National Institute of Neurological Disorders and Stroke (NINDS) CDE Project

Subgroup in Sport Concussion: Subacute

During the initial development stages of the Sport-Related Concussion (SRC) CDEs, the Working Group, consisting of approximately 34 experts, identified three Subgroups in which to examine the SRC CDEs: Acute (<72 hrs post-concussion), Subacute (3 days-3 months post-concussion), and Persistent-Chronic (3 months post-concussion). The Subacute Subgroup began reviewing and identifying relevant CDEs from the previous Traumatic Brain Injury (TBI) CDE effort. Each Subgroup member reviewed and categorized the TBI CDEs as Yes or No in regard to their applicability to the SRC Subacute Subgroup CDEs. Measures identified for inclusion were then reviewed and discussed by all Subgroup members via conference call. Following the initial reviews, including measures were assigned to Subgroup members for categorization (see categories below) and description- including strengths and limitations, applicable population, and supporting references. All reviews were evaluated by Subgroup members and discussed via conference calls until consensus regarding categorization/inclusion was achieved. It is important to note that all of the Subacute Subgroup CDEs were identified and reviewed in regard to their use between 3+ days and 3 months following a sport concussion. Population specific recommendations- e.g., pediatric- were also provided as appropriate for each CDE. Finally, the Subgroup members developed a list of new and emerging CDEs that were subsequently reviewed using the same process as outlined above. Following the identification of all potential CDEs, the individual measures were categorized by reviewers into one of the four NINDS CDE classifications categories:

Core is defined as a data element that collects essential information applicable to any SRC study. The NINDS and its appointed working groups assign the disease "Core" classification based on the current clinical research best practices. In each case, the SRC Core CDEs are a small subset of the available CDEs, where it is anticipated that investigators will need to collect the SRC Core CDEs on any type of study. These are required for all SRC studies.

Supplemental - Highly Recommended is a data element that is essentially based on certain conditions or study types in SRC clinical research studies. In most cases, these have been used and validated in SRC. These data elements are strongly recommended for specified SRC condition, study type or design.

Supplemental classification is a data element that is commonly collected in SRC clinical research studies (or research that can be deemed appropriate for use in SRC). Use depends upon the study design, protocol or type of research involved. These are recommended, but not required, for studies.

Exploratory classification is for a data element that requires further validation, but may fill current gaps in the CDEs and/or substitute for an existing CDE once validation is complete. Such data elements show great promise, but require further validation before they are ready for prime-time use in Sport Concussion clinical research studies. These elements are reasonable to use in an exploratory manner but have limited or no validation in SRC.

The instruments/elements recommended by the Subacute subgroup do not differ between the types of SRC. They do, however, highlight how the time since injury influenced the selection and categorization of CDEs for SRC. However, it is important to note that the current SRC-specific CDEs have limited overlap with existing TBI CDE recommendations, thereby adding substantially to their application in sport

concussion specific research. Among the issues that are specific to SRC are: a) some measures that were appropriate or supported empirically for the Subacute Subgroup were not appropriate or supported empirically at the Acute or Persistent-Chronic time points- as such, time since injury may influence the use of CDEs across time points; b) categorization of measures into the specific classification categories (Core, Supplemental-Highly Recommended, etc.) was challenging across measures and reviewers- as both the empirical support for some measures and the nuances of reviewers' application of categories were inconsistent at times; c) the general lack of validation and empirical study specific to SRC for many measures, particularly those that have been recently developed; d) some measures involve a cost associated with their use, thereby limiting there availability and use especially in unfunded research; and e) within certain CDE recommendations- e.g., computerized cognitive testing- there was significant variability in the empirical support and validity for each recommended measure. As the field SRC gains additional attention for further research needs, emerging areas of assessment include, but are not limited to, oculomotor, vestibular, and exertion need additional validated measures. There is also a need for additional measures associated with treating sport concussion. Neuroimaging, biomarker (blood, CSF...), and injury mechanism assessments require CDEs.

Below are some summary tables showing the Core and Supplemental- Highly Recommended CDEs recommended specific to the Subacute Subgroup. Each cell can indicate the CDE level or other relevant information.

Table 1. Core and Supplemental-Highly Recommended Outcome Measures for the Cognitive Assessment Subdomain

Sport-Related Concussion Subdomain	**Outcome Measure Name**	**Subacute (after 72 hours to 3 months)**
Cognitive Assessment*	Automated Neuropsychological Assessment Metrics (ANAM)	Core
Cognitive Assessment*	Axon Sports Computerized Cognitive Assessment Tool (CCAT)	Core
Cognitive Assessment*	CNS Vital Signs	Core
Cognitive Assessment*	Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)	Core
Cognitive Assessment	Controlled Oral Word Association Test (COWAT)	Supplemental-Highly Recommended
Cognitive Assessment	Hopkins Verbal Learning Test - Revised (HVLT-R)	Supplemental-Highly Recommended
Cognitive Assessment	Standardized Assessment of Concussion (SAC) †	Supplemental-Highly Recommended
Cognitive Assessment	Trail Making Test (TMT)	Supplemental-Highly Recommended
Cognitive Assessment	Wechsler Adult Intelligence Scale (WAIS-IV)	Supplemental-Highly Recommended

Cognitive Assessment	Wechsler Intelligence Scale for Children (WISC-V)	Supplemental-Highly Recommended

Table 2. Core and Supplemental-Highly Recommended Outcome Measures for the Post-Concussive/Mild TBI-Related Symptoms Subdomain

Sport-Related Concussion Subdomain	Outcome Measure Name	Subacute (time of injury until 72 hours)
Post-concussive/mild TBI-Related Symptoms*	Health and Behavior Inventory (HBI) ††	Core
Post-concussive/mild TBI-Related Symptoms*	Post-concussion Symptom Inventory (PCSI) †	Core
Post-concussive/mild TBI-Related Symptoms*	Post Concussion Symptoms Scale (PCSS)**	Core
Post-concussive/mild TBI-Related Symptoms*	The Rivermead Postconcussive Symptom Questionnaire (RPQ)	Core

Table 3. Core and Supplemental-Highly Recommended Outcome Measures for the Vestibular Function Subdomain

Sport-Related Concussion Subdomain	Outcome Measure Name	Subacute (time of injury until 72 hours)
Vestibular Function	Dizziness Handicap Inventory (DHI)	Supplemental - Highly Recommended
Vestibular Function	VOMS (Brief Vestibular/Ocular Motor Screening Assessment)	Supplemental - Highly Recommended

Table 4. Core and Supplemental-Highly Recommended Outcome Measures for the Quality of Life/Patient-Reported Outcomes Subdomain

Sport-Related Concussion Subdomain	Outcome Measure Name	Subacute (time of injury until 72 hours)
Quality of Life/Patient Reported Outcomes	Pediatric Quality of Life Inventory (PEDSQL)	Supplemental - Highly Recommended

* Only one assessment is needed for each time point.

**PCSS is included in ImPACT, but may be administered separately.

†The assessment is available within the Sport Concussion Assessment Tool (SCAT-5), but may be administered separately.

†† The assessment is available within the Child Sport Concussion Assessment Tool (Child SCAT-5), but may be administered separately.