The goal of this study was to develop predictive models to identify patients with delayed diagnosis and treatment initiation in IS. Delayed diagnosis and treatment initiation in IS can lead to long-term neurobehavioral problems. IS is a relatively rare disorder (estimated incidence: 0.25-0.42/1000 live births per year) and might be associated with a broad range of comorbidities. These clinical presentations could be misleading, given potential misdiagnoses and the overlap of symptoms with other conditions. This study used a claims database to identify presentations/diagnoses thought to be characteristic of IS, misdiagnosed conditions, and potential early clinical presentations/diagnoses. The project utilized input from medical experts and analyses of the IDV database to identify criteria that best predicted a later IS diagnosis.

Methods (cont’d)
- Using the list in Table 1 as a starting point, clinical, electrographic, radiological, and pharmacological variables associated with a diagnosis of IS were identified. These variables were then converted to ICD-9 and ICD-10 diagnostic codes and drug codes.
- Supervised machine-learning-based algorithms were leveraged to identify combinations of these codes that were most likely to predict a subsequent diagnosis of IS. Using principal components to create models.
- The overall methodology is presented in Figure 1.

Figure 1. Algorithm Development and Patient Identification

Clinical experts indicate key diagnostic codes, symptoms, and procedures that may potentially identify IS patients.

- Develop algorithm to identify patients on the basis of expert panel input.
- Test algorithm with 1 year of temporal data to determine accuracy.
- Adjust algorithm and relabel or accept as final.

Using final algorithm, analyze most recent claims data to identify patients with undiagnosed IS, forward information to the appropriate specialist.

Results
- Five combinations of clinical factors were identified that best predicted a later IS diagnosis (Figures 2 and 3; Table 2).
- The most successful of the predictive models identified 557 patients who had ≥2 symptoms pertaining to IS diagnosis, prescription, or procedure claims from 2015–2016 and were later diagnosed with IS. The combination of these clinical factors had a 54.6% positive predictive value.
- These results may support the application of this rule in electronic medical records to flag patients with high likelihood of being diagnosed with IS. Additional validation of the algorithm in an electronic medical record database is necessary.

Table 2. Combinations of Clinical Factors Predictive of IS: Positive Predictive Value

<table>
<thead>
<tr>
<th>Combination of Predictors</th>
<th>Identified with IS</th>
<th>Positive Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥2 Symptoms + ED Visit</td>
<td>304/557</td>
<td>54.6%</td>
</tr>
<tr>
<td>Symptom (Any Order)</td>
<td>323/5,198</td>
<td>6.2%</td>
</tr>
<tr>
<td>EEG Dx</td>
<td>20/406</td>
<td>5.0%</td>
</tr>
<tr>
<td>Conv / Dysph</td>
<td>49/2,061</td>
<td>2.4%</td>
</tr>
<tr>
<td>Neonatal Specialist or ED Visit</td>
<td>40/2,061</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Conclusions
- Our analysis identified the combination of ≥2 symptoms plus an ED visit as the strongest predictor (highest positive predictive value) for identification of IS in newborn-patient care settings. Our analysis not only lists the combination of clinical factors identified in patients approximately 24 days prior to diagnosis, but the interpretation of the model also supports the application of this rule in electronic medical records to flag patients with high likelihood of being diagnosed with IS. Additional validation of the algorithm in an electronic medical record database is necessary.
- Limitations include use of ICD-9 for evaluation of IS, which may fail to identify all IS cases. Similarly, the rates relied on the accuracy of coding and prescribing of the selected ICD-9 codes, which may vary by institution. Further research is needed to examine the impact of optimization of early diagnosis and treatment on patient health outcomes.

References

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