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Impact of a Standardized Neurologic Exam on Diagnosis of and Referral Pattern for Neurologic Disorder in Pediatric Toe Walking

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Introduction of the Problem

Successful management of toe walking, a common patient complaint addressed by pediatric orthopedic providers, requires detection of concerning neurologic causes for toe walking. Recent studies inform best practices for the history and physical (H&P) of toe walking patients, describe recommended guidelines, and point to the distribution of neurologic causes of toe walking to highlight the importance of prompt referral. Haynes et al. (2018) found that more than 60% of pediatric patients with toe walking referred to neurology by orthopedic surgeons had an underlying pathologic diagnosis. Prompt referral to a neurologist when a neurologic red flag is identified leads to earlier detection and treatment of problems (i.e. neurosurgery for tumor removal or early intervention and therapy services for developmental issues). If an incomplete history or physical occurs, missing a neurologic cause is possible, and treatment recommendations will be misguided. Treating with ineffective bracing or surgery when the cause of toe walking is neurologic is not cost effective and may cause patient harm.

Based on a chart review, nurse practitioners in an urban outpatient pediatric orthopedic clinic in eastern Missouri were not consistently documenting the H&P findings pertinent to a neurologic examination for toe walking patients nor following recommended guidelines, resulting in delayed or missed referrals and poorer patient outcomes. Over the course of one year, during an initial visit for toe walking, only 30% of patients seen had documentation of muscle tone, and only 65% of patients had documentation of timing of developmental milestones, both of which are vital in determining a neurologic cause for toe walking. At least 13% of patients did not receive a needed referral despite documented findings that should have prompted one. In discussion, nurse practitioners in this clinic verbalized a lack of confidence in

performing neurologic exams and sought guidance on the required aspects of the neurologic H&P for this patient population.

Thus, the stakeholders decided to pursue a performance improvement project to translate evidence from the literature into practice. Using plan-do-study-act (PDSA) cycles, the team worked to improve nurse practitioner compliance in completing documentation of neurologic assessments for toe walking patients to ensure prompt detection of signs or symptoms that require evaluation by a neurologist and elicit the needed referral.

Literature Review

Amongst experts, definitions of toe walking and the inclusion/exclusion criteria for diagnosing idiopathic toe walking vary. Thus, providers should use caution when diagnosing toe walking as idiopathic, as without a thorough H&P, providers may miss a neurologic or neuropsychiatric cause (Haynes et al., 2016; Haynes et al., 2018).

At a minimum, providers should document the H&P aspects that Haynes et al. (2018) used to refer patients to neurology: unilateral involvement, birth history of prematurity/complications/prolonged Neonatal Intensive Care Unit stay, concerning family history, start of walking greater than 18 months, upper motor neuron or lower motor neuron signs, hyperactivity, features of autism, and dysmorphic features. Haynes et al. (2018) noted even when toe walking presented years prior, most providers did not refer until around six years of age. They encouraged earlier referral as delays in referral mean delays in treatment.

Haynes et al. (2016) concluded neurologists often find a neurologic cause for toe walking when orthopedic surgeons refer to neurology. Furthermore, 18% of patients seen in this outpatient orthopedic clinic for toe walking were referred to neurology. In a different study by

Haynes et al. (2018), orthopedic providers referred 17% of children seen for toe walking to neurology.

Cognitive aids such as tools or checklists have played an important role in ensuring safe and reliable service in many industries, including healthcare. Williams, Tinley, and Curtin (2010) and Sivaramakrishnan and Seal (2015) published tools or best practices guidelines to evaluate patients who toe walk. Williams et al.'s "Toe Walking Tool" was found to be valid and reliable, albeit with a small sample size. Sivaramakrishnan and Seal (2018) wrote a best practices article and developed a table that describes etiology, assessment features, and management strategies.

Project Methods

This performance improvement project sought to educate pediatric nurse practitioners in an urban, outpatient, pediatric orthopedic clinic in eastern Missouri. Two PDSA cycles were utilized. The goals were to educate the team, increase documentation of important points in neurologic assessments for toe walking patients, ensure prompt detection of signs or symptoms that require evaluation by a neurologist, and elicit the needed referral. Rates of needed documentation compliance and rates of referral were compared pre- and post-intervention. The process improvement plan involved three stages: education, chart review, and data analysis. The project was deemed a quality improvement project, not human subjects research, by the Southern Illinois University Edwardsville Institutional Review Board.

Teaching Intervention for Nurse Practitioners in the Outpatient Clinic

The Institute for Healthcare Improvement's (IHI) (2016) course "QI 102: How to Improve with the Model for Improvement" and Roger Clarke's (1999) "Diffusion of Innovations Theory" were used to create the educational intervention. A Zoom lecture was recorded, which each member of the nurse practitioner team viewed.

Chart Review and Data Analysis

IHI (2016) recommend PDSA cycles as part of the Model for Improvement, which were utilized for chart review and data analysis. The project lead reviewed the charts for patients seen by nurse practitioners for an initial visit for toe walking to determine whether H&P exam findings that elicit neurologic differences were documented. The project lead recorded whether a referral to neurology was given within six months of the initial visit for each patient who would need one based on the documented H&P.

The project lead completed three phases of chart review: 1) the calendar year 2018, including patients seen by all nurse practitioners, as the pre-intervention data; 2) March to December 2019, including only the patients seen by the project lead, as the first PDSA cycle; and 3) one month after the group educational intervention, including patients seen by all nurse practitioners, as the second PDSA cycle.

Evaluation

Instruments

Data from the chart review was recorded in Excel, tracking 30 points pertinent to the H&P. The project lead used descriptive statistics to evaluate the pre- and post-intervention data.

Outcomes

The nurse practitioners educated verbalized understanding and appreciation for the intervention. Pertinent materials from the educational intervention were housed in a binder easily accessible to staff for future reference.

The 2018 cohort included 52 patients who met inclusion criteria. The first PDSA cycle, March-December 2019, included 18 patients. The second PDSA cycle, the one-month period

post-educational intervention, included four patients. The number of patients seen during the one-month period was likely impacted by clinic volume restrictions related to COVID-19.

The number of pertinent H&P exam findings charted:

- 2018: *0-5*: 9, *6-10*: 32, *11-15*: 12, *16-20*: 0.
- 2019: *0-5*: 0, *6-10*: 0, *11-15*: 7, *16-20*: 11.
- 2020: *0-5*: 2, *6-10*: 0, *11-15*: 1, *16-20*: 1.

In the first cohort, six patients saw neurology prior to the visit with orthopedics. Five of 52 patients seen were referred to neurology, a 10.8% referral rate compared to the 17-18% referral rate reported by Hayes et al. (2018) and Haynes et al. (2016). Pertinent outcomes from referrals to neurology included genetic consultation and electromyography. Several patients referred had no results of consultation in the medical record. Three of 52 patients had a plan of possible referral to neurology if they had no improvement by next visit with orthopedics. Based on the chart review, at least seven patients had pertinent H&P findings that should have prompted referral to neurology—13% of the total 52 patients, or 15% of patients who had not previously seen neurology.

In the second cohort, two patients saw neurology prior to the visit with orthopedics. Of note in this cohort, a toe walking tool was consistently used during evaluations. Six of 18 patients were referred to neurology, a 33% referral rate. Pertinent outcomes from referrals to neurology included diagnoses of global delay and possible seizures, diagnoses of attention deficit hyperactivity disorder and autism, diagnosis of diplegic cerebral palsy, and referral to a movement disorder clinic with initiation of a drug trial. Three patients had Magnetic Resonance Imaging (MRI) ordered by the orthopedic nurse practitioner or the neurologist, with one MRI that was read as normal, one that revealed a syrinx, and one with results pending. Based on the

chart review, three patients had pertinent H&P findings that should have prompted referral to neurology.

In the third cohort, no patients had seen neurology prior to the visit with orthopedics. One patient was referred to a neurodevelopmental pediatrician with no return note at the time of the chart review (this patient was seen by the project lead with a nurse practitioner colleague observing). Based on the chart review, no other patients had pertinent H&P findings that should have prompted referral to neurology. In this small cohort of four, the data did not have enough power to determine if the educational intervention to the wider nurse practitioner team was impactful. However, while only 10% of patients seen were referred to neurology pre-intervention, 32% were referred post-intervention if the two PDSA cycles are combined (35% or seven of 20, if those who saw neurology prior to orthopedics are excluded).

Impact on Practice

Findings pre- and postintervention were shared with nurse practitioner staff and other key stakeholders at the facility. As demonstrated by the increase of points charted, pediatric nurse practitioners improved documentation of a neurologic-focused H&P after education. The nurse practitioners reported increased knowledge and confidence after the educational intervention. They verbalized intent to apply the information to care for other orthopedic conditions with neurologic associations, like patients with cerebral palsy or acute change in gait.

The predicted long-term impacts of the intervention are increased performance and documentation of the neurologic H&P and an increase in referrals to neurology. Patients who toe walk, along with others with potential neurologic concerns, benefit. The nurse practitioner team will use the educational binder to educate new hires. Finally, with a consistent H&P, a research project to evaluate treatment methods is possible.

In the next phase of the PDSA cycle, the nurse practitioner team should continue to hold each other accountable in performance and documentation of the neurologic H&P. Team members regularly read each other's notes when preparing for future clinics and may use this time to track progress. None of the charts reviewed showed documentation of all the possible 30 points, so a charting tool or built-in note for the electronic medical record may be beneficial. They may choose to track the frequency of completion of referrals to neurology or track results from those referrals.

Conclusions

An educational intervention increased nurse practitioner completion and documentation of important neurologic findings when evaluating pediatric patients who toe walk. Consistency in performance of this skill set will lead to confidence, both in completing the exam and educating patients. Thus, neurologic causes that lead to morbidity and mortality will be quickly identified with needed referrals completed. In the future, the nurse practitioners will continue to apply this to neurologic exams for other patient populations, improving care.

Data suggests the educational intervention was helpful, especially in the first PDSA cycle. The second PDSA cycle did not have enough data to have power; however, the nurse practitioners could choose to continue to track documentation to improve data power. To save time during the visit, they could give families a screening tool to fill out while waiting to be seen. They could also build a note into the charting system specifically for toe walking, with click and free-text options.