fluency can be used to predict patients' understanding ability and to identify patients with intact and impaired understanding.

METHODS

Participants

Following institutional review board approval and the obtainment of informed consent, 41 brain metastases patients were recruited from the University of Alabama at Birmingham (UAB) Radiation Oncology Department. All diagnoses were made by a board-certified radiation oncologist and were verified histologically. Only patients meeting the following criteria were accepted for inclusion: aged 19 or older; presence of a supratentorial lesion; and absence of a serious psychiatric illness, history of substance abuse, or co-existing medical illness adversely affecting cognition. In total, 41 demographically-matched, cognitively healthy controls were included. Healthy controls were only evaluated for the purpose of classifying the brain metastasis group as exhibiting intact or impaired reasoning (see Data Analyses for details) and have been described in detail elsewhere [10].

The following treatments for brain metastases were used: conventional surgery; single fraction radiosurgery with Gamma Knife or LINAC technology (15 Gy–24 Gy) for tumors ≤4cm; hypofractionated focal radiation with LINAC for tumors >3–4cm (5–6 Gy×5 fractions for 25–30 Gy total); and whole brain radiation therapy (WBRT) (with LINAC technology) (30 Gy in 10 fractions to 37.5 Gy in 15 fractions). Off-study guidelines for radiosurgical treatment at UAB followed maximum tolerated doses outlined in RTOG 9005 [10].

In total, 41 healthy controls with selection to match for age, education, gender, and race were also recruited. Neurological and neuropsychological evaluations of controls were conducted to ensure the absence of medical and psychiatric conditions that could impair cognition. The control data was only used to classify participants into two groups – either intact or impaired understanding.

Measures

The Capacity to Consent to Treatment Instrument (CCTI) [2] was used to evaluate for treatment consent capacity. The CCTI is a conceptually-based, reliable, and valid instrument designed to assess for medical decision-making ability in adults [2,11] using clinical vignettes. In one vignette, a hypothetical medical problem and symptoms (i.e., cardiovascular disease) and two treatment alternatives with associated risks and benefits is presented. Participants answer standardized questions designed to test four core consent standards [1,2]: expressing a treatment choice (*expressing choice*); appreciating the personal consequences of a treatment choice (*appreciation*); providing rational reasons for a treatment choice (*reasoning*); and understanding the treatment situation, treatment choices, and respective risks/benefits (*understanding*). For understanding, scores range from 0–82 with higher scores being indicative of better performance.

In a previous study [10], we noted that brain metastases patients were impaired in relation to healthy controls on the CCTI core consent standard of understanding. Consequently, these analyses focused on this consent standard. CCTI administration and scoring were performed by trained research assistants according to existing standardized criteria [2]. Each participant's responses to the CCTI questions were audio-taped and subsequently transcribed to ensure scoring accuracy. Study investigators were not involved in administration or scoring and were blind to CCTI results.

The Hopkins Verbal Learning Test – Revised (HVLT-R) [12] is a measure of verbal learning and memory, in which subjects learn 12 words over three learning trials. After a 25-minute delay, free recall of the list is queried, as is recognition.

The Digit Span subtest from the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; [13]) is a measure of attention and concentration, in which subjects repeat orally presented digit strings, forwards and backwards.

The Digit Symbol subtest from the WAIS-III is a measure of processing speed and divided attention in which subjects have 120 seconds to correctly match number and symbol pairs using a key at the top of the page.

To evaluate phonemic verbal fluency, patients were given one minute apiece to name as many words as possible that begin with the letters "C," "F," and "L." To evaluate semantic verbal fluency, patients were given one minute to name as many animals—beginning with any letter—as possible [14].

Trail Making Test Parts A and B from the Halstead-Reitan Neuropsychological Battery are measures of visuomotor processing speed and set-shifting, respectively. For Trails A, the patient was asked to draw a line connecting 25 numbers in numerical order. For Trails B, the patient was asked to draw a line connecting 25 numbers and letters by switching between numbers and letters (i.e., 1 to A, A to 2, 2 to B). For both tasks, raw score is equal to the number of seconds to completion [11].

Depression symptoms were assessed with the Beck Depression Inventory – Second edition (BDI-II) [16]. The BDI-II contains 21 questions scored on a Likert scale of 0–3, with higher scores indicating greater depressive symptoms.

Data Analyses

For all of the cognitive tests, raw scores were used, with higher scores indicating better cognitive performance, except for the Trail Making Test, where lower scores indicate better performance. Pearson product moment correlations were calculated to examine the relationship between understanding scores and neurocognitive performances, age, education, time since diagnosis, and BDI scores. An independent t-test was used to determine whether understanding scores varied by gender. A one-way ANOVA was conducted to determine whether understanding scores varied by race (i.e., Black or African American, White or European-American, and other).

Patients were classified as exhibiting intact or impaired understanding based upon psychometric cutoff scores derived from control performance. This method is useful in categorizing level of decisional impairment and has been utilized in earlier capacity studies [9,10,14]. Intact understanding was defined as a score >1.5 SD below the control group mean. Impaired understanding in this study was defined as a score ≤1.5 SD below the control group mean. A series of independent t-tests were conducted to determine if neurocognitive performance, age, education, time since diagnosis, and BDI scores varied according to understanding status. Two Pearson's Chi square tests were conducted to determine whether gender or race varied according to understanding status.

Variables found to be significantly associated with understanding scores or that varied according to understanding status were then used to construct two predictive models. For the first model, a stepwise linear regression was conducted to predict CCTI understanding scores. For the second model, a backwards elimination binary logistic regression was conducted to identify patients with intact and impaired understanding. Predictive accuracy of the resulting model was calculated using receiving operating characteristic plots (ROC). Using ROC plots, sensitivity and specificity for each potential cut score was obtained by taking sensitivity against 1-specificity [17]. For both models, relative predictive power was obtained through either R^2 or the coefficient of determination of Nagelkerke or pseudo-R^2. Due to the number of comparisons, a more conservative two-tailed alpha of .01 was used for all analyses.

RESULTS

Sample Characteristics

There were 15 men and 26 women in this sample, with a mean age of 59 years (SD 12.4, range 31–84) and a mean education of 13.7 years (SD 2.7, range 9–20). The majority of the sample was Caucasian (85%). Table 1 also displays the clinical characteristics of the brain metastases sample. All participants in this study had KPS scores of 70 or greater, meaning they were independent with self-care activities and had minimal or no disability. Median Karnofsky Performance Status score for brain metastases patients was 80 (range=70–100, mean=82.4, *SD*=8.6). All patients had intracranial tumors. Primary tumor types were as follows: lung 18 (43.8%; 14 non-small cell, 3 small cell, and 1 mixed small and large cell), melanoma 8 (19.5%), breast 8 (19.5%), gynecological 2 (4.9%), and colon 2 (4.9%), renal 1 (2.4%), head and neck 1 (2.4%), and esophagus 1 (2.4%). In total, 28 (68.3%) patients had undergone chemotherapy treatments in the past and 3 (7.3%) were receiving chemotherapy at the time of their study assessment. Eight (19.5%) patients underwent surgical resection prior to testing. Thirty-one patients were within a week of starting radiation treatment (9 whole brain, 22 focal treatment) at the time of the study assessment. The remaining 10 patients were assessed prior to receiving cranial radiation treatment. There were 12 (29.3%) patients treated with antiepileptic drugs and 25 (61.0%) patients treated with corticosteroids. There were 17 patients with 1 tumor (41.5%), 6 with 2 tumors, and 18 (43.9%) with three or more tumors. Tumors were located in the left hemisphere for 12 (29.3%) patients, in the right hemisphere for 9 (22.0%) patients, and in both hemispheres for 20 (48.8%) patients. More than half (n=26, 63.4%) had active extracranial disease.

Neurocognitive Performance, Demographics, and CCTI Understanding Scores

Performances on the following neuropsychological tasks were significantly associated with understanding scores: Digit Span total (r=0.604, p<0.001), Animal Naming (r=0.724, p<.001), Phonemic Fluency (r=0.729, p<0.001), HVLT-R Total Recall (r=0.797, p<0.001), HVLT-R Delayed Recall (r=0.758, p<0.001), HVLT-R Recognition (r=0.729, p<0.001), Trails A (r=−0.658, p<0.001), Trails B (r=−0.704, p<0.001), and Digit Symbol Coding (r=0.608, p<0.001).

None of WRAT-III Reading (r=−0.096, p=0.724), BDI Scores (r=−0.358, p=0.022), age (r=−0.146, p=0.294), education (r=0.158, p=0.254), nor time from diagnosis (r=0.009, p=0.960) was significantly associated with understanding scores. Neither gender (t[39]=−1.2, p=.223) nor ethnicity (F[2,38]=0.6, p=0.547) had a significant effect on understanding scores.

Neurocognitive Performance in Patients With and Without Impaired Understanding

As can be seen in Table 1, performances on the following variables were significantly poorer for patients with impaired understanding: Digit Span from the WAIS-III, Animal Naming, Phonemic Fluency, HVLT-R Immediate Recall, HVLT-R Delayed Recall, and Digit Symbol Coding from the WAIS-III.

None of age, education, gender, time since diagnosis, race, WRAT-3 Reading, HVLT-R Recognition, Trails A, Trails B, and BDI score were significantly different between patients either with impaired or without impaired understanding (see Table 1).

Predicting Impaired Understanding from Neurocognitive Performance

The final models for understanding can be found in Tables 2 and 3. For the stepwise linear regression model used to predict understanding scores, pseudo-R^2 was 0.68. Results of each step in the model are presented in Table 4. The resulting model met all assumptions for regression, including normality of residuals (*Shapiro-Wilk*[41]=0.96, p=0.102). For the backwards elimination binary logistic regression model used to predict impaired or intact understanding, pseudo-R^2 was 0.71 and ROC was 0.92. Based on sensitivity and specificity, the optimal clinical cutting score for predicted values generated by completing the regression model equation was −0.19. For scores falling at or above this cutoff, impaired understanding is likely. Patients with scores falling below this cutoff are likely to have intact understanding. This cutoff achieved sensitivity of 94%, specificity of 71%, negative predictive value of 94%, positive predictive value of 70%, and overall correct classification rate of 79%. It should be noted that this cutoff score is not a raw CCTI score but the cutscore obtained from our model that achieved the best mixture of sensitivity and specificity.

DISCUSSION

Understanding is the most cognitively demanding medical decision-making consent standard [1,3–5] and requires a patient to utilize a number of cognitive domains. Ensuring a patient adequately comprehends the medical and treatment information is essential from an ethical and legal standpoint. Identifying the specific neuropsychological abilities related to decision making standards could lead to a better ability to ascertain when someone lacks or has diminished medical decision-making capacity, and such findings could be used as red flags for clinicians to assess MDC more closely. In the current study, it was demonstrated that understanding is associated with a number of cognitive variables and that impaired understanding is highly affected by impaired neurocognitive performance. We then demonstrated that using only two cognitive variables, simple models can be constructed to predict CCTI understanding performance and to identify patients at risk of having impaired understanding.

Consistent with a previous study in patients with malignant glioma [8], CCTI understanding scores were found to be associated with verbal memory and verbal fluency. We also found, however, attention, processing speed, and executive functioning to be significantly associated as well. This latter observation is interesting because executive functioning is a higher-order cognitive ability allowing for the integration of past experience with present action—in a sense, assimilating new information into a personal framework so understanding can be achieved. The association between attention and understanding is intuitive because patients must first attend to information before they can understand that information. The association between processing speed and understanding is also intuitive because a certain level of cognitive speed is needed before information can be compared to past experience and insight and understanding gained. The relationship between understanding and all cognitive variables went in the expected direction—as neurocognitive performance decreased, so did understanding. In sum, understanding in a medical context is a complex cognitive phenomenon and deficits in many cognitive domains may affect a patient’s capacity to make informed decisions.

In a previous study, we noted that over 50% of this cohort of brain metastases patients demonstrated impaired understanding and were significantly impaired in relation to demographically matched healthy controls [10]. In the current study, we found that patients with impaired understanding performed significantly poorer on measures of simple attention, processing speed, verbal fluency, and memory recall. In contrast, demographic variables, scores on a self-report measure of depression, and performance on measures of word reading, recognition memory, processing speed, and executive functioning did not differ between impaired and not impaired groups.

Although this information adds to the research literature and is useful in a clinical context, more information is needed for it to be used by clinicians. Thus, we next constructed two equations: one to predict CCTI understanding scores and one to identify patients with impaired understanding. As expected, although accounting for over two-thirds of variance, the resulting models did not account for the full variance on CCTI understanding performance. This means other variables (e.g., sensory processes, fatigue, anxiety, disease factors, etc.) may be contributing. Nevertheless, the resulting models may provide clinicians with useful tools when questions about capacity compromise arise.

Examples may be useful for those not familiar with regression-based models (see Tables 5 and 6). Using the model designed to predict CCTI understanding scores and sample averages, this sample of brain metastases patients would have an overall score of 27 (see Table 5). This score is indicative of borderline impaired performance on the CCTI. However, this model can be used for more than simply predicting performance on the CCTI. By dividing the difference of observed CCTI and predicted CCTI understanding scores by the standard error of the estimate of the regression model (Table 5), a z-score is calculated for each patient that shows how many standard deviation units he/she is away from his/her predicted score. For the case example using the model designed to predict CCTI understanding scores found in Table 5 (i.e., 5.10 + [21*0.25] + [27*0.79]), the patient scored a 25 on CCTI understanding but had a predicted score of 32. Thus, this patient has an observed score that is almost a full standard deviation unit poorer than the score predicted based on cognitive performance. For those interested, an Excel spreadsheet can be obtained from the first author of this study that will calculate both equations.

The model designed to identify patients with impaired and intact understanding can be found in Tables 3 and 6. For this current cohort of patients with brain metastases the following means were observed: 27.3 on Phonemic Fluency and 6.2 on HVLT-R Delayed Recall. Using average neurocognitive performances and this model (Tables 3 and 6), this sample of patients with brain metastases would have an overall score of −1.23—below the clinical cutoff of −0.19. This means the sample as a whole demonstrated intact understanding. However, most applications of this model will likely occur at the individual level, and one such example can be found in Table 6. For this example (i.e., 10.25 – [23*0.35] – [5*0.31] = 0.65), the obtained score lies above the clinical cutoff, so issues with understanding treatment decisions are likely (sensitivity of .94 and specificity of .71).

There are a number of limitations and future directions to be considered. First, like most other studies of rare disorders in a university-based hospital, the current sample may not be representative of the population. Patients needed to agree to participate in several hours of testing, be able to provide informed consent, and not have other central nervous system disorders. This likely yields a select group of patients with brain metastases, and, therefore, results might not generalize to all patients with brain metastases. More diverse samples should be examined in future studies. Second, patients may respond differently to hypothetical vignettes than to actual medical situations. For example, the emotions associated with real-life medical decisions are not necessarily triggered by hypothetical vignettes[2]. Finally, clinical validation of the resulting model was beyond the scope of this study, and external validation is needed before clinical decisions are influenced by these results. Future studies should examine the utility of the model in different samples of patients with brain metastases. Despite these limitations, these preliminary findings suggest that the understanding standard is related to cognition in these patients. It also remains a possibility that remediation of these cognitive deficits could lead to improvements in medical decision making capacity, which could be another direction for future studies.

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The ability to understand treatment decisions is highly influenced by cognition in patients with brain metastases. Using only two cognitive variables, actuarial equations can be constructed to screen for patients with brain metastases who are in need of a more comprehensive evaluation of their medical decision-making capacity.

Table 1

Demographics and Neurocognitive Performance of Patients with Impaired and Intact Understanding

Measure	Intact (n=22)	Impaired (n=19)	*t*	*df*	*p**	*d*
Demographics						
Age	57.2 (14.0, 31–80)	62.4 (9.8, 46–84)	−1.3	39	0.188	0.43
Education	14.3 (2.8, 9–20)	12.9 (2.5, 9–19)	1.6	39	0.124	0.53
Female	14 (64)	12 (63)	<0.1	1	0.975	n/a
Understanding	34.1 (5.6, 26–44)	19.4 (6.2, 1–25)	7.5	39	<0.001	2.48
Achievement						
WRAT-3 Reading	48.3 (7.3, 33–57)	41.2 (9.6, 13–53)	2.6	37	0.013	0.83
Attention						
Digit Span	16.9 (3.6, 10–26)	12.8 (2.9, 8–19)	3.9	37	<0.001	1.25
Expressive Language						
Animal Naming	17.5 (4.1, 11–25)	13.6 (4.0, 8–27)	3.0	37	0.005	0.96
Phonemic Fluency	34.7 (12.6, 21–60)	18.7 (6.4, 8–21)	5.1	31	<0.001	1.60
Memory						
HVLT Immediate	22.3 (4.8, 15–32)	15.9 (5.1, 5–29)	4.1	38	<0.001	1.29
HVLT Delayed	8.2 (2.7, 2–12)	4.0 (3.0, 0–10)	4.7	38	<0.001	1.47
HVLT Recognition	10.5 (1.2, 7–12)	8.9 (2.7, 1–12)	2.4	36	0.021	0.77
Executive Function						
Trails A	32.2 (10.6, 16–50)	54.5 (37.6, 28–180)	−2.4	19	0.025	0.81
Trails B	118.8 (81.3, 39–300)	184.9 (104.7, 72–300)	−2.2	37	0.033	0.71
Digit Symbol	61.4 (20.7, 32–97)	43.4 (14.4, 14–67)	3.0	33	0.006	1.0
Depression						
BDI	8.6 (6.2, 0–22)	11.6 (9.5, 3–43)	−1.2	35	0.257	0.37

Note. Except for male and female, values for Impaired and Intact are mean (SD, range). For male and female, values are *n* (%). *p** value for *t*-test analyzing group differences (age, education) or Pearson's Chi square test (gender). CCTI=Capacity to Consent to Treatment Instrument, HVLT=Hopkins Verbal Learning Test, BDI=Beck Depression Inventory, WRAT=Wide Range Achievement Test, n/a=not available, d=Cohen's d, n/a=not available.

Table 2

Prediction Equation for CCTI Understanding Score

Prediction equation
CCTI Understanding Predicted = 5.10 + (Phonemic Fluency*0.250) + (HVLT Total*0.786)

Note. CCTI=Capacity to Consent to Treatment Instrument, HVLT = Hopkin's Verbal Learning Test.

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Table 3

Prediction Equation for Impaired/Intact Understanding

Prediction equation
Impaired/Intact Understanding Predicted = 10.249 – (Phonemic Fluency*0.349) – (HVLT Delayed*0.312)

Note. HVLT = Hopkin's Verbal Learning Test.

Table 4

Results of the stepwise regression used to predict CCTI understanding scores.

Step	F; df; *p*	R^2	SEE	β, SE
1	44.9; 34; <0.001	0.58	5.47	
HVLT Total				1.14, 0.17
Constant				5.16, 3.46
2	33.6; 34; <0.001	0.68	4.84	
HVLT Total				0.79, 0.19
Phonemic Fluency				0.25, 0.08
Constant				5.10, 3.07

Note. SEE = standard error of the estimate of the regression model, β = unstandardized beta weights, SE = standard error of coefficient, CCTI=Capacity to Consent to Treatment Instrument, HVLT = Hopkins Verbal Learning Test.

Table 5

Examples for Equation Predicting CCTI Understanding Scores

Example 1: Sample averages (i.e., CCTI Understanding of 26.8, Phonemic Fluency of 27.3, and HVLT Total of 19.3)
CCTI Understanding Predicted = 5.10 + (Phonemic Fluency*0.25) + (HVLT Total*0.79)
CCTI Understanding Predicted = 5.10 + (27.3*0.25) + (19.3*0.79)
CCTI Understanding Predicted = 27.
Example 2: Patient with CCTI Understanding of 28, HVLT Total of 21, and Phonemic Fluency of 27
CCTI Understanding Predicted = 5.10 + (Phonemic Fluency*0.25) + (HVLT Total*0.79)
CCTI Understanding Predicted = 5.10 + (21*0.25) + (27*0.79)
CCTI Understanding z-score = (observed – predicted) / SEE
CCTI Understanding z-score = (28 – 32) / 4.84 = −0.83

Note. CCTI = Capacity to Consent to Treatment Instrument, HVLT = Hopkins Verbal Learning Test

Table 6

Examples for Equation Predicting Impaired/Intact Understanding

Example 1: Sample averages (i.e., Phonemic Fluency of 27.3 and HVLT Delayed of 6.2)
Impaired/Intact Understanding Predicted = – (Phonemic Fluency*0.35) – (HVLT Delayed*0.31)
Impaired/Intact Understanding Predicted = 10.25 – (27.3*0.35) – (6.2*0.31)
Impaired/Intact Understanding Predicted = −1.23
Example 2: Patient with Phonemic Fluency of 23 and HVLT Delayed of 5
Impaired/Intact Understanding Predicted = 10.25 – (Phonemic Fluency*0.35) – (HVLT Delayed*0.31)
Impaired/Intact Understanding Predicted = 10.25 – (23*0.35) – (5*0.31)
Impaired/Intact Understanding Predicted = 0.65

Note. HVLT = Hopkins Verbal Learning Test