

## Preliminary Evidence of Impaired Thinking in Sick Patients

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**Background:** Earlier anecdotal observations suggested to us that certain aspects of judgment in sick adults approximate the thinking of children.

**Objective:** To describe changes in judgment associated with serious illness in otherwise competent adults.

**Design:** Cohort study.

**Setting:** Urban acute-care hospital and senior citizen center.

**Participants:** Sicker (Karnofsky score  $\leq 50$ ;  $n = 24$ ) and less sick (Karnofsky score  $> 50$ ;  $n = 39$ ) hospitalized patients were compared with controls ( $n = 28$ ). Normal performance on the Mini-Mental State Examination (score  $\geq 24$ ) was required for study entrance.

**Measurements:** Seven Piagetian tasks of judgment designed to

study childhood cognitive development. Degree of sickness was determined by using the Karnofsky scale of physical function.

**Results:** Patients with Karnofsky scores of 50 or less responded correctly to fewer Piagetian tasks than controls (mean [ $\pm$ SD],  $1.8 \pm 2.6$  vs.  $5.9 \pm 1.6$ ;  $P < 0.001$ ). Furthermore, a smaller proportion of sicker patients responded correctly to each of the seven tasks. Patients with Karnofsky scores greater than 50 did not perform differently than controls.

**Conclusion:** In sicker hospitalized patients, performance on seven Piagetian tasks of judgment was similar to that among children younger than 10 years of age. This evidence of cognitive impairment warrants further investigation.

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Clinicians have long known that sick persons, although appearing to have normal mental capacity, may have difficulty thinking clearly when presented with complex clinical choices. Twenty-five years ago, one of us published observations suggesting that very sick patients might reason in a manner similar to children younger than 10 years of age (1).

We report the results of a study that examined the performance of hospitalized patients on seven conservation tasks devised by the developmental psychologist Jean Piaget to measure the cognitive development of children. We hypothesized that sicker patients would have impaired performance on these tasks compared with controls, but that less sick patients would not perform differently than controls.

### METHODS

#### Study Sample

We recruited 63 patients and 28 controls. This sample size provided sufficient statistical power ( $>0.80$ ) to detect large effect sizes (0.70). Patients had been consecutively admitted to the thoracic surgery and general medical services of the New York Presbyterian Hospital, New York, New York. The controls came from a non-residential senior citizen center. All participants spoke English and had at least a high school education. In

addition, participants had to have a score of 24 or higher on the Mini-Mental State Examination (MMSE) (2, 3) to be eligible to participate in the study. The Institutional Review Board of New York Presbyterian Hospital-Cornell University Medical Center approved the study. Each participant gave oral informed consent.

#### Assessment Procedures

The same investigator performed all testing. Patients were tested at the bedside, and controls were tested individually at the senior citizen center. An MMSE was administered to all potential participants. A Karnofsky scale rating of physical functioning (4) was then assigned for each participant. This well-established and widely used scale provides a rank order of illness based on 1) the degree to which independent functioning is impaired and 2) whether and how much care is required. We classified patients with Karnofsky scores less than 50 (indicating that the patient requires considerable assistance and frequent medical care) as sicker and those with scores of 50 or greater (indicating that the patient requires occasional assistance and cares for most personal needs) as less sick. The seven Piagetian tasks were administered in the same order to all participants, and the entire bedside procedure took approximately 15 to 20 minutes.

The following tasks were presented to each participant (5–7):

1. Conservation of quantity: The participant was presented with two identical containers (such as urine collection cups) that contained an equal amount of water. The participant was asked to confirm their equivalence. In full view of the participant, one container's contents was poured into a tall narrow container (such as a urinometer). The participant was then asked if the two liquid-filled containers had an equal amount of water.

2. Conservation of substance: The participant was shown two balls of clay and asked to confirm that the balls had an equal amount of clay. One ball was transformed into the shape of a long sausage, and the participant was asked if the two clay objects were still equal in amount.

3. Conservation of length: The participant was asked to choose two sticks of equal length among a choice of three. The two equal sticks were first placed side by side, and then one stick was picked up and moved to the right. The participant was asked if the stick lengths were still equal. The procedure was repeated another time, with the stick displaced both up and to the left.

4. Preservation of the horizon: An upright water glass was pictured with the water level drawn parallel to the bottom of the glass. Then a picture was displayed of the glass in a tilted position, and the participant was asked to draw the water line.

5. Conservation of area: Two pieces of paper, 8.5 × 11 inches (27.8 × 21.5 cm), were presented to the participant. The participant observed as one piece of paper was cut into strips that were laid end to end. The participant was asked if the strips were equal in area to the uncut paper.

6. Ability to decenter: The participant was asked to name each of the four simple scenes pictured on the sides of a box. The participant was then shown one side of the box and asked to name the scene on the opposite side.

7. Ability to classify: The participant was presented with pictures, each of which featured ducks, nonduck birds, or nonbird animals. The participant was asked to sort the pictures into three classes—A, ducks; B, birds; and C, animals—and put each picture into the appropriately labeled envelope (ducks, birds, or animals). The

participant was asked whether envelope B could still retain its label if envelope A was placed inside it. Similarly, envelope B was placed inside envelope C, and the participant was asked whether C's label still applied.

### Statistical Analysis

To test the hypothesis that sicker patients have poorer cognitive performance, our primary analyses compared performances on the seven Piaget tasks between controls ( $n = 28$ ) and sicker patients ( $n = 24$ ). To examine the competing hypothesis that being a patient, not sickness itself, accounted for the altered cognition, we compared the scores of controls ( $n = 28$ ) with the scores of patients who had Karnofsky scores greater than 50 ( $n = 39$ ). The Fisher exact test was used to compare the proportions of each group that performed correctly on each of the seven tasks. The Mann-Whitney U test was used to compare the groups on the number of correct responses to the seven tasks. A Spearman rank correlation coefficient was used to examine the strength of the relationship between the Karnofsky score and the total number of correct responses on the seven tasks among the patients. All tests were two tailed, and a  $P$  value less than 0.05 indicated statistical significance.

### Role of the Funding Source

The New York Bar Association provided the funding to conduct assessments but had no role in the design, conduct, or reporting of this study.

### RESULTS

The median age among the 63 patients and 28 controls was 62 (mean [ $\pm$ SD], 59.6  $\pm$  15.0) and 79.5 (mean, 77.8  $\pm$  8.7), respectively. The sicker and less sick patient groups did not differ by sex or age. Surgical patients ( $n = 20$ ) had had coronary artery bypass surgery or thoracotomy within 72 hours before testing and were usually still receiving analgesics. Eleven patients were recovering from acute myocardial infarction. Twenty-four patients were more severely ill (conditions such as pneumonia, AIDS, cancer, and heart failure) according to their Karnofsky score ( $\leq 50$ ) (2). By design, all participants had normal MMSE scores of 24 or higher, but we did not retain data on the actual scores.

The sicker patients responded correctly to fewer of the total number of tasks (median, 0) than the less sick patients (median, 6) or the controls (median, 6). In addition, a significantly smaller proportion of the sicker patients compared with less sick patients or controls responded correctly on each of the 7 tasks (Table). The performance of the patients with Karnofsky scores higher than 50 did not differ statistically from the performance of controls in the total number of correct responses or responses to each of the individual tasks. In the 63 patients, the number of correct responses to the seven tasks increased as Karnofsky score declined (Spearman correlation = 0.64;  $P < 0.001$ ).

## DISCUSSION

Among hospitalized patients with Karnofsky scores of 50 or less, performance on seven tasks of cognitive function was similar to that reported for children younger than 10 years of age (8). These Piagetian tasks and the mental abilities that they evaluate are mastered during middle childhood (approximately 6 to 10 years of age). The thinking of persons who cannot do these tasks correctly has been described as being focused on particular states (9); such persons are therefore unable to take into account transitions, such as the change in water level after water is poured from one container into a container of a different shape. Persons who think like this can attend to only a limited amount of information at one time. They cannot grasp the logical reversibility of a transition, such as the option of molding a clay ball that has been rolled into a sausage shape back into a ball of the original shape and size. As an entrance criterion, patients had achieved a passing score on a clinical test of mental function (MMSE); therefore, the participants' results on this widely accepted bedside test did not suggest impaired cognition.

A limitation of our study was that the evaluator was not blinded to the patients' degree of sickness. Furthermore, our study method precluded insight into which aspects of severe sickness (for example, fatigue, medication, dependency, change in social role, or immobility) impaired performance. In addition, the participants' actual scores on the MMSE were not retained.

The findings of this investigation are troubling because patients often must give consent for treatment or study participation or engage in activities that require

**Table. Comparison of Cognitive Performance among Sicker and Less Sick Patients and Controls\***

Variable	Participants with Correct Responses		
	Sicker Patients ( <i>n</i> = 24)	Less Sick Patients ( <i>n</i> = 39)	Controls ( <i>n</i> = 28)
	←———— % —————→		
Piagetian task			
Conservation of volume	33.3	76.9	85.7
Conservation of substance	29.2	87.2	82.1
Conservation of length	29.2	89.7	96.4
Preservation of the horizon	12.5	33.3	53.6
Conservation of area	33.3	92.3	96.4
Ability to decenter	29.2	92.3	96.4
Ability to classify	12.5	74.4	75.0
Mean ± SD total correct answers, <i>n</i>	1.8 ± 2.6	5.5 ± 1.8	5.9 ± 1.6

\* For comparison between sicker patients and controls on the preservation of the horizon task and on all other tasks,  $P = 0.003$  and  $P < 0.001$ , respectively. For comparison of performances between less sick patients and controls on all tasks,  $P > 0.05$ .

reasoned consideration (such as writing wills or designating surrogates)—regardless of medication use, fatigued state, or impact of a change in social role or dependency and with their thinking capacity assessed only with an MMSE. It is important to understand that just because sick patients may respond to certain tests of cognitive function in a manner similar to that of children, that does not mean they are childish; rather, they are in a state of sickness.

We acknowledge that ours was an unusual application of Piagetian tasks, but these brief tests are portable, easy to administer, and readily available to the physician at the bedside. They are not meant to substitute for a comprehensive neuropsychological assessment. The relevance of Piagetian tests as measures of cognitive ability in adults has not been established. Tests, some markedly different in form, based on Piaget's concepts of cognitive development have been used in many different populations of children and adolescents with consistent and stable results (10). The Piagetian tasks used in our study have been used for decades.

Our preliminary investigation suggests that problems in thinking may increase as Karnofsky performance decreases. These findings indicate the importance of further investigation of the reasoning of sick patients and their ability to make sound judgments about clinical decisions, informed consent, and the execution of legal documents.

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