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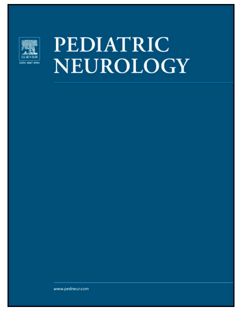

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Implementation of the Hammersmith Infant Neurological Exam in a High-Risk Infant Follow-Up Program

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Short title: Implementation of the HINE

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Abstract
Background: High-Risk Infant Follow-Up (HRIF) programs provide early identification and referral for treatment of neurodevelopmental delays and impairments. In these programs, a standardized neurological exam is a critical component of evaluation for clinical and research purposes.
Implementation: To address primary challenges of provider educational diversity and standardized documentation, we designed an approach to training and implementation of the Hammersmith Infant Neurological Exam **(**HINE) with pre-course materials, a workshop model and adaptation of the electronic medical record.
Conclusions: Provider completion and documentation of a neurologic exam were evaluated before and after HINE training. Standardized training and implementation of the HINE in a large HRIF is feasible and effective and allows for quantitative evaluation of neurological findings and developmental trajectories.

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Introduction

The goal of high-risk infant follow-up (HRIF) programs are similar across continents and countries: they provide early identification and referral for treatment of neurodevelopmental delays and impairments to preterm infants or those with perinatal insults contributing to their developmental vulnerability. HRIF programs are also referral centers for general providers who have identified delays on routine screenings. A cornerstone of neurodevelopmental follow-up is the neurological exam, complemented by various developmental and medical assessments. Utilizing a standardized neurological exam common to all HRIF providers can further support diagnoses, provide a mechanistic understanding of disorders, help define prognoses, monitor the longitudinal history of a disease and document the effects of interventions. Neurological examinations suitable for young infants after the neonatal and through the toddler period have been developed for use in clinical care and research studies. They include the Touwen[1], the Amiel-Tison[2] and the Milani-Comparetti[3] and the Hammersmith Infant Neurological Examination (HINE).[4]

Because the purpose of HRIF programs is to identify impairments as early and broadly as possible and to provide guidance for families, their choice of standardized assessment is heavily influenced by feasibility and prognostic considerations. In particular, exams need to balance the demands of clinical imperatives and time constraints, at the same time as they fulfil the needs of research studies often associated with HRIF. We selected the HINE for implementation in the HRIF program at our institution because it is a well-studied neurological exam in healthy or high-risk infants and can meet both our clinical and research needs (Table 1).

The HINE is an easily performed and relatively brief standardized and scorable clinical neurological examination for infants between 2 and 24 months of age, accessible to all clinicians, with good inter-observer reliability even in less experienced staff. It has no associated costs such as lengthy certifications or proprietary forms. The use of the HINE optimality score and cut-off scores provides prognostic information on the severity of motor outcome. The HINE can further help to identify those infants needing specific rehabilitation programs. It includes 26 items assessing cranial nerve function, posture, quality and quantity of movements, muscle tone, and reflexes and reactions. Each item is scored individually (0, 1, 2 or 3), with a sum score of all individual items (range: 0-78). A questionnaire with instructions and diagrams is included on the scoring sheet, similar to the Dubowitz neonatal neurological examination.[30] Optimality scores for infants 3-18 months are based on the frequency distribution of neurological findings in a typical infant population: when an item is found in at least 90% of infants it considered optimal.[4]

Sequential use of the HINE allows the identification of early signs of cerebral palsy and other neuromotor disorders, while individual items are predictive of motor outcomes. For example, in preterm infants assessed between 6-15 months corrected age, scores above 64 predict independent walking with a walked sensitivity of 98% and specificity of 85%. Conversely, scores below 52 were highly predictive of cerebral palsy and severe motor impairments.

Despite its general utility, the HINE currently lacks a standardized training or widely available course, prompting our team to design an education process for the follow-up clinic. The goal of this article is therefore to describe the training and implementation process of the HINE exam in an HRIF program, from challenges to solutions, educational tools, and metrics for success and opportunities for further improvement.

Methods:

Patients and Setting:

The neonatal follow up program at Nationwide Children's Hospital is an umbrella for 3 clinics addressing the needs of high-risk children, with over 5000 yearly visits. One of these clinics is focused on optimizing the neurodevelopmental trajectories of infants within the context of their families. In this developmental clinic, infants are seen for a common neurodevelopmental journey at 3-4 months, 9-12 months, 22-26 months and 33-36 months corrected age for preterm infants and chronologic age for all others (see Figure 1). Ideally, all visits include medical and neurological exams, needs assessment and standardized testing by certified therapists (Test of Infant Motor Performance[31] and General Movements Assessment[32] at 3-4 months and Bayley Scales of Infant and Toddler Development Third Ed[33] at 12-36 months). Interim visits address specific developmental needs and include targeted standardized assessments. The team of medical providers, therapists, nurses, social workers and dieticians together develop a multidisciplinary individualized plan. They ensure referrals to targeted early intervention services or research studies (e.g. high-intensity physical therapy[34,35], constraint therapy[36], Hanen programs[37,38]) or to specialty provider evaluations (e.g. ophthalmology, audiology, neurosurgery). In the 2-year period prior to the study (01/2014 to 12/2015) clinic personnel made 574 new developmental impairment diagnoses (excluding delays), with about 2/3 of them motor or sensory (including cerebral palsy, muscle hyper/hypotonia, gait abnormality, vision and hearing impairments). The clinic also participates in the follow-up studies of the Neonatal Research Network (NRN)[39], which requires its own exam and documentation at 22-26 months.

Identification of challenges

Challenges were identified through provider query using Survey Monkey.[40] Questions asked what were the challenges to performing a neurological exam in infants and what support could be provided to allow more effective performance of a neurological exam. Multiple non-exclusive choices were provided as well space for open-ended answers. The goal of this survey was to obtain qualitative data. In addition, individual provider neurological exam documentations were compared to identify electronic medical record (EMR) strategies utilized. Identified challenges are reported in the results section.

Intervention:

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Documentation: The electronic health record programming team (EPIC, Copyright © 2016 Epic Systems Corporation) developed a standardized form, making the HINE a rapid and easy addition to the visit note. The documentation tool met both clinical and research needs. Drop down menus had item descriptions for easy scoring; sidebars included pictorial representations from the HINE form to enhance written descriptions; and a summary assessment was automatically extracted (Figure 2). Each item was coded as a unique field, making it easily extractable for research purposes. Individual items were also visible in EPIC as table or chart forms to facilitate clinical care and longitudinal views. The score for each domain and total HINE score was automatically calculated, with flagging of abnormal values at appropriate ages based on optimality scores. A modification to the published HINE form was inclusion of an asymmetry score (present in prior forms of the HINE[4]); this score corresponded to the total number of items on the HINE with dissimilar left and right side findings.

Provider and knowledge-base diversity: A workshop was planned during which all providers would simultaneously be trained in the theoretical, research and practical aspects of the HINE. This was not to be a certification but rather a continuing education project. Preparation course work, workshop training and testing and on-site training verification were essential components. This would allow the HINE to become the standard neurological exam across all age groups from 3 months to 24 months and at all visits, even when elements of the NRN exam were performed to complete research requirements.

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To overcome clarity issues in the published HINE form and ensure reliability, we designed a workshop (Table 2) with a neurologist instructor was chosen who was trained by the developers of the HINE and had participated in published studies utilizing the assessment.

Course design was based on models used in Neonatal Resuscitation^{TM} program[41] and Pediatric[42] Advanced Life Support courses developed and regulated by the American Academy of Pediatrics and the American Heart association, respectively. First, a pre-workshop component included two articles describing the use of the HINE by experts in the field as well as the predictive value of the exam. The purpose of HINE implementation was to improve early identification in order to provide more rapid and targeted intervention. Therefore, a crucial component of this process was to improve the communication of HINE findings to the therapy assessment team in order to develop the multidisciplinary care plan. Therefore, the feeding, occupational, physical and speech pathology therapy leaders were charged with compiling educational presentations on therapist training, scope of practice, standardized specialty assessments and available evidence-based interventions. They also designed corresponding multiple-choice questionnaires to be administered prior to HINE training.

Secondly, the workshop opened with a didactic session explaining each component of the HINE, the purpose of the item tested and the scoring system for each individual item. This section was interactive and allowed providers to request clarifications and possible adaptations of the exam for special situations. In particular, the trainer addressed behavioral issues inherent to testing active

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toddlers or infants with stranger-anxiety. The utility of the HINE in clinical practice was complemented by an overview of its use in research studies its predictive value for diagnosing cerebral palsy.

The third part of the workshop included hands-on exam demonstrations of volunteer patients by the trainer, with direct observation and indirect viewing through a one-way mirror to allow the entire class to watch. Demonstrations of specific challenging items by trainees were permitted within the limits of infant and parent well being. In order for workshop participants to closely review and score the demonstrated exams, they were videotaped and immediately uploaded for review in the classroom. Videotaped exams were reviewed for individual item scoring, abnormalities, and difficulties in performing specific items, visualized adaptations and trainee performance. Infants of varying ages and neurological status were recruited in order to review both normal and abnormal findings.

The final exam included videotaped items in children of varying age and health conditions. Examinees were asked to identify both the item being tested and the score that the item would receive on the HINE. Examples are provided in Figure 3 and a library of item administration on patients of varying age and neurological status is provided as a link in this journal.

Implementation verification

In the month prior to start of the training program, we performed an EMR audit of provider documentation across 50 random charts over 1 month preceding the HINE workshop. This was a convenience sample representing at

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least 4 charts from each provider. An experienced neurodevelopmental provider with >10 years of practice with various neurological exams including the HINE and the NRN exams audited only standard developmental visits. All provider types were included in the audit, including neurologists and developmental/behavioral pediatricians. We examined whether the 5 major domains of the HINE were scorable on the published paper form, using data recorded in the EMR. A score of 100% was given if the domain form could be filled out completely, a score of 50% if a domain exam was documented in a generic manner (e.g. “tone normal, moves all extremities well”) and a score of 0% was given when the domain was not addressed in the EMR. At 3 weeks after the training, most providers had practiced the HINE greater than ten times on their patients and an experienced HINE practitioner observed each provider performing the exam, giving feedback and answering questions as needed. After this, 50 random charts were again audited in the manner described above. Comparisons before and after the intervention were performed using Wilcoxon Rank Sum Test for logistic variables and 2-tailed test for continuous variables, with alpha set to 0.01. We also queried the EMR database over an identical three-month period in 2014 and in 2016, before and after provider training to identify number of new diagnoses of cerebral palsy and corrected age in months at diagnosis. We excluded 2015 data collection to prevent possible diffusion effects of enhanced awareness of early cerebral palsy detection during the planning phase of HINE training implementation.

Results

Challenges to implementation:

Twelve providers returned survey data and documentation of neurological exams were reviewed for all providers. Most of the cited obstacles to HINE implementation could be grouped into three categories: (1) concerns about increasing time demands due to the documentation in the electronic medical record (EMR), (2) inconsistent knowledge-base about timing and specifics of the neurological exam due to provider type diversity and (3) concerns about a complex neurological exam decreasing the clinical flow without providing tangible benefits to patients. We examined the root causes of provider concerns and classified them as follows.

Consistency challenges:

The medical provider base of the clinic is diverse in order to accommodate a highly variable mix of patients with general or specialized needs. All providers must be able to evaluate the neurodevelopment of high-risk patients and confidently know when to refer to specialty services and providers. The clinic medical team is comprised of advance practice nurses, general pediatricians, developmental/behavioral pediatricians, a pediatric neurologist, neonatologists and specialty fellows in neonatology and developmental medicine. This diversity contributed to a lack of common language to describe neurological findings and a widely variable knowledge base in performing basic components of a neurological exam. The timing of neurological exams was also inconsistent. While providers often performed components of a neurological exam at 22-26

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months, they rarely did so at 3-4 months or 9-12 months. While therapists were provided with a clearly defined schedule of standardized assessments (see Figure 1), medical providers did not have an equivalent algorithm. Finally, the neurological exam administration sometimes depended on whether patients were participating in research studies or not. For example, Neonatal Research Network[39] study patients followed in the clinic received a standardized research exam based on the Amiel-Tison.[43] Because of the length of the NRN exam providers stated that consistent use of this exam at every visit would slow the flow of patients. Furthermore, it was designed only for a 22-26 month visit and some items such as gait observations or pincer grasp did not apply to 3-4 month infants.

Documentation challenges:

The EMR was originally designed to include a standard neurological exam, with multiple choices appropriate for older children or adolescents but not for developing infants between the ages of 3-24 months. To circumvent this issue, one provider used the HINE at all visits but documented it in a free text format with item descriptions and without scores. Because most high-risk infant visits are time-consuming, providers were also reluctant to use any system that excessively slowed or complicated documentation. Again, providers stated that the NRN exam form was lengthy and adding it to every visit would excessively increase the time burden of documentation by an estimated 5-6 minutes per patient.

Challenges inherent to the HINE:

The exam has published questionnaire with graphics but no user manual. The stick figures representing the positions of the patients are not always self-explanatory and the small descriptions under each item name are brief. No reference currently exists for clarification purposes. With 2 exceptions, the providers had never heard of the HINE and of its advantages for clinical diagnosis.

Efficacy of implementation:

Children ages 3-4 months, 9-12 months and 22-26 months, provider types and days of the week were represented equally. Completion of HINE domains was improved after training (Table 2). Before and after implementation, documentation in patients who received the Neonatal Research Network neurological exam resulted in 80% of HINE completion. This was due to an imperfect overlap between the two exam forms. After training, 10/50 visits did not have a completed HINE EMR form, with 1/10 having the NRN form instead, and 9/10 representing 3 providers. Primary reason for not documenting the exam was reported as non-awareness of the EMR form and secondary as not knowing if the exam should be performed at all visits.

When comparing the identical three-month period prior to implementation of the program and post implementation, we found a comparable number of new cerebral palsy diagnoses in the same period relative to patient volume (2.2 vs. 2.6%, $p = 0.41$). However the mean age at diagnosis pre-HINE was significantly lowered ($p<0.001$) from a pre-HINE mean of 27.9 months (SD 1.8, range 23-30) to a post-HINE of 15.7 months (SD 7.1, range 4-29).

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Post-implementation feedback:

During the 3-week period after the training, a trained HINE examiner available in the clinic questioned the providers. With regards to knowledge-base, providers were asked if they wanted the examiner to confirm their exam. Four providers requested this. With regards to time management concerns, providers were asked if these concerns were still present. The majority of replies were that the exam was short and easily performed during a routine visit. Concerns remained about the documentation, as each item required scoring, sometimes on both sides. One provider stated that this added 2-3 minutes to the documentation time per patient. One comment was a request to build a “one-click option” if all items were normal to decrease documentation time. The request was considered and discussed with the 2 neurology experts in the HINE, but was eventually not implemented. Reasons for the refusal were that a “one-click option” would not promote performing the full exam every time, not recognize the fact that even typically developing children have variations in optimality scores, not reinforce the knowledge of the exam that is obtained by reading items repeatedly and that it may increase the risk of missing slight asymmetries.

Discussion

HINE training and implementation in a high-risk infant follow-up clinic is feasible and effective when combined with EMR adaptation. A workshop model preceded by targeted coursework and post-workshop feedback allowed a wide variety of medical providers to be effectively trained. The elements of (1) relative

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brevity compared to other exams, (2) optimality score for clinical and research purposes (3) predictive value for diagnosis of cerebral palsy make the HINE unique among neurological assessments in the first two years.

The relative brevity of the exam with only 26 items (compared to 35 in certain age groups on the Amiel Tison) and the relative ease of documentation make it well suited for clinical practice. Rather than scoring items on whether they are typical, moderately abnormal, or abnormal for age, HINE scoring is based only on observation of item performance. Optimality score is then determined based on the child's age.

New international guidelines and recommendations for early detection of cerebral palsy (International Conference on Cerebral Palsy and other Childhood-onset Disabilities, Stockholm, June 2016)[44] state that the HINE is the most predictive neurological exam for cerebral palsy and is recommended in the first year of life, when a General Movements Assessment cannot be performed at 3-4 months. In our setting, the mean age at diagnosis was lowered by 12.2 months on average, but the overall frequency of diagnosis after HINE implementation remained the same. The HINE may increase diagnostic precision, but does not appear to result in an over-diagnosis. Other factors may have played a role in this apart from the exam itself, such as increased awareness of the need for early diagnosis after the didactic teaching component of HINE-use for cerebral palsy detection. Earlier diagnosis allowed earlier referral to intervention services and parent support. Given the nature of HRIF clinics as follow-up for NICUs and referral centers for community pediatricians, they are often the first setting in which cerebral palsy is diagnosed[45] and NICU graduates constitute 50-70% of all new diagnoses. Implementation of the HINE in HRIF may therefore facilitate earlier detection and intervention at a regional level.

Opportunities for improvement in the model included clearer communication of EMR changes to providers during the course with a demonstration of the scoring, data retrieval and longitudinal view possibilities. Another opportunity to streamline the documentation process included the addition of HINE items missing from other research assessments such as the NRN to the EMR.

To maintain and build on current training, a professional videographer from the Department of education at Nationwide Children's Hospital filmed the workshop exams to begin a video library, included with this manuscript. This library will allow continued education, yearly retraining and standardization to prevent drift in the standardized use of the HINE. During regular clinic visits, additional videos of the HINE obtained with informed consents approved by the Institutional Review Board will help document variations due to age groups and health conditions, and expand the video library.

New provider HINE training will be addressed with an individual version of the workshop, modeled on the currently described one and administered by the most experienced HINE examiners. A refresher course for those previously trained will include the instructor presentation, videos from the library and a test involving scoring a standardized videotaped exam. The clinic currently uses the same model of an annual 1-hour video refresher followed by scoring of a videotaped exam for NRN certification. Additionally, as with the NRN exam, an experienced practitioner will shadow and provide feedback upon provider request. For research studies, an additional review of videotaped exams of participating providers would be necessary to establish inter-rater reliability. New research on the HINE (for example correlations with the GMA) will be added to the yearly educational program and to the clinic's operation manual.

In conclusion, we present a feasible training and implementation program for the HINE in a high-risk infant follow-up clinic in the United States. We do not propose that this model should be implemented in its entirety in all settings. Clinics with fewer providers may wish to use the didactic component only and perform the patient demonstrations with videotaping during clinical practice. Others may consider the use of simulation models, especially when teaching large number of inexperienced trainees. The number of demonstrations in the workshop can be adjusted to the number of trainees to allow hands-on learning reinforcement. A tailored approach to implementation of this clinical and research tool should allow its use in multiple settings throughout the world. The videos included in this article represent testing of each item on patients of different ages and health status, and may prove useful to others designing their own training course.

Finally, the HINE was chosen as the neurological exam with the greatest research and clinical potential for our population, and as the easiest to perform. However, the HINE did not have a User's guide. While this does not constitute a problem for highly trained and experienced neurologists who use this exam

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routinely, it increased the challenge of training and training verification in our HRIF clinic setting. Each item needed to be described fully, visualized and performed consistently, and recorded for future benchmarking. This necessitated the engagement of experts who routinely use the HINE in both clinical and research settings in order to ensure fidelity with published clinical and research metrics. Future opportunities for improvement of the program could therefore include the development of an administration manual by published experts in the HINE, and a shared video library for online training courses.

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FIGURE LEGENDS

Figure 1: High Risk Infant Follow-Up schedule and assessments

From the NICU to three years of age, infants are followed using a standard schedule at 3-4, 9-12, 22-26 and 33-36 months. In addition, interim visits may be scheduled when specialty needs are identified. Ideally, every visit for developmental needs should have a standardized neurological exam. For a standard visit (red dots), both neurological and medical exams should be performed in addition to the developmental history. At these visits, therapists perform a small set of standardized tests. For an interim specialty visit (blue dots), medical specialists address additional concerns (pulmonary, behavioral pediatrics, cerebral palsy, complex care, feeding) and infants can receive a more diverse set of therapist assessments (e.g. Peabody Developmental Motor Scales, Gross Motor Function Measure, Infant Toddler Sensory Profile, Receptive Expressive Emergent Language Test). Nutrition and social work assessments may also be required needed. For neurological exams in the neonatal period, the Hammersmith Neonatal Neurological Examination is preferred, while the for 33-36 month visit, the Amiel Tison is recommended in the literature. A simplified version better adapted to this older age group is feasible and is already partly available in EMR, but does not produce a score.

GMA: General Movements Assessment; TIMP: Test of Infant Motor Performance; BSID: Bayley Scales of Infant and Toddler Development (Third. Ed.); CBCL: Child Behavior Checklist.

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Figure 2: Electronic medical record representation of HINE scoring and report extracted into the clinic note

A: Screen shot of the provider view of the medical record HINE form. Providers use drop down menus for each item to select a score and description of the item. Scores are abstracted by the EPIC program, and domain subscores are calculated. When left and right sides for individual items do not match, a score of 1 is added to the total asymmetry score.

B: Screen shot of HINE summary automatically extracted into the clinic visit note.

Red color highlights scores below the optimality score for age. No asymmetries were noted.

Figure 3: Demonstration of the HINE assessment items

The HINE examiner can assess a child in their parent's lap if it reduces infant stress. To obtain demonstrations of all items in several children of varied ages and health conditions, click on embedded link.

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TABLES

Table 1: HINE use in infant studies

Study	Population	N	Sex male (%)	GA wk	Months at assessment	Comment
Amess et al[5]	Preterm infants	102	NR	28 (23-34)	Term, 12	
Haataja et al[6]	HIE	53	29 (55)	Term	9-14	
Frisone et al[7]	Preterm infants	74	NR	27 (24-30)	6-15	
Fowler et al[8]	deformational plagiocephaly and controls	99	NR	32	4-13 m	
Gkoltsiou et al[9]	Kernicterus	11	6 (54)	5 term; 6 preterm (35:27–36)	12-18	
Karagianni et al[10]	Preterm infants SGA, matched controls	41 SGA 41 controls	21 (51)	32 (26-34)	18	Controls appropriate for GA
Karagianni et al[11]	preterm infants w/wo BPD	191	101 (53%)	≤32	6, 12	
Karagianni et al[12]	VLBW	174	93 (53)	29 $\pm$ 2	6, 12	
Leppänen et al[13]	VLBW preterm infants with abnormal fetoplacental flow	83	44 (53)	28 (23-34)	24	
Lind et al[14]	VLBW with postnatal caudothalamic cysts	5; 23 controls	3 (60)	25-33	24	Controls (23) VLBW no HINE
Lind et al[15]	VLBW with and without NDI	164	82 (55%)	29 (no NDI) 27 (NDI) (23-35)	24	148 w/o NDI, 16 with NDI
Luciano et al[16]	Preterm (7 Term (9)	16	NR	33.6	24	
Mathew et al[17]	Preterm infants	8	NR	31 (28–32)	42 wks.	
Maunu et al[18]	VLBW/VLGA	225	54	28 (27-29)	24	
Pizzardi et al[19]	Preterm infants, neonatal Encephalopathy	658	NR	34.8± 2.14	3,6,9,12	
Ricci et al[20]	Neonatal Encephalopathy	15	67	Term	6	
Ricci et al[21]	Cystic PVL	24	NR	1 term 23 preterm 30 (26-35)	6-9	

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Romeo et al[22]	Preterm infants (<37wks)	903	55	34.5 ±2.3	3	
Romeo et al[23]	Cerebral Palsy	70	64	Term, 32 (26-36)	3,6,9,12	13 term 57 preterm
Romeo et al[24]	Preterm infants	103	54	29 (25–31)	3,6,9,12	
Romeo et al[25]	NICU	1541	53	638 term; 903 preterm (25–36)	3, 6, 9, 12	
Romeo et al[26]	Near term	448	50	35-37	6,9,12	
Romeo et al[27]	Low risk, VPI Preterm	188	56	<37	3,6,9,12	
Setänen et al[28]	VPI	96	48	28 (26, 30)	24	
Spittle et al[29]	Preterm, Late preterm Term	80 129 201	48 50 52	33 35 39	48 hrs	

*Table expanded and modified from: Romeo DM, Ricci D, Brogna C, Mercuri E. Use of the Hammersmith Infant Neurological Examination in infants with cerebral palsy: a critical review of the literature. Developmental Medicine & Child Neurology. 2015 Aug 1.

**NR: Not reported; wks: weeks; hrs: hours; VPI: Very preterm infants; VLBW; very low birth weight; VLGA: Very low gestation age; PVL: Periventricular leukomalacia; SGA: Small for gestation age. GA: Gestation age.

Table 2: Workshop modules for HINE training

Workshop elements	**Duration**
Pre-course Work Test	30 min
Lecture on supporting literature for utility of the HINE	30 min
Review of individual HINE item administration and scoring	45 min
HINE Demonstrations with simultaneous videotaping (varied age and health status)	15 min per patient
Review of videotaped exams and discussion of HINE item administration and scoring	20 min per patient
HINE Video Test	30 min

Table 3: Completion of HINE elements before and after training

HINE scorable element	**% Documented Before training**	**% Documented After training**
Nerve Function	54	92*
Movements	41	88*
Reflexes and Reactions	22	92*
Posture	41	87*
Tone	33	92*
Total average	**37**	**90***

* all p<0.01 on Wilcoxon Rank Test

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Figure 1: High Risk Infant Follow-Up schedule and assessments

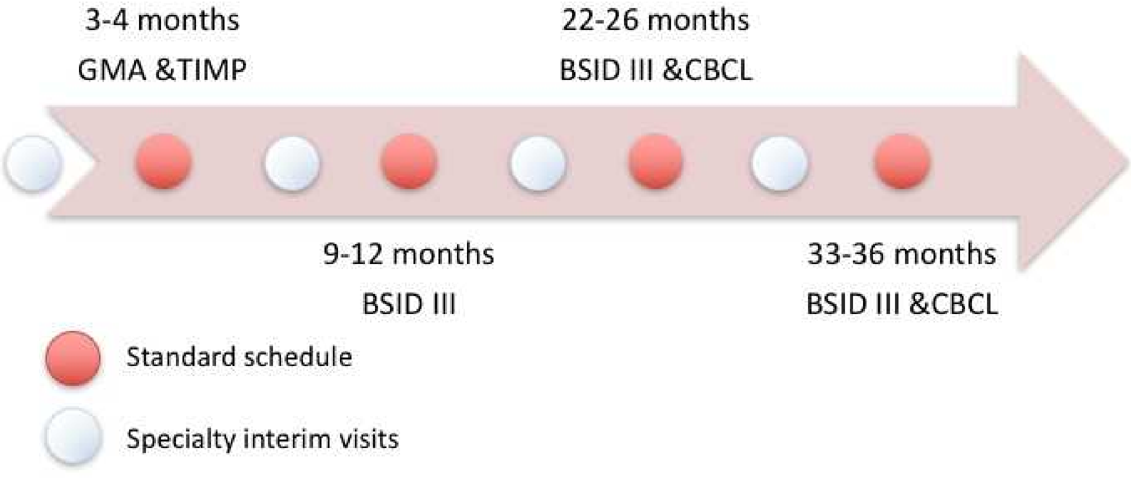

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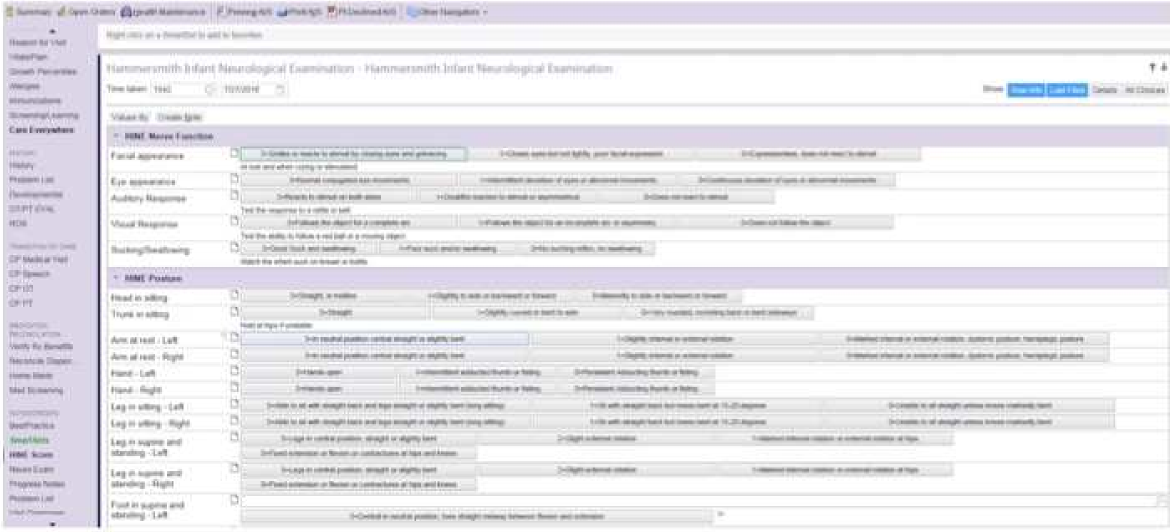
Figure 2 A,B: Electronic medical record reporting of HINE



Overall, results of the Hammersmith Infant Neurological Examination were {normal mildlyabnormal abnormal:25747} The following were the scores in specific domains of our exam.

Hammersmith Infant Neurological Exam Total Score: 68

Nerve Function Score: 15
Posture Score: (!) 16
Movements Score: 6
Tone Score: (!) 18
Reflexes and Reactions Score: (!) 13

Asymmetry Score: 0

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Figure 3: Demonstration of the HINE assessment items

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