PEDIATRIC NEUROPSYCHOLOGICAL FEEDBACK AND PATIENT OUTCOMES

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

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presented by Emilie sparrow,

a candidate for the degree of master of arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

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TABLE OF CONTENTS

LIST OF TABLES

Table

PEDIATRIC NEUROPSYCHOLOGICAL
FEEDBACK AND PATIENT OUTCOMES

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ABSTRACT

The present study advances the literature on the utility of current neuropsychological assessment (NA) by offering an in-depth examination of medical records of youth patients who complete NA, identifying the presence of NA report characteristics that may enhance NA utility, and examining NA recommendation follow-through within the hospital system.

Participants include all patients aged 5 years or older who received neuropsychological testing services in the MU Health Care Pediatric and Adolescent Specialty Clinic between October 2021 and October 2022 (N=130). The PI created a novel coding system, "NA Characteristics Coding System" to collect all data for this study.

Results show that majority of patients were referred by a source within the MU healthcare system (91.5%) and in-person feedback was the most common oral feedback modality (42.9%). NA reports for 130 patients included over 1,800 recommendations total (across school, medical, parenting/behavior change, books/websites/community resources, and therapy/mental health categories), with each patient receiving an average of 14 recommendations. The two neuropsychologist assessors differed significantly in the number and type of recommendations they provided. Follow-through with medical recommendations was most common for the general health follow-up, specialty provider follow-up, and medication categories.

Future studies may utilize this method of chart review to characterize aspects of neuropsychological assessment, though caregiver interview is necessary to further investigate the subjective aspects of the process, such as attitudes and barriers to follow-through.

Pediatric Neuropsychological Feedback and Patient Outcomes

Neuropsychological assessment (NA) is the use of various tools (e.g., standardized tests of cognitive/academic/motor functioning, emotional/behavioral questionnaires, and clinical interviews) to obtain a range of data about a person's cognitive strengths and weaknesses as well as the nature and severity of any type of cognitive impairment (Gruters et al., 2012; Longley et al., 2012). These data can be used for various outcomes including informing medical decision making (e.g., for surgery, medication, rehabilitation services, etc.), educational services, and differential diagnosis.

NA is often utilized in medical settings for patients with both organic disorders and acquired diseases/injuries that are known to have neurological impacts on development and/or cognition. In medical settings, physicians are accurate in assessing impairment only in the most severe cases of cognitive impairment; making NA results available for the physician's clinical exam substantially increases accuracy in identifying impairments in adult patients (Arffa & Knapp, 2008). Though helpful for medical management and treatment planning, NA can also be time-consuming, challenging, and potentially frustrating for adult patients who may not understand results or receive feedback that is meaningful to them (Tharinger & Pilgrim, 2012). It is essential to establish and maximize the utility of NA, in order to judiciously use scarce resources (e.g., patient and provider time, financial costs) and create sustainable services.

Consumer satisfaction is the most common metric used to assess utility in the healthcare setting (Farmer & Brazeal, 1998). For NA, caregiver satisfaction is certainly a goal; for example, the evaluation itself may provide validation and support for caregivers. However, the articulated benefits of NA (e.g., informing medical management, treatment, and educational planning) do not come solely from completion of the procedure itself, but extend to desired outcomes derived from application of the resulting information and recommendations. Prior research in both adult and pediatric literature has gone beyond informal acknowledgement of the hypothesized usefulness of NA and formally investigated the clinically meaningful outcomes associated with the service, such as diagnostic changes or additions, changes to approaches in treatment, and increased or appropriate access to services (Allott et al., 2011). One study analyzed "usefulness" on a two-factor scale including useful understanding and useful changes (Arffa & Knapp, 2008). Investigators identified multiple variables that loaded highly on caregiver-reported usefulness such as refining the diagnosis, understanding strengths and weaknesses, changing home management strategies, and changing psychological treatment. Another study found satisfaction ratings to be directly related to the types of recommendations provided, specific mention of patients' strengths and problem areas, and suggestions for practical ways to apply the information to their everyday lives (Farmer & Brazeal, 1998). This research supports the idea of assessing NA utility beyond patient satisfaction alone by considering other clinically meaningful outcomes such as recommendations generated and behavior change or actions such as recommendation follow-through.

Communicating Results/Recommendations

One potentially important way of maximizing NA's utility is by providing clear communication to patients about the results of the assessment. Providing feedback to caregivers about the results of neuropsychological assessment, with the goal of helping them understand the child's condition and any implications for daily life functioning, is part of current typical assessment practices (Gruters et al., 2021). Such results/recommendations are typically communicated following assessment in both a written (i.e., NA report) and oral (i.e., NA feedback session) format. All psychologists conducting assessment are required under the

American Psychological Association's ethics code to "take reasonable steps to ensure that explanations of results are given to the individual or designated representative…" (APA, 2017, Standard 9.10). They have an additional ethical obligation to provide feedback that is understandable and useful to clients (APA, 2017, Standard 9.10).

Historically, the NA feedback session was severely underutilized and undervalued. It wasn't until 1986 that professionals began focusing on this session as both a therapeutic and diagnostic obligation (Allen et al., 1986; Smith et al., 2007). Only a handful of studies have focused on the most effective way to conduct a feedback session (Fallows & Hilsabeck, 2013). Research with adult patients has demonstrated that neuropsychological feedback is a valuable practice that results in direct benefit to clients who receive it compared to those who do not (Pegg et al., 2005; Smith et al., 2007; Rosado et al., 2018). In adult populations, feedback has been shown to improve individuals' ability to cope with their conditions, improve quality of life, contribute to reduced psychiatric and cognitive symptoms, and improve self-efficacy (Gruters et al., 2021; Smith et al., 2007; Rosado et al., 2018). Although less research in this area has included pediatric populations, it is believed that feedback increases caregiver understanding of a child's strengths and weaknesses (Farmer & Brazeal, 1998; Kirkwood et al., 2017; Bodin et al., 2007; Arffa & Knapp, 2008). Caregivers report an increased understanding of how to address problems at home, as well as a more positive perception of the child's quality of life (Quillen et al., 2011; Kirkwood et al., 2017; Bodin et al., 2007).

In addition to the oral feedback sessions, results are also communicated through a written neuropsychological assessment report. One study compared two methods of feedback in a population of veterans – oral feedback only compared to oral and written information (Fallows & Hilsabeck, 2013). The study found that receiving supplemental written information improved recollection of recommendations and that patients preferred to receive written information in addition to oral feedback compared to no written information. An additional study investigating how often the NA report was shared with other professionals, researchers found that 100% of participants shared the report with another professional, most often with a teacher or school psychologist (DeVries, 2017). These findings support the utility of providing assessment reports to caregivers, particularly so that they can share information with other individuals who participate in the child's care (e.g., primary care providers) or initiate services.

Measures of Feedback Utility

Across studies, participants continuously identify increased understanding and behavior change as two major measures of NA utility (Allott et al., 2011; Arffa & Knapp, 2008; Farmer & Brazeal, 1998). NA feedback represents an opportunity contribute to these measures of usefulness in its unique ability to enhance understanding and explain recommendations in an individualized manner (Glaun et al., 1998).

Suggesting Useful Change

One suggested goal of NA feedback is setting the groundwork for appropriate intervention (Pollak, 1988). Recommendations, both for services and behavior changes (both for the child, such as sleep routine, and the caregiver, such as parenting approach), must be part of an individualized and collaborative process between the patient and evaluator (Braaten, 2007; Gorske, 2017; Westervelt et al., 2006). Providing knowledge to patients about treatment strategies and community resources is one aspect of suggesting change (Farmer & Brazeal, 1998). Suggesting specific behavior changes is an additional source of feedback utility and individualized examples for these change recommendations have been shown to be an effective means of communication (Spano et al., 2021). In a survey of referring clinicians' usefulness, referrers identified that over half of the adult clients referred received recommendations for beneficial changes to treatment (Allott et al., 2011).

Recommendation Follow-Through

Only a few studies have examined patients' follow-through with NA report recommendations (Gruters et al., 2021). On average, overall adherence to recommendations in these studies was 40% (Gruters et al., 2021). Because following through with assessment recommendations is arguably a much more direct index of the benefit of assessment than patient satisfaction, examining facilitators and barriers to follow-through is an important research focus.

One study found that NA recommendation follow-through was facilitated by parental agreement with diagnoses, positive attitudes/beliefs about the recommendations, and knowledge of parent's role in obtaining treatment for their child (Cadman et al., 1984). Research has shown that adherence to NA recommendations that are not pharmacological in nature is generally low for various healthcare populations (Stimmel et al., 2019). When recommendations are divided between medical, educational, and social service (e.g., counseling, community resources) categories, caregivers are found to be significantly less successful in obtaining social services compared to medical or educational (Roizen et al., 1996). Even when investigating recommendations for change in the home environment, only 47% of home-based recommendations were implemented (Cheung et al., 2014). In a scoping review of NA feedback, identified barriers to recommendation follow-through were similar to those of caregiver understanding identified prior and include patient disagreement with or unwillingness to adapt to recommendations, patient misunderstandings or a need for more information about the recommendations, a desire to speak with physician regarding recommendations, and difficulty obtaining recommended services (Gruters et al., 2021).

Several of these barriers (misunderstanding, need for more information, desire to speak with physician) may be impacted by the complexity of the recommendations, which may encompass several aspects of the recommendations. For example, complexity may be influenced by the layout of recommendations in the written report, amount of information included, and readability (e.g., reading level, jargon language) of written reports (Gruters et al., 2021). Treatment recommendations that require multiple appointments or long-term dedication are also more complex and likely to jeopardize follow-through (Roizen et al., 1996; Glaun et al., 1998). The barrier of a patient's attitude (unwillingness to accept the recommendation) can be influenced by the type of recommendation, ease of implementation, cost, involvement of others (e.g., family), and difficulty getting the child on board (Cheung et al., 2014). Ambivalence about recommendations and patients having multiple presenting problems are two additional factors that are associated with noncompliance (Roizen et al., 1996; Jones & Caldwell, 1981). Because one of the primary goals of NA is setting the groundwork for appropriate intervention, barriers to follow-through introduce a significant problem in the utility of overall neuropsychological assessment (Pollak, 1988).

Current Study

The present study advances the literature on the utility of current neuropsychological assessment (NA) by offering an in-depth examination of medical records of youth patients who complete NA. to identify the presence of NA report characteristics that may enhance NA utility and follow-through, and to examine follow-through with NA recommendation within the hospital system.

This study examines several factors identified in current neuropsychology literature that may be associated with the utility of NA, including feedback delivery format (e.g., modality of oral feedback, paragraph or bullet point presentation of written recommendations) and recommendation characteristics that may reflect the effort required to understand and follow through, such as reading level of written recommendations, financial and time burden of pursuing recommendations (e.g., insurance coverage, repeated vs. single follow-up visits, travel requirements), novelty of recommendations (i.e., recommendation to pursue a new action vs. to continue a current action).

The study addresses three overarching research questions: (1) how is NA feedback is provided to patients? (2) what recommendations are given to patients? And (3) how frequently do patients follow medical recommendations? Within Question 1, we examine specific characteristics of the feedback (e.g., modality of oral feedback) and recommendations (e.g., presented in paragraph vs. bullet point form, recommending a new vs. continuing behavior, required travel distance to follow the recommendation). Within Question 2, we examine recommendation types (e.g., medical vs. non-medical and types of medical recommendations). Within Question 3, we examine overall rates of recommendation follow-through, as well as examining follow-through by recommendation characteristics and types.

This careful and detailed characterization of how patients received NA feedback, what types of recommendations they received, and how often they followed through with medical recommendations will guide future testable hypotheses about potential predictor of NA utility and follow-through. Although this study does not have sufficient power to examine potential predictive relationships regarding follow-through of recommendations directly, the descriptive data collected may suggest such relationships that warrant examination in future studies.

Method

Participants

Participants include all patients aged 5 years or older who received neuropsychological testing services in the MU Health Care Pediatric and Adolescent Specialty Clinic between October 2021 and October 2022 (N=130). NA reports were available in electronic medical records (i.e., charts) for all patients. Patients were 53.8% male, 80% White, and averaged 11.6 years old (see Table 1 for additional demographic information). Half (50%) of patients had commercial insurance and they traveled an average of 40.7 miles to receive testing.

Procedures

The PI conducted electronic medical record review (via PowerChart) of all patients' charts who met participant criteria (in terms of age and date of NA). One of the study's co-investigators coded a randomly selected 20% of charts to obtain the inter-rater agreement goal of 80% for all variables. Data were recorded in an Excel data dictionary. Most information was either immediately evident from the assessment report or within the patients' broader electronic medical record. The PI developed a coding system ("NA Characteristics Coding System") for the chart review, which included demographic data (gender, age, insurance, address, and travel from address to Pediatric and Adolescent Specialty Clinic), NA report and oral feedback characteristics (reason for referral, source of referral, NA assessor, whether patient presented for a re-evaluation, format of recommendations, count of each type of recommendation, and feedback presence and modality) and NA medical recommendation characteristics (type of medical recommendation, whether the recommendation included the patient's name, suggested a new or continued behavior, was invasive, and suggested a one-time or repeated action, reading level) and follow-through with the recommendation) (see Appendix A for coding system details).

Outside applications were used to calculate two variables. First, Google Maps was used to calculate the miles from patients' home addresses to the Pediatric and Adolescent Specialty

Clinic at MU Women's and Children's Hospital. Second, the Readability Scoring System (readabilityformulas.com; see Appendix 2) was used to calculate the Flesch-Kincaid Reading Level readability score for recommendations. To obtain the readability score for each recommendation, patient names were replaced with a placeholder (NAME) and any websites included in the recommendation were removed as these would inflate the score.

Measures

NA Characteristics Coding System

Patient Demographics. Demographics obtained from chart review included gender (male, female, transgender male, transgender female, or other), age (in years), insurance (Medicaid, commercial, or none listed), and address (used to calculated travel miles).

NA Report and Oral Feedback Characteristics. Data obtained from the overall NA report included the reason for testing, referring source and name, whether referring source was within MU system, neuropsychologist assessor (one of two providers), and whether the patient presented for re-evaluation.

Within patient NA reports, recommendations were coded into five mutually exclusive and exhaustive categories (school, medical, therapy/mental health, parenting/behavior change, and books/websites/community resources). School recommendations include all things school-related, and coding here took primacy over coding in another category. Medical recommendations include those for outpatient therapy, medication, general health follow-up, specialty provider follow-up, further assessment, and re-evaluation. Therapy/mental health recommendations include any recommendation for mental health treatment. Parenting/behavior change recommendations include any recommendation for caregivers or patients to change behavior (e.g., sleep schedule changes, parenting skills, etc.). Recommendations solely focused on providing other resources such as books or websites were included in the resources category. The total number of books/websites/apps/other resources within a report, regardless of category, was also recorded as a total number of resources provided to each patient.

Recommendations were written in either narrative paragraphs or numbered lists. For all non-medical recommendations, each paragraph/number counted as one recommendation, regardless of the number of actions suggested. For medical recommendations, each action was counted separately to allow more detailed coding of action follow-through. Therefore, the number of medical recommendations was inflated compared to the other types.

NA Medical Recommendation Characteristics and Follow-Through. Medical recommendations were coded in more detail. Each medical recommendation was copied and pasted into the recommendation-level tab within the Excel data dictionary. For each part of the recommendation that indicated a specific action, the PI coded whether the patient's name was included within the broader paragraph/numbered bullet, the type of recommendation (i.e., outpatient therapy, medication, general health follow-up, specialty provider follow-up, further evaluation, or re-evaluation), whether it was for a new or continued behavior (e.g., begin a new treatment or continue a current treatment), invasiveness, whether it was for a one-time or repeated action (e.g., one time consultation or multiple-visit outpatient therapy regimen), and the Flesch-Kincaid reading level (using readabilityformulas.com) of the broader paragraph/numbered bullet. For example, if the broader recommendation was for occupational and physical therapy, the entire paragraph/numbered bullet recommendation would be pasted twice (once in reference to the occupational therapy recommendation and once for physical therapy) and each variable would be recorded respective to the relevant action (i.e., both coded as outpatient therapy type, new behaviors, non-invasive, repeated actions, and the same reading level since they came from the same broader paragraph/numbered bullet).

Next, follow-through was evaluated for each patient's "primary" medical recommendations. These recommendations include only the first medical recommendation in each category (i.e., outpatient therapy, medication, etc.) per patient. Using only primary medical recommendations limited the data to one datapoint per patient in each category and thus avoided non-independent data in analyses involving medical recommendation follow-through.

Follow-through was coded as yes/no for all medical recommendations. Follow-through was defined as any action made to complete the recommendation. For example, if outpatient therapy was recommended, the patient did not have to complete a full "X" number of sessions but needed to present for an evaluation/first session to count as followed. Additionally, patients were considered to have followed through on recommendations made about medication if the medical record contained evidence that they had either discussed the medication with a provider (other than the NA assessor) or started a medication. Four patients did not receive oral feedback due to inability to contact/schedule but were only mailed reports. These patients are not included in follow-through data since the assessor was not able to explain recommendations to caregivers. For data on follow-through, recommendations that re-evaluation was not necessary or for re-evaluation at a future date (further than May 2024) were removed either because patients did not need to do anything to complete this recommendation or because patients did not have the opportunity to complete this recommendation yet.

Results

Results examined three primary research questions. The first question, how NA feedback is provided, was examined with general descriptive statistics (means, standard deviations, counts and percentages) to characterize the NA visit and feedback, including written reports and oral feedback, and to characterize the format of recommendations included in written reports. The second question, what recommendations are given to patients, was examined with general descriptive statistics as well to characterize the types of recommendations included in written reports. Differences across the two assessors' recommendation formats and types were also examined, with descriptive statistics and chi-square analyses. The third question, how frequently do patients follow medical recommendations, was examined with general descriptive statistics and chi-square analyses. Due to the exploratory nature of analyses, no alpha corrections were used with chi-square or follow-up analyses.

NA Report and Oral Feedback Characteristics

Table 2 provides descriptive data on the neuropsychological visit and report at the patient-level. Patients were split evenly between neuropsychologist assessors 1 and 2. The majority of patients were referred by a source within MU system (91.5%) and oral in-person feedback was the most common oral feedback modality (42.9%) in addition to written reports. The format of NA report recommendations was split evenly between paragraph/narrative text and numbered/bullet point styles and had a perfect correlation with assessor (assessor 1's recommendations were all numbered and assessor 2's were all paragraph format).

Recommendation Types

NA reports included over 1,800 recommendations across 130 patients. Table 3 presents the frequency of recommendations by type and by assessor across all reports and the average number of recommendations of each type and by each assessor per report. On average, patients received about 14 recommendations each. Assessor 2 provided over twice the total number of recommendations and mean recommendations per report as assessor 1. Across both assessors, school recommendations were provided the most frequently, closely followed by medical recommendations. Within assessor, assessor 1 provided mostly medical recommendations and assessor 2 provided mostly school recommendations.

Chi-square analyses examined whether there were significant relations between assessor and total number of recommendations made or recommendation types. There was a significant relation between assessor and total number of recommendations provided, $X^2(1, N = 1805) = 217.8$, $p<.001$, as assessor 1 provided significantly fewer recommendations than expected and assessor 2 provided significantly greater recommendations than expected. The chi-square test of independence examining the relation between assessor and recommendation type was also significant, $X^2(4, N = 1805) = 423.6$, $p<.001$, meaning that the variables assessor and recommendation type are not independent and the relationship did not occur by chance. Follow-up tests examined differences across recommendation type for each assessor, Assessor 1 showed significant differences across recommendation types, $X^2(4, N = 589) = 285.4$, $p<.001$, with significantly more medical recommendations, $X^2(1, N = 368) = 153.12$, $p<.001$, and significantly fewer school, $X^2(1, N = 74) = 95.39$, $p<.001$, and resource recommendations, $X^2(1, N = 19) = 32.79$, $p<.001$, than expected under the null hypothesis. We found the opposite pattern for assessor 2, with significant differences across recommendation types, $X^2(4, N = 1216) = 285.4$, $p<.001$, but significantly fewer medical recommendations, $X^2(1, N = 230) = 74.17$, $p<.001$, and significantly more school, $X^2(1, N = 595) = 46.21$, $p<.001$) and resource recommendations, $X^2(1, N = 181) = 15.88$, $p<.001$) than expected. Neither assessor differed from the null hypothesis on providing recommendations for parenting/behavior change or therapy/mental health.

Across all recommendations in the 130 NA reports, over 700 specific resources (websites, books, etc.) were provided. Assessor 2 provided 723 specific resources and assessor 1 provided 46. Resources were dispersed across types of recommendations (e.g., books for teachers within school recommendations and phone numbers for mental health providers within therapy/mental health recommendations).

Medical Recommendation Types

Table 4 presents frequencies of medical recommendations by type and by assessor across all reports and average number of recommendations of each type by each assessor per report. Across all reports, recommendations to see a specialty provider were provided the most frequently, followed closely by recommendations for outpatient therapy, and recommendations for further assessment were provided the least frequently. Within assessor, assessor 1 provided mostly specialty provider follow-up recommendations and assessor 2 provided mostly outpatient therapy recommendations.

Chi-square analyses examined whether there were significant relations between assessor and total number of medical recommendations made or medical recommendation types. Overall, there was a significant relation between assessor and total medical recommendations provided, $X^2(1, N = 598) = 31.8, p<.001$, as assessor 1 provided significantly greater medical recommendations than expected and assessor 2 provided significantly fewer medical recommendations than expected. The chi-square test of independence examining the relation between assessor and medical recommendation type was also significant, $X^2(5, N = 598) = 25.1$, $p<.001$, meaning that the variables assessor and medical recommendation type are not independent and the relationship did not occur by chance. Follow-up tests examined differences across recommendation type for each assessor. For assessor 1, there was no significant difference across recommendation types, $X^2(5, N = 368) = 10.38, p = .065$. Assessor 2 showed significant differences across recommendation types, $X^2(5, N = 230) = 16.6, p =.005$), with significantly more recommendations for outpatient therapy $X^2(1, N = 67) = 4.67, p = .031$) and significantly fewer recommendations for specialty provider follow-up, $X^2(1, N = 35) = 6.80, p = .009$) than expected under the null hypothesis. Although statistically significant, the difference in percentages of outpatient therapy and specialty provider follow-up provided by assessor 2 throughout all reports was minor, 29.1% compared to 15.4%, respectively.

Medical Recommendation Characteristics

Table 5 provides additional details about the characteristics of the medical recommendations. Medical recommendations had an average readability score of 15.6 meaning that the average reading level was just above 15^{th} grade (college-level). Overall, a greater number of medical recommendations involved beginning a new behavior/service rather than continuing a behavior, completing non-invasive rather than invasive procedures, involved a one-time action compared to repeated actions, and recommended pursuing treatment rather than solely seeking further assessment/information. There were very few recommendations that involved an invasive procedure (15 out of 598) or a service that would only provide information rather than treatment (3 out of 598).

Average Patient Follow-Through

Table 6 details average patient follow-through overall and by the demographic variables and oral feedback characteristics discussed in Tables 1 and 2. On average, patients followed about half of the recommendations provided in their NA report. Follow-through percentages were similar for patients evaluated by each assessor, for those who traveled over vs. under 40 miles, for patients who received feedback via different modalities, and for patients with Medicaid vs. commercial insurance.

Primary Medical Recommendation Follow-Through

Table 7 includes data on follow-through with primary medical recommendations by type of recommendation. Patients completed recommendations for medication (61.8% of recommendations followed), general health follow-up (65.2% of recommendations followed), and specialty provider follow-up (63.4% of recommendations followed) most often out of all types. Recommendations for further evaluation were followed least often (15.8%).

Table 8 details primary medical recommendation follow-through by type and by recommendation characteristics discussed in Table 5. Examining patterns of primary medical recommendation follow-through suggests that recommendation characteristics appear important for follow-through of the various types of medical recommendations. For example, patients had a higher rate of follow-through of outpatient therapy recommendations when they were to continue a current behavior. Medication recommendations had a higher rate of follow-through for those with a readability score above 15 and those that involved a one-time action and a beginning a new behavior. Recommendations with a readability score of 15 or below, repeated actions, and continued behaviors all had a greater rate of follow-through for general health follow-up recommendations. Specialty provider follow-up recommendations were followed most often for those that were to continue a current behavior. Recommendations for further assessment and re-evaluation both had greater follow-through rates for those with a readability of 15 or below and further assessment additionally had greater follow-through for continued behaviors.

Discussion

Contributions and Implications

Overall, results portray the outcomes of recent pediatric neuropsychological services at MU Women's and Children's Hospital. The current study utilizes chart review to glean patient and feedback characteristics, format and type of recommendations included in written reports, and follow-through characteristics (e.g., effort) of medical recommendations. The chart review method may represent an efficient way to evaluate follow-through as well as several aspects of the effort required for patients and their families to follow NA recommendations, as chart review requires no response from caregivers. Thus, chart review can be helpful as a first step in examining recommendation follow-through before contacting patients.

We posed three primary research questions: how is NA feedback provided in both written report and oral feedback formats, what recommendations are given to patients, and how frequently do patients follow-through with medical recommendations.

Question 1: How is NA Feedback Provided?

Patients were split evenly between the two neuropsychologist assessors included in this study. Majority of patients were referred by a source within MU system and majority received oral feedback via telehealth. Notably, COVID-19 precautions impacted feedback modality during this time as providers were more likely to utilize telehealth, which was a new feature as of 2020, for oral feedback sessions compared to in-person appointments. When in-person, providers and families were both masked and distanced.

The two neuropsychological assessors differed in the number and types of recommendations they provided. There are multiple potential reasons for this discrepancy in number and type of recommendations including the differing formats of the recommendations between assessors and how these formats were coded. Assessor 1 tended to place multiple recommendations within a category into the same number (i.e., all school recommendations under number one in the numbered list, thus counting as one recommendation in that category), whereas assessor 2 broke each recommendation into a separate paragraph (i.e., each school recommendation placed in a different paragraph, thus each counting as one recommendation in that category).

Question 2: What Recommendations are Provided to Patients?

Within medical recommendations, general health follow-up, specialty provider follow-up, and medication recommendations were provided most frequently overall. Discrepancies between number and type of medical recommendations between assessors are not accounted for by the coding method of recommendations as each medical recommendation, regardless of if it was part of a larger number/paragraph, was counted as one in order to evaluate follow-through of each action. Therefore, data suggests that each assessor truly did provide significantly different numbers of medical recommendations, with assessor 1 providing significantly more than assessor 2. This difference may be due in part to the reason for referral of each patient. It is possible that assessor 1 saw patients primarily for school-related concerns, thus providing a greater number of school recommendations, whereas assessor 2 may have seen patients primarily for medical-related concerns, thus providing a greater number of medical recommendations. Despite differences in the number and types of medical recommendations, patients of each assessor had comparable rates of follow-through across medical recommendations.

Question 3: How Frequently do Patients Follow-Through with Medical Recommendations?

In terms of medical recommendation follow-through, results show that within MU Healthcare, patients are following about 50% of recommendations given. This is slightly higher than general recommendation follow-through rates found in the literature (e.g., 40%) (Gruters et al., 2021). Some reasons that patients may not follow-through are that they followed outside of MU system (including that providers have left MU system and they followed with them or that services were not available through MU system), they aged out of services, they were discharged from outpatient therapies, or that the wait time for services was too long. The COVID-19 pandemic may also have played a role in patient follow-through as patients may have felt unsafe following some recommendations or otherwise unable to do so.

Examining the pattern of findings suggests that the rate of medical recommendation follow-through differs by type of recommendation and patient insurance, as suggested by the literature (Stimmel et al., 2019; Cheung et al., 2014). General health follow-up, specialty provider follow-up, and medication recommendations were both provided and followed the most frequently. Previous literature identified that follow-through of recommendations not pharmacological in nature is generally low, but, within MU system, we found the two most highly followed categories of medical recommendations were non-pharmacological. It is possible that general health follow-up and specialty provider follow-up were among the most followed recommendations due to patients typically being able to access these services within MU system. This would make it easier for the assessors to place referrals for patients or message their other providers within MU system to place less burden on patients for scheduling their own appointments. Additionally, recommendations for medication may be among the most followed due to majority requiring only a one-time action (discussion of the medication). The production and subsequent follow-through of recommendations within MU system portrays the downstream revenue and referral generation that neuropsychological services stand to produce.

Patients with Medicaid follow a greater average number and percent of medical recommendations. Medicaid provides the least financial burden to families and higher cost is identified in the literature as one barrier to recommendation follow-though (Cheung et al., 2014). Other barriers identified in the literature include layout of recommendations, readability, and ease of implementation (Gruters et al., 2021; Roizen et al., 1996; Glaun et al., 1998). Our data suggest that outpatient therapy, further assessment, and re-evaluation recommendations with a readability score of 15 or below had higher rates of follow-through. Additionally, medication recommendations for a one-time action compared to repeated action had greater rates of follow-through. In terms of novelty, outpatient therapy, general health follow-up, and specialty provider follow-up all had higher rates of follow-through for recommendations to continue a current behavior, thus being potentially easier to act on.

Our data do not suggest that layout of recommendations or travel distance made a difference in rates of recommendation follow-through. This finding is quite interesting as we expected to find recommendations that required greater effort (as measured by travel distance and action required) to result in less follow-through. It may be that patients who travel a greater distance are used to traveling for medical appointments and therefore are not discouraged by the distance required. It is also possible that the severity of the medical diagnosis the recommendation is regarding is a greater predictor of follow-through rather than the effort required.

Limitations

Despite being an efficient means of gathering data, chart review to evaluate NA assessment utility does present limitations. Documentation within and between patient charts is not exhaustive nor perfectly consistent. For example, chart review does not capture all aspects of effort identified in the literature (e.g., patient’s attitude, involvement of others including family). In terms of the documentation of follow-through, some medical recommendation types required providers mention specifically whether that type was followed. Specifically for recommendations related to medication, providers had to include conversations about medication in their notes. Additionally, the variable “travel” was calculated from the listed home address in the patient's medical record. This address may not actually be where they are traveling from, nor may not be up to date. Chart review is also unable to capture services pursued outside the healthcare system maintaining the chart. For the current sample, chart review captured services provided by a large and fairly comprehensive university healthcare system, but it is likely that patients pursued at least some services outside of this system, especially those patients who may have travelled a long distance for specialty assessment but can pursue medical recommendation follow-up closer to home. Finally, because chart reviews typically cover a finite period of time, they may not capture recommendations that fall outside the time frame of the study.

In addition, this study was limited by a small sample size and heterogeneous sample in terms of race/ethnicity that precluded statistical analyses that would have allowed investigation of predictive relationships. With greater power, a multilevel modeling approach would be helpful to allow for examination of all medical recommendations rather than only primary medical recommendations. A broader study across sites outside of MU Hospital would have increased generalizability in addition to yielded more assessors and variability in report styles to further examine relationships between variables, such as layout of recommendations, and follow-through of recommendations.

Conclusion and Future Directions

The current study contributes a new chart review measure that future investigators can use with patient charts to characterize aspects of neuropsychological assessment. We provide a largely descriptive dataset to the literature to characterize current practices in one NA clinic and inform future hypotheses to be tested with larger sample sizes and greater power.

One future direction may be to see how this clinic's findings compare to other clinics. Investigating what NA reports from other clinics look like would allow for the identification of commonalities in variables discussed (e.g., readability), and inform which variables are truly important for predicting follow-through of recommendations. This would inform potential changes to clinic practices, whether implementing training in particular clinic(s) to change NA report and feedback practices or changes on a broader scale (i.e., field-wide). One takeaway for current practice within MU system's neuropsychology service includes being cognizant of the readability level used in NA recommendations.

Although this study did not suggest that all measures of effort (e.g., travel distance) contribute to rates of follow-through, future research should continue investigating which aspects of effort are most strongly related to follow-through. With greater power, future studies may analyze the rates of follow-through for different types of medical recommendation follow-through, depending on specific patient characteristics or circumstances.

Future studies may utilize this method of chart review as a first step when analyzing patient outcomes. We want to place as little burden on caregivers as possible and this method allows researchers to capitalize on existing data, reserving caregiver interviews for only what cannot be gained from patient charts (including subjective explanations of experience). Next steps include conducting a similar study with a larger sample to test relationships between variables and predictors of medical recommendation follow-through, overall. Following this larger chart review, families should be interviewed about reasons follow-through did not occur as well as about the presence of follow-through of recommendations outside of MU system.

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Table 1

Patient Sociodemographic Characteristics

	N	%
Gender (n=130)		
Female	58	44.6
Male	70	53.8
Transgender Male	2	1.5
Race/Ethnicity (n=130)		
White	104	80
Black or African American	7	5.4
Hispanic, Latino, or Spanish Origin	6	4.6
Asian	2	1.5
Some Other Race or Multiple Selections	10	7.7
Declined to answer	1	0.8
Insurance (n=130)		
Medicaid	63	48.5
Commercial	65	50
None	2	1.5

Table 2
Neuropsychological Assessment Report and Oral Feedback Characteristics

	N	%
Neuropsychological Assessments	130	
Neuropsychologist Provider		
Assessor 1	65	50
Assessor 2	65	50
Referring source within MU	119	91.5
Received Oral Feedback	126	96.9
Oral feedback Modality (n=126)		
In-Person	54	42.9
Telehealth via Zoom	41	32.5
Telehealth via Phone	25	19.8
Unspecified Telehealth	6	4.8
Written Recommendations Format (n=130)		
Paragraph/narrative text	65	50
Numbered/bullet points	65	50

Table 3

Number and Percent of Recommendation Types – Overall, per Report, and by Assessor

	N (%) for All Reports			Mean N per Report (SD)		
	Total	Assessor 1	Assessor 2	Total	Assessor 1	Assessor 2
Total	1805	589	1216	13.9 (6.6)	9.1 (2.6)	18.7 (5.8)
Type						
School	669 (37.1)	74 (12.6)	595 (48.9)	5.1 (5.1)	1.1 (0.8)	9.2 (4.4)
Medical	598 (33.1)	368 (62.5)	230 (18.9)	4.6 (2.4)	5.7 (2.4)	3.5 (1.8)
Parenting/Behavior Change	236 (13.1)	84 (14.3)	152 (12.5)	1.8 (1.3)	1.3 (1)	2.3 (1.4)
Books/Websites/ Community Resources	200 (11.1)	19 (3.2)	181 (14.9)	1.5 (1.9)	0.3 (0.5)	2.8 (1.9)
Therapy/Mental Health	102 (5.7)	44 (7.5)	58 (4.8)	0.8 (0.6)	0.7 (0.6)	0.9 (0.5)

Note. Percentages within each column are percentages of that assessor's total number of recommendations.

Table 4

Number and Percent of Medical Recommendation Types – Overall, per Report, and by Assessor

	N (%) For all Reports			Mean N (SD) Per Report		
	Total	Assessor 1	Assessor 2	Total	Assessor 1	Assessor 2
Total	598	368	230	4.6 (2.4)	5.7 (2.4)	3.5 (1.8)
Outpatient Therapy	134 (22.4)	67 (18.2)	67 (29.1)	1 (1.2)	1.1 (1.1)	1 (1.2)
Medication	86 (14.4)	49 (13.2)	37 (16.2)	0.7 (0.6)	0.7 (0.7)	0.6 (0.6)
General Health Follow-Up	91 (15.2)	60 (16.2)	31 (13.6)	0.7 (0.5)	0.9 (0.4)	0.5 (0.5)
Specialty Provider Follow-Up	141 (23.6)	106 (28.6)	35 (15.4)	1.1 (1.4)	1.6 (1.5)	0.6 (0.9)
Further Assessment	29 (4.8)	23 (6.2)	6 (2.6)	0.2 (0.6)	0.4 (0.7)	0.1 (0.3)
Re-evaluation	117 (19.6)	63 (17)	54 (23.7)	0.9 (0.3)	1 (0.2)	0.9 (0.4)
Possible within time frame of study	57 (48.7)	26 (41.3)	31 (57.4)	0.8 (0.3)	0.9 (0.3)	0.8 (0.4)
Recommended for future time (beyond study timeframe)	39 (33.3)	17 (27)	22 (41)	1 (0)	1 (0)	1 (0)
Not necessary	21 (17.9)	20 (31.7)	1 (1.9)	1 (0)	1 (0)	1 (0)

Table 5
Medical Recommendation Characteristics

	Total Medical Recommendations (n=598)	
	N	%
Type of Behavior		
New Behavior	381	63.7
Continue Behavior	217	36.3
Action Required		
Repeated Action	258	43.1
One-Time Action	340	56.9
Outcome of Follow-Through		
Information	3	0.5
Treatment	595	99.5
Invasiveness		
Invasive	15	2.5
Not Invasive	583	97.5

Note. Average readability of medical recommendations was 15.6 with a standard deviation of 3.5.

Table 6
Average Follow-Through of Medical Recommendations per Patient – Overall, by demographic variables, and by Oral Feedback Characteristics

	Recs Made	Recs Followed	
	Mean (SD)	Mean n(%)	SD
Total	4.6 (1.8)	2.1 (49.3)	1.8 (33.3)
Travel			
Under 40 miles	4.3 (0)	1.9 (43.6)	1.4 (28.4)
Over 40 miles	5.3 (2.7)	2.3 (50.1)	0.03 (33.3)
Feedback Modality			
In-Person	4.7 (2.5)	2.4 (52)	1.9 (32)
Telehealth - Zoom	4.4 (2.7)	2.1 (41.8)	1.9 (30)
Telehealth - Phone	3.2 (2)	2 (68.3)	1.6 (36.1)
Provider			
Assessor 1	5.1 (2.2)	2.5 (46.7)	1.9 (30.1)
Assessor 2	3.3 (1.7)	1.9 (53.5)	1.6 (36.5)
Insurance			
Medicaid	4.4 (2.1)	2.5 (53.5)	1.3 (26.3)
Commercial	4 (2)	1.8 (47.4)	1.1 (25.3)

Table 7

Number and Percent of Primary Medical Recommendation Follow-Through by Rec Type

	Recs Made	Recs Followed	
	N	*N*	%
Outpatient Therapy	65	24	36.9
Medication	76	47	61.8
General Health Follow-Up	89	58	65.2
Specialty Provider Follow-Up	71	45	63.4
Further Assessment	23	9	39.1
Re-evaluation	57	9	15.8

Table 8
Number and Percent of Primary Medical Recommendation Follow-Through by Type and Recommendation Characteristics

Outpatient Therapy (*N*=65)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	23	10	43.5
Above 15	42	14	33.3
Action Required			
Repeated Action	44	17	38.6
One-Time Action	21	7	33.3
Type of Behavior			
New Behavior	50	16	32
Continue Behavior	15	8	53.3

Medication (*N*=76)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	21	9	42.9
Above 15	55	38	69.1
Action Required			
Repeated Action	23	10	43.5
One-Time Action	53	37	69.8
Type of Behavior			
New Behavior	51	35	68.6
Continue Behavior	25	12	48

Table 8 Continued

General Health Follow-Up (*N*=89)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	45	36	80
Above 15	44	22	50
Action Required			
Repeated Action	82	57	69.5
One-Time Action	7	1	14.3
Type of Behavior			
New Behavior	10	1	10
Continue Behavior	79	57	72.2

Specialty Provider Follow-Up (*N*=71)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	36	23	63.9
Above 15	35	22	62.9
Action Required			
Repeated Action	31	20	64.5
One-Time Action	40	25	62.5
Type of Behavior			
New Behavior	34	19	55.9
Continue Behavior	37	26	70.3

Table 8 Continued

Further Assessment (*N*=23)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	15	7	46.7
Above 15	8	2	25
Action Required			
Repeated Action	0	-	-
One-Time Action	23	9	39
Type of Behavior			
New Behavior	22	8	36.4
Continue Behavior	1	1	100

Re-evaluation (*N*=57)	Recs Made	Recs Followed	
	N	*N*	%
Readability			
15 or below	24	6	25
Above 15	33	3	9.1
Action Required			
Repeated Action	0	-	-
One-Time Action	57	9	15.8
Type of Behavior			
New Behavior	57	9	15.8
Continue Behavior	0	-	-

Appendix A: Chart Review

Variable	Description
Patient Level	
Insurance	Medicaid, commercial, or n/a
Address	Patient address
Travel (miles)	Calculated from address to MU Women's and Children's
Feedback and modality	Y/N and in-person, telehealth-zoom, telehealth-phone, telehealth-unspecified, or n/a
Gender	Male, female, transgender male, transgender female, other
Age (years)	
Reason	Reason for visit listed in report
Provider	Assessor 1 or Assessor 2
Re-evaluation	Y/N
Referee and source	Name, specialty, and within MU Y/N
Format	Paragraph or numbered
Type	School, Medical, Therapy/Mental Health, Parenting/Behavior Change, Books/Websites/Community Resources
Total Books	Total number of books/websites/apps/phone numbers within all recommendations
Recommendation Level	
Summary	Pasted recommendation
Name	Y/N if recommendation included patient's name
Type	Outpatient therapy, medication, general health follow-up, specialty provider follow-up, further evaluation, or re-evaluation
New/Continued	New behavior or continued behavior
Invasive	Y/N
One/Repeated	One time action or repeated action
Flesch-Kincaid Reading Level	
Follow	Y/N

Appendix B: Flesch-Kincaid Grade Level Calculation

> The specific mathematical formula is:
>
> **FKRA** = (0.39 x ASL) + (11.8 x ASW) - 15.59
>
> Where,
>
> FKRA = Flesch-Kincaid Reading Age
>
> ASL = Average Sentence Length (i.e., the number of words divided by the number of sentences)
>
> ASW = Average number of Syllable per Word (i.e., the number of syllables divided by the number of words)

Appendix C: Annotated Bibliography

Empirical Studies

Citation Key (In-text)	**Method;Outcomes;Results**
(Bennett-Levy et al., 1994)	survey (51% response rate);experience with NPA;
(Arffa & Knapp, 2008)	survey (70% response rate) sent following feedback session medical records;satisfaction with NPA number of recommendations;high ratings of perceived utility and evidence of changes in diagnosis and recommendations for treatment planning
(Belciug, 2006)	survey - presented with open ended list of concerns and asked to identify their own concerns and challenges (then concerns ranked in hierarchy);concern regarding patient's level of functioning after NPA;
(Bodin et al., 2007)	survey (35% response rate);satisfaction with NPA;
(Cheung et al., 2014)	semi-structured interviews (22 by phone, 1 by email, 2 in person) Miles and Huberman methodological framework for identifying major themes: QSR NVivo 9.0 data analysis software;perceived effectiveness of report difficulty of implementing recommendations;implementation of recs at home: 47% implementation of recs at school: 41% patient understanding plays sig role in implementing recs
(Connery et al., 2016)	survey;post-concussive symptom reduction parent satisfaction with NPA;
(Fallows & Hilsabeck, 2013)	structured interview directly after feedback and 1 month later by phone;retention of diagnostic info adherence to treatment recs;
(Farmer & Brazeal, 1998)	survey (47% response rate) Assessment Impact Questionnaire;effect of NPA on parent perceptions of their child coping with child's disability adequacy of NPA;
(Foran et al., 2016)	systematic search focus groups pilot study;satisfaction with NPA (14 item scale);
(Gruters et al., 2020)	questionnaires..patient satisfaction, patient-doctor relationship, and the questions in notes ;experiences with NPA and diagnostic disclosure;questionnaire for patients/family: "I understand my NPA results", "The expalanation gave insight into cognitive weakneses", "The explanation gave insight into cognitive strengths" rated on 5-point likert scale this all happened during feedback session though
(Holst et al., 2009)	survey - letter with info about study with questionnaires attached (two clinics - one with 30 patients and one with 29. 32 people gave written consent. if stuff didnt get sent back in 1 month then they were contacted again as a

	reminder. 3 people requested help from study personnel (2 in person and 1 via telephone)) the assessment questionnaire (AQ) SF-36 GAF DIP-Q Basic and Earning Self-Esteem scales;satisfaction with feedback self-perceived health basic and earning self-esteem;correlation tested btwn AQ scores and age, gender, diagnosis, GAF, SF-36, DIP-Q, and basic earing self-esteem statistically sig variables were general health, mental health, and basic self esteem were set in multivariate regression with degree of satisfaction as dependent variable divided participants into two groups (satisfied vs dissatisfied depending on great or less than 3.4 score on AQ groups scored low on new self-awareness and positive/accurate mirroring groups differeed significantly on total satisfaction signitificant relationship btwn low satisfaction and low self-esteem
(Kirkwood et al., 2017)	survey The satisfaction survey consisted of the thirty-item rating scale utilized by Bodin et al. (2007), plus two additional items. The Bodin instrument was comprised of all eight items from the Client Satisfaction Questionnaire (Larsen, Attkisson, Hargreaves, & Nguyen, 1979), which was used to measure general satisfaction. The questionnaire also included six of the most psychometrically robust items from the Assessment Impact Questionnaire (Farmer & Brazeal, 1998), and eight items from the Measure of Processes of Care (King, Rosenbaum, & King, 1996). Eight new items were also created by Bodin et al. to more explicitly evaluate structural variables (e.g., satisfaction with insurance coverage, time on wait list, report). Bodin et al. conducted a factor analysis of their instrument that resulted in four retained factors: General Satisfaction, Clinician

	Acceptance/Empathy, Provision of Help, and Facilities/Administrative Assistance.;satisfaction with NPA;
(Lanca et al., 2019)	survey;satisfaction with NPA psychiatric and cognitive symptoms perceived memory ability self-efficacy;
(Longley et al., 2012)	survey;knowledge of cognitive profile, coping;
(Meth et al., 2016)	telephone interview 7 weeks after NPA;retention and adherence to recommendations following letter or no loetter of supplemental written reminder of recs;
(Meth et al., 2019)	survey;type/frequency of recommendations;
(Postal & Armstrong, 2013)	semi-structured interviews;;
(Pritchard et al., 2014)	survey after NPA and after 5 months surveys: satisfaction with the assessment and satisfaction with recommendations;parent rating of child symptoms parent rating of child quality of life satisfaction with NPA;
(Quillen et al., 2011)	survey - 5 point likert scale helpfulness rating (for how helpful they perceived the implemented recs to be in improving their child's quality of life;implementation of recommendations improvement of parent perceived child quality of life;
(Rosado et al, 2018)	survey at baseline and 6-8 weeks later semi-structured interview;perceived stress understanding of condition coping;
(Stimmel et al., 2019)	semi-structured interview: asked if they recalled receiving mailed report and phone call for feedback what recommendations they recall and which they completed...if not completed asked why and then put into 1/5 categories: 1) wanting more information or to speak with their neurologist about the recommendation, 2) difficulty navigating insurance or finding a provider, 3) not thinking the recommendation was necessary, 4) too busy/lack of time, and 5) other. asked whethery they adheared to rtherapy and other meds retrospective record review: Age, Education duration, Time since MS diagnosis, Time between testing date and phone interview, Depression: PHQ-9 score, Fatigue, Race , Marital status, Adherence to medication, Employment status also recorded number of recs given (1-4 with most receiving 3);;at least 4 attempts to contact patient wwere made before excluding from study
(Tharinger & Pilgrim, 2012)	survey;parent and child experiencd with NPA satisfaction with NPA;

(Turner et al., 2012)	informal questions during NPA;satisfaction with NPA;
(Westervelt et al., 2007)	survey (37% response rate);satisfaction with NPA;

Opinion Articles

Citation Key (In-text)	**Notes**
(Carone et al., 2010)	in-person feedback model with three phases
(Carone et al., 2013)	in-person feedback model with three phases
(Carone, 2017)	in-person feedback model with three phases
(Clement et al., 2001)	army medical center
(Crosson, 2000)	describes potential pitfalls and solutions for delivery in-person feedback
(Evans et al., 2019)	recommendations for report writing, such as language translation and considering both cultural and linguistic differences
(Gass & Brown, 1992)	in-person feedback model with six phases
(Gorske, 2007)	in-person feedback model with five phases
(Gorske & Smith, 2009)	in-person feedback model with five phases
(Green, 2000)	discusses final stage of NPA and followup
(Griffin & Christie, 2008)	audit showing most families found report difficult to understand or unhelpful
(Ruppert & Attix, 2014)	recs for feedback summary