# Neuroimaging Diagnostics Working Group

**NINDS CDE Project**

**Working group: Neuroimaging Diagnostics**

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Please answer the following questions below.

1. **Approach for selection of elements** (How did you go about drafting the recommendations and/or reviewing the current tools/instruments, and did you have any criteria for selection and classification?):

The workgroup is made up of clinicians and researchers that are familiar with the use of neuroimaging in evaluation of high-risk infants and children with cerebral palsy (CP). We reviewed common data elements (CDE) and case report forms (CRF) related to neuroimaging that were developed for other neurological diseases as part of NINDS CDE project. We also searched for existing instruments that have been developed for documenting or interpreting neuroimaging findings in children with cerebral palsy and infants and children at risk for developing CP. There are no commonly accepted tools/instruments for neuroimaging in CP, however several recent neuroimaging instruments are highlighted and included in our Neuroimaging References list. We also reviewed published reports of abnormal brain MRI findings in children with CP.

Magnetic resonance imaging (MRI) of the brain has been shown to be useful in the diagnostic evaluation of children with CP and other neuroimaging modalities have been used to demonstrate lesions which are risk factors for CP or predictive of CP. As did most of the groups who worked on neuroimaging CDEs for other neurological diseases, our workgroup decided to focus on developing CDEs and a CRF for documenting the characteristics and findings that would be obtained using conventional clinical MRI of the brain. At this time, we decided not to develop CDEs or CRFs for diffusion tensor imaging (DTI) although this is a promising neuroimaging tool for studying children with CP. We also did not specifically address use of ultrasound, computed tomography, or functional MRI. From our review of existing neuroimaging tools related to CP, we decided to start with the neuroimaging report form being used by the NICHD Neonatal Research Network (NRN) as the basis for a case report form (used in Hintz et al. 2015). Through discussion and consensus-building phone calls, the workgroup members modified the NRN form to ensure that our CRF includes all the aspects of standard MR neuroimaging that are relevant to diagnostic evaluation and research for CP.

1. **Differential application to types of cerebral palsy** *(Do the instruments/elements you recommended differ between the types of cerebral palsy?):*

It was our intent to develop a CRF that would be useful for documenting neuroimaging findings for any type of CP. We included a comprehensive list of CDEs that would allow for coding and documentation of lesions that would be found in any of the types of CP, i.e., dyskinetic CP (basal ganglia lesions), spastic CP (cortical lesions, periventricular white matter injury, and diffuse white matter injury), ataxic CP (cerebellar lesions), or mixed types.

1. **Summary recommendations** *(We could consider a summary table OR each group could summarize their recommendations).*

Our goal for this project was to develop a case report form and list of common data elements that provide a comprehensive means for evaluating and documenting brain MRI findings in children with cerebral palsy. Brain MRI is being used to evaluate children in the neonatal period before CP is diagnosed and has been found to have some predictive utility. It is also now considered a standard modality in the diagnostic evaluation of children with CP. The CRF developed allows for documentation of both acute and chronic changes on a single form. Future efforts should focus on classification of MRI findings, interpretation, and prognostication based on those findings. Additionally, tools such as DTI and functional MRI are being used to evaluate changes in structure and functional connectivity of the brain pre and post intervention, and CDEs and CRFs for these tools should be developed.

1. **Comparison to other cerebral palsy standards** (Are there any notable similarities/differences in the CDE recommendations as compared with other standards?)

Conventional MRI of the brain is the imaging modality of choice for clinical diagnostic evaluation of children with CP and is consistent with the practice parameter “Diagnostic Assessment of the Child with Cerebral Palsy” of the American Academy of Neurology (Ashwal et al., 2004) as well as the practice parameters of other international groups. The Surveillance of Cerebral Palsy in Europe (SCPE) group published a classification system for standardizing the abnormal findings of brain MRI in children with CP (Himmelmann et al., 2016). Their approach was different from ours in that it tried to define categories of patterns of involvement for research studies. Our approach was to promote coding and documentation of all abnormal findings in a consistent manner but with much less focus on interpretation and categorizing patterns of involvement. This tool developed by SCPE would be useful for research and complementary to the CRF that we developed. They could be used together.

1. **Issues unique to cerebral palsy** *(Were there any issues encountered when developing the CDE standards which are unique to cerebral palsy or which highlight a unique concern about cerebral palsy data collection?*

For the other neurological disorders for which a CRF has been developed, the types of findings are more narrow and the populations more homogeneous. Because CP has many etiologies and there can be a wide range of findings, it is important that a CRF for neuroimaging allow for data collection of any relevant findings. We also found it challenging to allow for documentation of acute findings (recent injury) and chronic findings that would be relevant to development of CP. We feel that we were able to develop a reasonable report form that can be used for documenting both acute and chronic findings.

1. **Unmet needs; unanswered questions** *(What unmet need / unanswered questions were identified via the CDE process in cerebral palsy? What areas are in need of further research and development?)*

Coding systems for evaluating different structures in the brain by neuroimaging will gradually become more refined. The various etiologies of CP will be increasingly correlated with specific findings on neuroimaging. This research will need to be incorporated into the CDE framework for neuroimaging in CP. CDEs for newer neuroimaging modalities (e.g., DTI and fMRI) relevant to CP will need to be developed. We also recognize a need for a comprehensive automated analysis of brain MRI that can address current limitations such as those related to identification of abnormal signal intensity, relatively large slice thickness, and can expand on axial, coronal, and sagittal plane views to provide more precise identification of relevant injury and offer improved predictive value for high-risk infants and children.

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