Behavioral and Neurologic Assessment

Using the National Institutes of Health Toolbox

Laura McLaughlin, PhD, RN, and Suzanne M. Mahon, DNSc, RN, AOCN®, AGN-BC

Oncology nurses routinely assess and seek to better understand the constructs of cognition, psychological well-being, stress, pain, and functional status. The National Institutes of Health (NIH) Toolbox for Assessment of Neurological and Behavioral Function was created for measuring emotional health, as well as cognitive, motor, and sensory function (Hodes et al., 2013). This is a resource that can be used by researchers and clinicians. In 2006, the NIH commissioned the creation of this set of royalty-free, easy-to-administer, reliable behavioral and neurologic measures that have a wide range of potential applications (Hodes et al., 2013). The initial impetus for creating the toolbox was to help researchers from a variety of disciplines standardize outcomes across samples, settings, and age groups (Hodes et al., 2013).

Launched in 2012, the toolbox was created by a team of more than 250 multidisciplinary content experts from about 100 academic institutions (Hodes et al., 2013). The full toolbox includes four functional areas in the domains of cognition, emotion, motor, and sensation (see Table 1). The full toolbox can be administered in less than two hours. Subdomains and subscales can be completed in a few minutes and can be used for the purposes of data collection for research, quality improvement projects, or for screening patients for untoward effects of therapy at a single instance or over time (Gershon et al., 2013).

Contents of the Toolbox

The toolbox includes detailed information on how to administer and score each instrument, so assessment is complete and consistent across users. Similarly, researchers can use the toolbox to measure a construct once or over time. An option exists to save the data for analysis for quality improvement and research studies.

The toolbox offers multiple instruments to assess cognition. It would take about two hours to administer all of these instruments, but brief cognitive subdomain measures of executive function, episodic memory, language, processing speed, working memory, and attention are all designed to be administered in minutes using minimal equipment (Weintraub et al., 2013). Using subdomain components of the toolbox can be effective and acceptable measures for cancer research or quality improvement projects and potentially routine clinical assessment. For example, distress screening is now routinely done using a simple tool to detect problems with the goal of early intervention. Cognitive changes are a subtle but important problem in oncology practice. Routinely screening for such changes with a normed, easy-to-use tool could identify patients who are experiencing cognitive decline with the goal of more comprehensive evaluation and interventions to

Keywords
NIH Toolbox; behavioral assessment; neurologic assessment; instruments

Digital Object Identifier
10.1188/17.CJON.30-33
promote safety and quality of life (Weintraub et al., 2013).

The emotional burden of the cancer experience may be assessed using a variety of brief questionnaires. These tests include 18 instruments for assessing aspects of negative affect, 11 for psychological well-being, 15 for social relationships, and 7 for stress and self-efficacy. Each of the 51 individual measures in the emotional domain may be downloaded in PDF format for immediate use. These tools are brief and can be implemented in a variety of research samples and clinical settings. They were designed to reflect function and health status over time while being responsive to changes in a diverse population of individuals aged 3–85 years (Salsman et al., 2013).

Motor strength and coordination are integral to quality of life, functional status, and independence (Reuben et al., 2013). The toolbox includes tests on dexterity, grip strength, standing balance, gait speed, and endurance. These tests may be used to assess functional status before, during, and after cancer treatment. The researcher or clinician may need to purchase some equipment, such as pegboards, a dynamometer for grip strength, a stop watch, and cones, for the walking speed tests. Equipment and supply lists and step-by-step instructions, including videos, are provided for each motor function assessment to simplify the process and ensure consistent application of the tests when quantifying these important physiologic variables. These quick and reliable assessments can be used to screen patients for referral to physical or occupational therapy because the assessments were developed from experts in these fields (Reuben et al., 2013). Two self-report questionnaires are provided for pain assessment: the Patient Reported Outcomes Measurement Information System (PROMIS)–Pain Interference computerized adaptive test and the PROMIS–Pain Intensity. In addition, the toolbox includes assessment tools for neuropathic pain, which are available in the sensory domain. Peripheral neuropathy is a commonly observed long-term consequence of cancer treatment and is associated with pain and safety concerns (Cook et al., 2013). Loss of sensation may result in burn accidents, difficulties with ambulation, increased fall risk, and difficulty feeding, toileting, and dressing. The Early Childhood Sensation Battery and the Sensation and Pain Battery can be used to assess for and evaluate treatment of this recalcitrant problem (Dunn et al., 2013).

Other sensory assessment tools include objective measures of visual acuity, dynamic visual acuity, and hearing. The sensory taste test includes regional intensity test of bitter and salty. A taste test scoring manual and detailed instructions for preparing and storing taste stimuli solutions are provided. The odor identification test recommends scratch-and-sniff cards of

TABLE 1.
MEASUREMENT COMPONENTS FROM THE NATIONAL INSTITUTES OF HEALTH TOOLBOX

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>MEASURES</th>
<th>AGE RECOMMENDATIONS</th>
</tr>
</thead>
</table>
| Cognition       | Executive function, attention, episodic memory, language, processing speed, and working memory | - Cognition Battery for ages 7 years or older
|                 |                                               | - Early Childhood Cognition Battery for ages 3–6 years   |
| Emotional function | Psychological well-being, social relationships, stress and self-efficacy, and negative affect | - Parent Proxy Emotion Battery for parents of children aged 3–12 years
|                 |                                               | - Emotion Battery for ages 8 years or older             |
| Motor           | Dexterity, balance, endurance, locomotion, and strength | - Motor Battery for ages 7 years or older
|                 |                                               | - Early Childhood Motor Battery for ages 3–6 years       |
| Sensation       | Audition, olfaction, pain, taste, vestibular, vision, sensation and pain battery, and somatosensation | - Sensation and Pain Battery for ages 7 years or older
|                 |                                               | - Early Childhood Sensation Battery for ages 3–6 years   |

Note. Based on information from National Institutes of Health & Northwestern University, 2012.
Clinicians decide to assess executive function in man aged 30–75 years undergoing chemotherapy for stage III adenocarcinoma of the lung.

Executive function in the toolbox is operationally defined as the capacity to plan, organize, and monitor the execution of behaviors that are strategically directed in a goal-oriented manner.

The toolbox focuses on the following components of executive function:
- Inhibition of automatic response tendencies that may interfere with achieving a goal
- Set shifting (the capacity for switching among multiple aspects of a strategy or task)

The toolbox has two measures to evaluate executive function:
- Dimensional Change Card Sort Test
- Flanker Inhibitory Control and Attention Test

Note. Based on information from HealthMeasures, 2016.

Benefits of Using the Toolbox
The toolbox can facilitate cancer research and clinical assessments with innovative approaches and enhanced scientific rigor. The data collection methods are innovative because the toolbox instruments can be administered using an Apple® iPad® application that provides detailed examiner instructions and immediate data entry. In addition, many of the tests use computerized adaptive testing for use on an iPad, which provides considerably shortened testing time and immediate scoring. When these tests are used, study participants or patients may be compared to a nationally representative sample of noninstitutionalized individuals aged 3–85 years (Beaumont et al., 2013). The tests include scoring programs, keys, and directions readily available for download. Special instructions and considerations for vulnerable and special needs populations, including pediatric, geriatric, culturally diverse, or non-English-speaking people, as well as people with disabilities, are also available (Victorson et al., 2013). Training and administration manuals and materials, including videos, are easily downloaded from the toolbox website (www.nihtoolbox.org). Detailed lists of required supplies are included to help researchers and clinicians anticipate costs when preparing grants.

Another innovative aspect of the toolbox is that tests were designed to be administered to individuals aged 3–85 years, so long-term longitudinal evaluation is possible. This is particularly important for evaluating and monitoring the long-term effects of childhood cancer because the same instruments could potentially be used as patients advance from pediatric to adolescence and adult to older adult (Heaton et al., 2014). It could also be useful for evaluation at late-effects and survivorship clinics. The toolbox can be used in research studies to monitor a specific treatment-related side effect at one time or at multiple time points to determine if the side effect is improving or progressing. Using a single tool across age groups allows for consistent assessment of a clinical problem (Gershon et al., 2013).

The toolbox is beginning to be used in oncology populations. Von Ah and Tallman (2015) found some of the instruments from the toolbox to be useful in evaluating cognitive function in breast cancer survivors. It has also been used to assess cognition following physical activity interventions in breast cancer survivors (Hartman et al., 2015). Its current use is primarily in the research setting, but efforts are being made to use these instruments more widely in the clinical setting (Rehabilitation Institute of Chicago Center for Rehabilitation Outcomes Research, 2015).

How to Use the Toolbox
Clinicians and researchers with Internet access can download the instruments, which include detailed information about how to administer the tests. The toolbox is also available as an iPad application for a fee of $499.99 annually for use on as many as 10 iPads (HealthMeasures, 2016). Although this is a big expense, it allows for brief, time-efficient assessment using computerized adaptive testing. It also enables research or quality improvement project data to be collected and stored simultaneously, so there are no additional charges for data entry. The free NIH Toolbox eLearning course is easily accessed through the website. This detailed audiovisual presentation was created to familiarize researchers and clinicians with the test administration and procedures. It includes quizzes to test knowledge of the educational material provided. All of the toolbox materials and manuals can be printed from the eLearning course, and detailed instruction for using required equipment and setup are provided. Researchers and clinicians may choose to complete training on one or all of the domains. Best practices for test administration are provided for each of the four domains, so toolbox users will be well prepared to collect data accurately and efficiently. An example of how to use the toolbox website in clinical practice is presented in Figure 1.

Conclusion
The toolbox is an ideal resource for cancer researchers assessing the emotional, cognitive, sensory, and functional outcomes of cancer treatments. These expertly designed measurement tools may be used to quantify symptom burden in at-risk patient populations and identify patients who would benefit from nursing interventions or referral for ancillary services. The care of patients with cancer is complex and requires a multidisciplinary team approach. The toolbox instruments...
were designed by a wide range of practitioners and researchers for use by a variety different disciplines. Although the toolbox is primarily used in the research setting, it is slowly moving toward more widespread use in the clinical setting for patient assessment.

Laura McLaughlin, PhD, RN, is an associate professor in the School of Nursing, and Suzanne M. Mahon, DNSc, RN, AOCN®, AGN-BC, is a clinical professor in the Division of Hematology/Oncology and the Department of Internal Medicine, both at Saint Louis University in Missouri. McLaughlin can be reached at lashmann@slu.edu, with copy to CJONEditor@ons.org.

The authors take full responsibility for this content and did not receive honoraria or disclose any relevant financial relationships.

REFERENCES


