

### Identification of Children With High-Intensity Neurological Impairment

Children with neurological impairment frequently experience unmet health care needs, high-severity acute illnesses, coexisting condition exacerbations, adverse medical events, and disproportionately high health care utilization and spending.<sup>1,2</sup> Our clinical experience within the clinical spectrum of neurological impairment has suggested that children with high-intensity neurological impairment have increased severity of health problems, needs, and care. Best practices for managing the acute and chronic health care needs of children with high-intensity neurological impairment are underdeveloped, partly owing to the limited methods of distinguishing these patients.

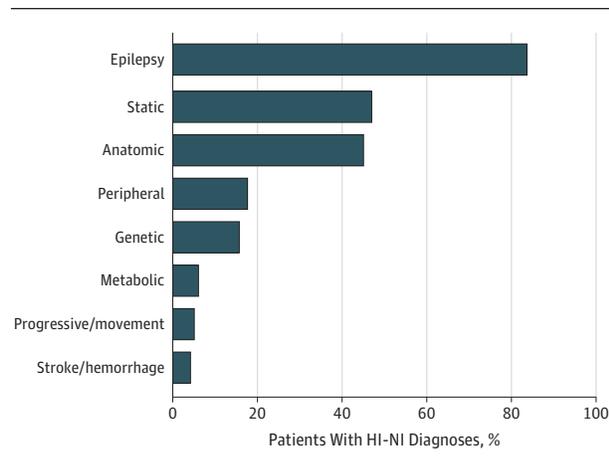
Existing pediatric classification systems for identifying complex neurological conditions (eg, cerebral palsy) in administrative data sets do not include disorders with neurological impairment originating from genetic, metabolic, and other organ systems (eg, trisomy 18, glutaric acidemia).<sup>3,4</sup> Current classification systems that focus on neurological impairment include heterogeneous arrays of conditions with varied severity levels, which make studying patients with these conditions as 1 cohort challenging (eg, a child with mild intellectual disability and no functional limitations vs a non-verbal child with profound hypotonia and respiratory failure from Pompe disease).<sup>1</sup>

In the present study, we aimed to improve the method of distinguishing children with high-intensity neurological im-

pairment by refining the classification of underlying neurological impairment diagnoses. We compared the high-intensity neurological impairment classification system's performance with that of an existing classification scheme to assess whether children with high-intensity neurological impairment had higher multimorbidity, polypharmacy, and health care utilization and spending.

**Methods** | This cross-sectional study involved children 1 to 18 years of age who had neurological impairment and were continuously enrolled in Medicaid in 2016 according to records from 10 states in the IBM MarketScan Medicaid Database. The institutional review board of Cincinnati Children's Hospital Medical Center exempted this study from review as it used deidentified data. Informed consent was also waived for this reason.

**Figure. Frequencies of High-Intensity Neurological Impairment (HI-NI) Diagnostic Categories**



The most common diagnosis within each HI-NI diagnostic category and the relative percentage of patients within that category are as follows. Epilepsy (29.7%), including unspecified, not intractable, and without status epilepticus; static (31.6%), including cerebral palsy and unspecified; anatomic (9.4%), including hydrocephalus and unspecified; peripheral (10.2%), including quadriplegia and unspecified; genetic (45.6%), including Down syndrome and unspecified; metabolic (19.9%), including lipoprotein deficiency; progressive or movement (22.8%), including cerebral infarction; and stroke or hemorrhage (15.4%), including extrapyramidal and movement disorder and unspecified.

We updated the most widely used neurological impairment coding system, *International Classification of Diseases, Ninth Revision, Clinical Modification*,<sup>1</sup> to *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*, diagnostic codes using General Equivalence Mappings, which was developed by the National Center for Health Statistics. Two of us (J.A.F. and J.E.T.) independently identified codes indicative of high-intensity neurological impairment, defined as a neurological diagnosis reasonably expected to last longer than 12 months and result in substantial functional impairments that require subspecialty medical care. Discrepancies were arbitrated by one of us (J.G.B.) and resolved by group consensus. High-intensity neurological impairment diagnoses and codes are available elsewhere (<https://www.childrenshospitals.org/Research-and-Data/Pediatric-Data-and-Trends/2019/High-Intensity-Neurologic-Impairment-Codes>).

We used  $\chi^2$  and Wilcoxon rank sum tests to compare demographic details, clinical information, and use of health services between children with high-intensity neurological impairment and children with lower-intensity neurological impairment diagnoses.

**Results** | Of the 302 383 children with neurological impairment, 120 121 (39.7%) were classified as having high-intensity neurological impairment. The most frequent high-intensity neurological impairment categories included epilepsy (100 357 [83.6%]), static (56 479 [47.0%]), and anatomic (54 004 [45.0%]) (Figure). Compared with children with lower-intensity neurological impairment, children with high-intensity neurological impairment were 4.8 times more likely to have 6 or more body systems with chronic condition indicators (17.2% vs 3.6%;  $P < .001$ ) and 9.9 times more likely to have 3 or more organ systems with complex chronic conditions<sup>5</sup> (10.9% vs 1.1%;  $P < .001$ ). Children with high-intensity neurological impairment had 2 times the exposure to 15 or more unique medications annually (6.8% vs 3.1%;  $P < .001$ ) and 1.6 times the exposure to 5 or more chronic medications<sup>6</sup> (13.5% vs 8.4%;  $P < .001$ ).

Children with high-intensity neurological impairment had higher use of health care services across all domains, with 2.0

**Table. Health Care Spending and Utilization of Services for Children With Neurological Impairment**

Variable	Neurological Impairment			P Value
	Overall (N = 302 383)	Low Intensity (n = 182 262)	High Intensity (n = 120 121)	
Total expense, \$	4 806 791 440	1 860 026 056	2 946 765 384	NA
PMPY expense, \$	15 896	10 205	24 532	NA
Utilization, No. (%)				
Inpatient	39 040 (12.9)	17 011 (9.3)	22 029 (18.3)	<.001
Primary care physician	250 300 (82.8)	146 403 (80.3)	103 897 (86.5)	<.001
Specialty	233 608 (77.3)	131 379 (72.1)	102 229 (85.1)	<.001
Emergency department	149 549 (49.5)	88 690 (48.7)	60 859 (50.7)	<.001
Home health	10 435 (3.5)	2446 (1.3)	7989 (6.7)	<.001
Therapy	107 608 (35.6)	50 329 (27.6)	57 279 (47.7)	<.001
Durable medical equipment	72 836 (24.1)	38 132 (20.9)	6 (28.9)	<.001

Abbreviations: NA, not applicable; PMPY, per member per year.

times more inpatient admissions (22 029 [18.3%] vs 17 011 [9.3%];  $P < .001$ ), 5.2 times more home health services (7989 [6.7%] vs 2446 [1.3%];  $P < .001$ ), and 1.7 times more therapy needs (57 279 [47.7%] vs 50 329 [27.6%];  $P < .001$ ) (Table). The 39.7% of children with high-intensity neurological impairment accounted for 61.3% (\$2 946 765 384) of total health care costs and had 2.4 times the per-member-per-year spending (\$24 532 vs \$10 205) of those with lower-severity neurological impairment (Table).

**Discussion** | Distinguishing children with high-intensity neurological impairment from those with lower-intensity neurological impairment is important, as evidenced by their greater multimorbidity, polypharmacy, and health care use and spending. Although inherent limitations exist when using diagnostic codes, the results of this study suggest that high-intensity neurological impairment codes may allow health care systems and payers such as Medicaid to efficiently identify these medically complex children with unique, higher-intensity needs. We believe the use of high-intensity neurological impairment codes could enable the prioritization of comparative effectiveness, health outcomes, and pharmaceutical research in this vulnerable population.

Joanna E. Thomson, MD, MPH

James A. Feinstein, MD, MPH

Matt Hall, PhD

James C. Gay, MD, MHC

Breann Butts, MD

Jay G. Berry, MD, MPH

**Author Affiliations:** Division of Hospital Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio (Thomson); Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, Ohio (Thomson); Adult and Child Consortium for Health Outcomes Research & Delivery Science, Children's Hospital Colorado, University of Colorado, Aurora (Feinstein); Children's Hospital Association, Lenexa, Kansas (Hall); Division of General Pediatrics, Department of Pediatrics, Monroe Carell Jr Children's Hospital at Vanderbilt, Vanderbilt University Medical Center, Nashville, Tennessee (Gay); Pediatric Housestaff, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio (Butts); Complex Care Service, Division of General Pediatrics, Department of Medicine, Boston Children's Hospital, Harvard Medical School, Boston, Massachusetts (Berry).

**Accepted for Publication:** April 5, 2019.

**Corresponding Author:** Joanna E. Thomson, MD, MPH, Division of Hospital Medicine, Cincinnati Children's Hospital Medical Center, 3333 Burnet Ave, ML 9016, Cincinnati, OH 45229 (joanna.thomson@cchmc.org).

**Published Online:** August 19, 2019. doi:10.1001/jamapediatrics.2019.2672

**Author Contributions:** Dr Hall had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** Thomson, Feinstein, Hall, Berry.

**Acquisition, analysis, or interpretation of data:** All authors.

**Drafting of the manuscript:** Thomson, Feinstein, Hall, Berry.

**Critical revision of the manuscript for important intellectual content:** Feinstein, Gay, Butts, Berry.

**Statistical analysis:** Thomson, Feinstein, Hall.

**Obtained funding:** Thomson, Feinstein, Berry.

**Administrative, technical, or material support:** Gay, Butts, Berry.

**Supervision:** Gay, Berry.

**Conflict of Interest Disclosures:** None reported.

**Funding/Support:** This study was funded by award K08HS025138 from the Agency for Healthcare Research and Quality (AHRQ) (Dr Thomson) and award

K23HD091295 from the Eunice Kennedy Shriver National Institute of Child Health & Human Development (NICHD) of the National Institutes of Health (Dr Feinstein). Drs Berry and Hall were supported by grant HRSA-17-060-147599 (Children with Special Healthcare Needs Research Network) from the Maternal and Child Health Bureau.

**Role of the Funder/Sponsor:** The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

**Disclaimer:** The content is solely the responsibility of the authors and does not necessarily represent the official views of the AHRQ, NICHD, National Institutes of Health, or the Maternal and Child Health Bureau.

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### Association of No Promotion of Homosexuality Laws and Electronic Cigarette Use Disparities for Sexual Minority Youth

Although US laws regarding sexual minorities have advanced in recent years, many state laws may still foster environments that can promote health disparities. As of March 2019, 7 US states (Texas, Arizona, South Carolina, Oklahoma, Louisiana, Alabama, and Mississippi) with nearly 9 million public school students<sup>1</sup> have laws explicitly prohibiting positive portrayals of sexual minority individuals or nonheterosexual activities in public school education (no promotion of homosexuality [NPH] laws). Recent school climate studies have demonstrated that the presence of NPH laws in a state is associated with a greater likelihood that students with sexual minority status will experience harassment or assault at school.<sup>1</sup> Thus, NPH laws may reflect and support school environments that exacerbate stress for these adolescents.<sup>2</sup>

Use of tobacco is a stress-driven health disparity for sexual minority individuals.<sup>3</sup> Most research on tobacco use by members of sexual minority groups has focused on cigarette smoking, but use of e-cigarettes has increased rapidly in recent years, and in 2016, e-cigarettes became the most commonly used tobacco product among middle school and high school students.<sup>4</sup> Adolescents believe that flavored e-liquids, which contain glycerin-based liquids not meant to be inhaled,<sup>5</sup> are targeted toward them.<sup>6</sup> We investigated the associations between current e-cigarette use and NPH laws by sexual orientation and sex.