



# Accuracy of Parent Perception of Comprehension of Discharge Instructions: Role of Plan Complexity and Health Literacy

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The authors have no conflicts of interest to disclose.

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Received for publication May 8, 2019; accepted January 8, 2020.

## ABSTRACT

**OBJECTIVE:** Inpatient discharge education is often suboptimal. Measures of parents' perceived comprehension of discharge instructions are included in national metrics given linkage to morbidity; few studies compare parents' *perceived* and *actual* comprehension. We 1) compared parent perceived and actual comprehension of discharge instructions and 2) assessed associations between plan complexity and parent health literacy with overestimation of comprehension (perceive comprehension but lack actual comprehension).

**METHODS:** Prospective cohort study of English/Spanish-speaking parents ( $n = 192$ ) of inpatients  $\leq 12$  years old and discharged on  $\geq 1$  daily medication from an urban public hospital. We used McNemar's tests to compare parent perceived (agree/strongly agree on 5-point Likert scale) and actual comprehension (concordance of parent report with medical record) of instructions (domains: medications, appointments, return precautions, and restrictions). Generalized estimating equations were performed to assess associations between low parent health literacy (Newest Vital Sign score  $\leq 3$ ) and plan complexity with overestimation of comprehension.

**RESULTS:** Medication side effects were the domain with lowest perceived comprehension (80%), while  $>95\%$  of parents perceived comprehension for other domains. Actual comprehension varied by domain (41%–87%) and was lower than perceived comprehension. Most (84%) parents overestimated comprehension in  $\geq 1$  domain. Plan complexity (adjusted odds ratio 3.6; 95% confidence interval 2.9–4.7) and low health literacy (adjusted odds ratio 1.9; 1.3–2.6) were associated with overestimation of comprehension.

**CONCLUSIONS:** Parental perceived comprehension of discharge instructions overestimated actual comprehension in most domains. Plan complexity and low health literacy were associated with overestimation of comprehension. Future interventions should incorporate assessment of actual comprehension and standardization of discharge instructions.

**KEYWORDS:** communication; discharge instructions; health literacy; hospital medicine; inpatient setting; pediatrics

**ACADEMIC PEDIATRICS** 2020;20:516–523

## WHAT'S NEW

While most parents perceive comprehension of their child's inpatient discharge instructions, this does not equate to actual comprehension. Low parent health literacy and discharge plan complexity are associated with overestimation of comprehension.

THE HOSPITAL-TO-HOME TRANSITION is a vulnerable time for patients, with 15% of children having unanticipated healthcare utilization (eg, readmissions, emergency department [ED] visits)<sup>1</sup>; readmission rates are even higher for medically complex children.<sup>2</sup> Patient- and family-centered interventions around the time of discharge may help mitigate morbidity (eg, unanticipated visits, adverse drug events) associated with hospital-to-home transitions,<sup>1,3,4</sup>

especially as 20% to 60% of posthospitalization morbidity in adults may be preventable or ameliorable.<sup>5,6</sup> Despite efforts to improve care transitions, communication between providers and patients/families is variable.<sup>4,7</sup> This gap results in frequent parent errors in comprehension of, and subsequent adherence to, their child's discharge instructions across domains of care, including medications, appointments, return precautions (signs and symptoms to monitor and how to act on them), and restrictions.<sup>8</sup>

There remains a lack of consensus on how to ensure parent comprehension of and adherence to their child's discharge instructions. One of the simplest ways of doing so is assessing perceived comprehension, or asking the patient/family about whether they believe they understand specific aspects of discharge instructions or how to manage their or their child's health after discharge. Notably, 2 of the 3 items

on the Care Transitions Measure 3 (CTM-3), endorsed by the National Quality Forum<sup>9</sup> and a hospital value-based program measure for Centers for Medicare and Medicaid Services,<sup>10</sup> assess perceived comprehension. Items include: “When I left the hospital, I had a good understanding of the things I was responsible for in managing my health” and “When I left the hospital, I clearly understood the purpose for taking each of my medications.”<sup>11</sup> Such assessments have been associated with lower readmission rates and ED visits in some, but not all, adult studies.<sup>11–13</sup> One pediatric study did not find an association between perceived parent comprehension and decreased readmissions in adjusted analyses.<sup>14</sup> While comprehension of discharge instructions likely contributes to adherence and subsequent postdischarge morbidity,<sup>3</sup> the inconsistent links between perceived comprehension and postdischarge morbidity may be due to a lack of a relationship between perception of comprehension and actual comprehension.<sup>15</sup> Use of teachback, or assessing comprehension by having patients or caregivers summarize instructions in their own words, may be a superior strategy to ensure learning and improve outcomes.<sup>16,17</sup>

The relationship between perceived comprehension and objective measures of (actual) comprehension of discharge instructions has not been studied in pediatrics. Overestimation of comprehension, or when parents perceive comprehension but do not actually comprehend, may lead to worse outcomes as parents may not ask clarifying questions. Providers may not explicitly check for comprehension or provide additional counseling for parents reporting understanding. Previous studies have found that complexity of instructions<sup>18,19</sup> and low parent health literacy<sup>20,21</sup> are associated with errors in comprehension of and adherence to discharge instructions in the pediatric ED or in isolated domains of care (eg, medications, appointments) in the inpatient setting. No studies have examined risk factors associated with parent overestimation of comprehension in a holistic way across care domains.

Our objectives were to 1) determine the relationship between parents’ *perceived* comprehension and *actual* comprehension of discharge instructions and 2) examine whether discharge plan complexity and parent health literacy are associated with overestimation of comprehension.

## METHODS

### STUDY DESIGN AND SETTING

This was a prospective cohort study of parents of children admitted to the pediatric acute and intensive care units at Bellevue Hospital Center, a public hospital part of New York City Health + Hospitals; these units had 70 to 100 discharges per month during the study period. The hospital serves a primarily immigrant population with low socioeconomic status. As part of usual care at the study site, pediatric housestaff and nurses each complete discharge instructions (free-text in English, not standardized) in specific sections of an electronic health record (EHR)-based template. These instructions, along with information imported from the discharge medication reconciliation and appointments, are printed and provided to families. Nurses utilize these written

instructions as part of verbal counseling; interpreter services are available for all. There is no standardized process for verbal counseling from providers, although all parents in our study reported receiving verbal education from providers. Housestaff and nurses receive no formal education in discharge communication.

This study was approved by the New York University School of Medicine Institutional Review Board and New York City Health + Hospitals. Parents received a \$20 gift card as an incentive for participation.

### ENROLLMENT

Research assistants (RAs) consecutively approached parents to determine eligibility during daytime hours when parents and research staff were available during the hospitalization. We included the parent or legal guardian (subsequently referred to as parent) who spoke English or Spanish and self-identified as the primary caregiver; the child needed to be  $\leq 12$  years old and discharged on  $\geq 1$  daily medication (including vitamins). We excluded parents  $< 18$  years old and those with self-reported hearing difficulty, who had  $< 20/50$  vision on Rosenbaum screener, or who were previously enrolled. We obtained written informed consent in the preferred language of eligible parents who agreed to participate.

### ASSESSMENTS

We conducted structured parent surveys at 2 time points: at enrollment and within 12 hours of receiving formal discharge instructions. Surveys were conducted in English or Spanish (parent preference) by bilingual RAs.

After all surveys were completed, RAs extracted information related to the child’s discharge instructions from the EHR; for each case, 2 RAs performed this task given the unstructured nature of the instructions. In cases of disagreement between information extracted by the 2 RAs, the first author performed a third chart review.

### PRIMARY OUTCOME VARIABLES: COMPREHENSION OF DISCHARGE INSTRUCTIONS

RAs administered surveys within 12 hours of receipt of discharge instructions to assess parent comprehension. This survey included measures of perceived comprehension and an objective measure of comprehension (actual comprehension), described below. We assessed perceived and actual comprehension of instructions related to the following 4 domains (subdomains listed in parentheses): medications (name, indication, dose, frequency, duration, and side effects), appointments (physician name/specialty, indication), return precautions (symptoms), and restrictions (diet, activity, bathing, and school return). We adapted survey questions from other studies,<sup>14–16</sup> ensuring comprehensiveness of content and understandability for parents with limited health literacy by piloting questions prior to study initiation. Parents were encouraged to use the discharge instructions when answering survey questions. RAs were blinded to the instructions when administering the survey.

### PERCEIVED COMPREHENSION

Parents who believed that they understood the discharge instructions had perceived comprehension. For example, we assessed perceived comprehension of medication frequency with: “When we leave the hospital, I know how many times a day to give each medicine.” Parents rated their agreement on a 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree). Parents who reported “strongly agree” or “agree” were categorized as having perceived comprehension. Similar statements were used to assess perceived comprehension for all subdomains (Supplementary Appendix 1).

### ACTUAL COMPREHENSION

Actual comprehension was defined as whether parent report of instructions was concordant with instructions documented in the EHR. For example, we assessed actual comprehension of medication frequency by asking: “How many times a day will you give [MEDICINE NAME] to [CHILD’S NAME]?” We asked similar open-ended questions to assess actual comprehension of instructions for all subdomains (Supplementary Appendix 1). For all domains except for medication side effects, 2 clinicians independently assessed concordance between parents’ responses and instructions extracted from the EHR ( $\kappa > 0.9$  for all questions) to determine if parents made comprehension errors. Disagreements were resolved by consensus discussion. Parents were given credit for actual comprehension of side effects if able to report at least 1 known side effect<sup>22</sup> of any severity for each medicine, as written discharge documentation typically did not provide information on side effects. For individual restrictions, we categorized errors in actual comprehension if parents could not identify documented restrictions; for the purposes of our multivariable analysis, restriction responses were “correct” if no restrictions were documented in the EHR.

### OVERESTIMATION OF COMPREHENSION

In multivariable analyses, our primary outcome was overestimation of comprehension, defined as a parent both perceiving comprehension and responding with an answer that did not reflect actual comprehension. We assessed overestimation of comprehension for each individual subdomain.

### PRIMARY PREDICTOR VARIABLES

#### DISCHARGE PLAN COMPLEXITY

Discharge plan complexity was assessed separately for each domain (medications, appointments, return precautions, and restrictions). A medication regimen was considered complex if it had  $\geq 2$  medications, while  $\geq 2$  appointments were considered complex; prior work has shown higher error rates for discharge plans containing  $\geq 2$  medications or appointments.<sup>18</sup> Discharge plans with  $\geq 3$  return precautions or  $\geq 1$  restriction in any subdomain were categorized as complex (median split).

### HEALTH LITERACY

We assessed parent health literacy at enrollment using the Newest Vital Sign, consisting of 6 questions and previously validated in English and Spanish.<sup>23</sup> Parents were categorized as having low (0–3 questions correct) or adequate (4–6 correct) health literacy.<sup>23</sup>

### POTENTIAL COVARIATES

We collected the following variables at enrollment: parent age, sex, race/ethnicity, country of birth, preferred language, education, income, insurance type, number of children at home; child age, and sex. We administered the Beliefs About Medicines Questionnaire-General<sup>24</sup> as a measure of trust/cultural beliefs related to medications. We later asked parents whether they would have preferred additional interpreter use during discharge counseling. We extracted the following from the EHR: evening versus daytime discharge, weekend versus weekday discharge, if time was spent in the intensive care unit, length of stay, chronic disease status (Pediatric Medical Complexity Algorithm<sup>25</sup>), and if discharge medications were previously administered by parents at home at the same dose.

### ANALYSIS

We used descriptive statistics to characterize all predictor, outcome, and potential confounding variables. We used Stata SE 12.1 (StataCorp, College Station, Tex) for all analyses. A *P* value of  $< .05$  was considered statistically significant.

### COMPARISON OF PERCEIVED AND ACTUAL COMPREHENSION

We used McNemar’s tests to assess concordance between parent perceived and actual comprehension for each subdomain.

### ASSESSMENT OF PREDICTORS OF OVERESTIMATION OF COMPREHENSION

We used generalized estimating equations (exchangeable correlation structure, binomial distribution, logit link) to account for assessment of multiple types of errors in overestimation of comprehension for each subject. This allowed for creation of single models that assessed errors across subdomains, avoiding multiple comparisons. Unadjusted analyses were performed with our primary predictor variables: discharge plan complexity and parent health literacy. Adjusted analyses were performed with these variables in the same model, adjusting for the following potentially relevant confounders determined a priori based on literature review<sup>8,14,21,26</sup>: parent race/ethnicity, preferred language, child age, chronic disease status,<sup>25</sup> and length of stay. Other variables, including parent perception of appropriate interpreter use, were not associated with overestimation of comprehension in unadjusted analyses and were not included in adjusted analyses (Supplementary Appendix 2).

In addition to our main analyses, in which all subdomains were included, we performed a sensitivity analysis excluding those subdomains not regularly discussed in written instructions (side effects and restrictions).

## RESULTS

### SAMPLE CHARACTERISTICS

A total of 267 parents met eligibility criteria from June 15, 2015 to April 5, 2017 (Figure); 225 (84.2%) agreed to participate. The final sample included 192 parents (85.3% of those enrolled) for whom follow-up assessments were performed within 12 hours of discharge, most (72.4%) occurring in-person immediately after formal discharge education.

Subjects were primarily female (92.7%), Hispanic (71.4%), and born outside of the United States (69.3%; Table 1). Most (91.7%) had public/no insurance. Of the children, 39.6% were less than 1-year old. The most common primary discharge diagnoses were epilepsy, hyperbilirubinemia, cellulitis/abscess, urinary tract infection, asthma, appendicitis, and pneumonia, each accounting for  $\geq 5\%$  of diagnoses.

Most (78.1%) discharge plans had  $\geq 1$  complex domain of care. Most (74.5%) parents had low health literacy.

### PERCEIVED COMPREHENSION

Over 95% of parents perceived comprehension of instructions related to medication name, indication, dose, frequency, duration; appointment physician name/specialty and indication; and return precautions (Table 2). Fewer (80.2%) perceived comprehension of side effect instructions. In cases of documented restriction instructions, perceived comprehension was 100% for diet ( $n = 10$ ), activity ( $n = 9$ ), bathing ( $n = 13$ ), and school return ( $n = 2$ ).

### ACTUAL COMPREHENSION

Levels of actual comprehension varied between 80% and 90% for medication name, indication, frequency, duration; appointment physician name/specialty, and indication (Table 2). Levels were lower for instructions related to medication dose (76.0%), medication side effects (47.9%), and return precautions (40.6%). Actual comprehension varied (44.4%–100.0%) for restriction instructions when present.

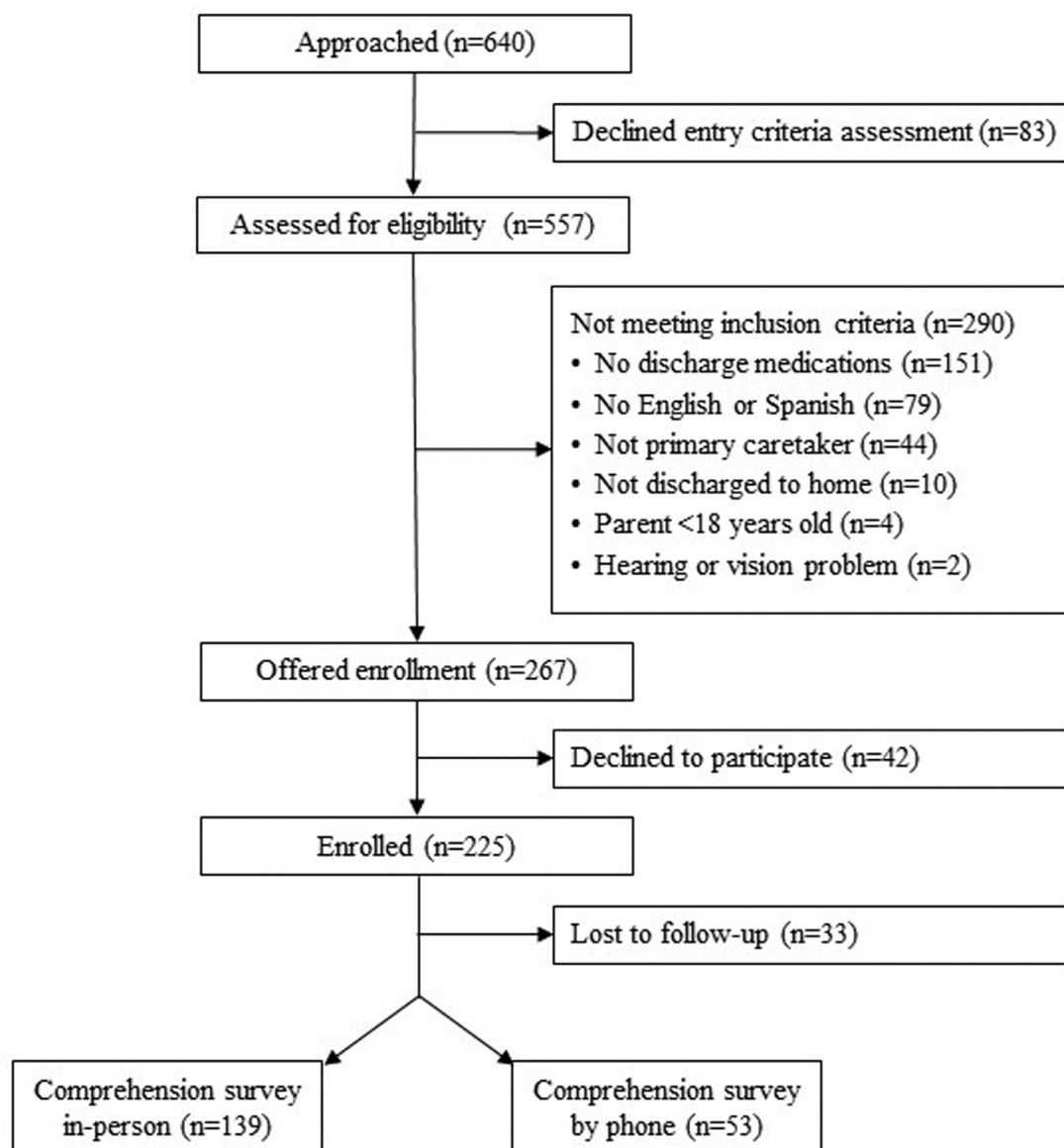


Figure. Study flow diagram.



**Table 1.** Parent, Child, and Hospitalization/Discharge Characteristics (n = 192)

Variable	Value*
<b>Parent</b>	
Age in years, median (IQR)	32 (27.25–28)
Female sex	178 (92.7)
Race/ethnicity	
Hispanic	137 (71.4)
Black, non-Hispanic	26 (13.5)
Asian, non-Hispanic	13 (6.8)
White, non-Hispanic	11 (5.7)
Other	5 (2.6)
Preferred language to speak	
English	114 (59.4)
Spanish	78 (40.6)
Born outside the United States	133 (69.3)
Income	
Less than \$25,000	74 (38.5)
\$25,000 or more	52 (27.1)
Missing (parent refused or did not know)	66 (34.4)
High school graduate	
Less than high school	56 (29.2)
High school or equivalent	61 (31.8)
More than high school	75 (60.9)
Number of children under 18 living at home, median (IQR)	2 (1–3)
Beliefs About Medicines Questionnaire-General, median (IQR)	24 (21–28)
Low health literacy (Newest Vital Sign Score 0–3)	143 (74.5)
<b>Child</b>	
Age in months, median (IQR)	27 (1.5–84.0)
Female sex	78 (40.6)
Chronic disease status <sup>25</sup>	81
No chronic disease	111 (57.8)
Noncomplex chronic disease	36 (18.8)
Complex chronic disease	45 (23.4)
Insurance	
Medicaid/Medicaid managed care	167 (87.0)
Private	13 (6.8)
No insurance	9 (4.7)
Other	3 (1.6)
Receiving discharge medication prior to admission	103 (53.6)
<b>Hospitalization/discharge-related</b>	
Length of stay in days, median (IQR)	2 (1–3)
Spent part of admission in pediatric intensive care unit	17 (8.9)
Evening discharge	11 (5.7)
Weekend discharge	27 (14.1)
Parent preference for additional use of interpreter for discharge counseling	29 (15.1)
Complex discharge plan	
Medications ( $\geq 2$ medications)	74 (38.5)
Appointments ( $\geq 2$ appointments)	46 (24.0)
Return precautions ( $\geq 3$ return precautions)	117 (60.9)
Restrictions ( $\geq 1$ restriction)	27 (14.1)
$\geq 1$ complex domain	150 (78.1)

IQR indicates interquartile range.

\*n (%) unless otherwise specified.

Parent perceived comprehension was significantly higher than actual comprehension for all medication, appointment, and return precaution subdomains (McNemar's  $P < .001$ ; Table 2). When restrictions were documented, perceived comprehension levels were generally higher than actual comprehension levels (not analyzed with McNemar's tests

given perceived comprehension of 100% and small sample size).

### OVERESTIMATION OF COMPREHENSION

Overestimation of comprehension varied by subdomain. Notably, 57.8% of parents overestimated comprehension of instructions related to return precautions, 42.2% for medication side effects, and 22.9% for medication dose (Table 2). Most (83.9%) parents overestimated comprehension of one or more subdomains.

In adjusted analyses, presence of a complex discharge plan (adjusted odds ratio 3.6, 95% confidence interval 2.9–4.7,  $P < .001$ ) and low parent health literacy (adjusted odds ratio 1.9, 95% confidence interval 1.3–2.6,  $P < .001$ ) were associated with overestimation of comprehension. This association remained when side effects and restrictions were excluded from analysis (Table 3).

### DISCUSSION

To our knowledge, this is the first study that assesses the relationship between parent perceived and actual comprehension of discharge instructions, as well as the factors associated with overestimation of comprehension. We found parental perceived comprehension of discharge instructions overestimated actual comprehension in most domains. Presence of a complex discharge plan and low parent health literacy were independently associated with overestimation of comprehension.

More than 95% of parents perceived comprehension of instructions related to medication name, indication, dose, frequency, and duration, as well as appointments, return precautions, and restrictions. These results are consistent with other work that found high levels of perceived comprehension of discharge instructions.<sup>14</sup>

While perceived comprehension was universally high, actual comprehension levels were significantly lower; more than 80% of parents overestimated comprehension of at least one of their child's discharge instructions. The statistically significant differences in perceived and actual comprehension observed across subdomains remain after use of a Bonferroni correction ( $P < .006$  [ $\alpha = .05$  and 9 subdomains]) to account for multiple comparisons. These results suggest that assessing perceived comprehension of discharge instructions alone may not be enough to prevent posthospitalization morbidity and may potentially explain the inconsistent connection between perceived comprehension and readmissions primarily studied in adults.<sup>12–14</sup> Assessment of actual comprehension may therefore be a superior method to ensure parents are able to follow discharge instructions. Use of health literacy-informed strategies, such as teachback, can lead to fewer medication dosing errors and improved knowledge of postdischarge regimens.<sup>16,17</sup> Future work should examine use of teachback in improving parent comprehension of inpatient discharge instructions and possibly ameliorating postdischarge morbidity.

While rates of overestimation of comprehension were high overall, errors were most common for return precautions, consistent with prior studies.<sup>8,15</sup> Accurately comprehending

**Table 2.** Comparison of Parent Perceived and Actual Comprehension of Discharge Instructions and Overestimation of Comprehension

Domain	Total n*	Perceived Comprehension, n (%) <sup>†</sup>	Actual Comprehension, n (%) <sup>‡</sup>	P Value <sup>§</sup>	Overestimation of Comprehension, n (%) <sup>  </sup>
Medications					
Name	192	190 (99.0)	167 (87.0)	<.001	25 (13.0)
Indication	192	187 (97.4)	154 (82.3)	<.001	33 (17.2)
Dose	192	189 (98.4)	146 (76.0)	<.001	44 (22.9)
Frequency	192	189 (98.4)	170 (88.5)	<.001	20 (10.4)
Duration	192	187 (97.4)	163 (84.9)	<.001	29 (15.1)
Side effects	192	154 (80.2)	92 (47.9)	<.001	81 (42.2)
Appointments					
Name/specialty	192	183 (95.3)	161 (83.9)	<.001	29 (15.1)
Indication	192	189 (98.4)	157 (81.8)	<.001	34 (17.7)
Return precautions	192	189 (98.4)	78 (40.6)	<.001	111 (57.8)
Restrictions					
Diet (n = 10)	10	10 (100)	7 (70.0)	¶	3 (30.0)
Activity (n = 9)	9	9 (100)	4 (44.4)	¶	0 (0.0)
Bathing (n = 13)	13	13 (100)	12 (92.3)	¶	1 (7.7)
School return (n = 2)	2	2 (100)	2 (100)	¶	0 (0.0)

\*Total number of parents for whom perceived and actual comprehension was assessed (comprehension of restriction instructions only assessed when documented in the electronic health record).

†Agree or strongly agree in 5-point Likert scale.

‡Concordance between parent report of instructions for all items within a given domain and instructions documented in the medical record (parents encouraged to use discharge instructions when answering questions).

§McNemar's test comparing perceived and actual comprehension of discharge instructions.

||Parent perceives comprehension but does not actually comprehend.

¶McNemar's test not performed as perceived comprehension at 100% with small sample size.

**Table 3.** Predictors of Overestimation of Comprehension\*

Variable	Primary Analysis Adjusted Odds Ratio (95% Confidence Interval) <sup>†</sup>	Sensitivity Analysis Adjusted Odds Ratio (95% Confidence Interval) <sup>‡</sup>
Complex discharge plan <sup>§</sup> (reference: noncomplex discharge plan)	3.6 (2.9–4.7) <sup>#</sup>	6.6 (4.8–9.0) <sup>#</sup>
Low health literacy <sup>  </sup> (reference: adequate health literacy)	1.9 (1.3–2.6) <sup>#</sup>	1.9 (1.2–2.9) <sup>¶</sup>

\*Generalized estimating equations (exchangeable correlation structure, binomial distribution, and logit link) to account for assessment of overestimation of comprehension (parent perceives comprehension but does not actually comprehend) for multiple subdomains of care for each subject. Models also adjusted for the following variables (chosen a priori), none of which reached statistical significance in the adjusted model: parent race/ethnicity, preferred language, child age, length of stay, and chronic disease status.<sup>25</sup>

†Model includes the following subdomains: medication name, indication, dose, frequency, duration, side effects; appointment physician name/specialty, indication; return precautions, restrictions.

‡Including subdomains from primary analysis other than side effects and restrictions.

§Complexity based on number of items per domain: ≥2 medications, ≥2 appointments, ≥3 return precautions, ≥1 restriction.

||Newest Vital Sign score dichotomized into low (0–3 of 6) and adequate (4–6 of 6).

¶P < .01.

#P < .001.

these instructions is important to ensure timely return to care for severe problems and to avoid unnecessary visits for expected benign symptoms. Providing adequate verbal and written education, including use of strategies like teachback, can lead to improved comprehension of return precautions.<sup>27</sup> Based on the results of our study, it is clear that an assessment of perceived comprehension (eg, “do you have any questions?” or “do you understand?”) alone would not allow providers to determine whether parents know about potentially concerning symptoms.

Medication side effects were also challenging for parents in our study. Perceived comprehension of side effects was lower (80.2%) compared to the other subdomains (>95%), suggesting parents have some insight into their difficulty with this area. Nonetheless, over 40% of parents overestimated comprehension of side effects, consistent with other

research.<sup>28</sup> Not being familiar with side effects could lead to parents presenting to care for benign side effects or not knowing how to react to more severe side effects. Future work should examine ways to improve comprehension of side effects, including standardizing instructions to ensure key side effects are outlined, as adverse drug events are less likely in patients given education in this area.<sup>29</sup>

Over 20% of parents overestimated comprehension of medication dose instructions, consistent with high dosing error rates found in other studies.<sup>16,26</sup> This is a key area for intervention given the possibility of adverse drug events associated with incorrect medication dosing. Use of health literacy-informed communication strategies, such as teachback and pictographic dosing diagrams, can help parents overcome challenges associated with dosing.<sup>16</sup> Such strategies should be incorporated into standardized discharge processes.

Parents overestimated comprehension in several other subdomains, albeit at lower rates. Over 15% of parents overestimated comprehension of instructions related to medications (indication and duration) and appointments (name/specialty and indication). Notably, perception of comprehension of medication indication is a component of the CTM-3,<sup>11</sup> but 17.2% of parents in our study overestimated comprehension in this area. Some individuals who have adequate ratings on the CTM-3 may therefore be at risk for posthospitalization morbidity, especially if they confuse which medication should be given for which purpose when regimens are complex (eg, controller and rescue medications for asthma).

Parents whose children had complex discharge plans were twice as likely to overestimate comprehension in our study. These findings are consistent with prior work, which established that complex regimens are associated with errors in discharge plan comprehension and adherence.<sup>18,19</sup> Additional studies are needed to determine how to most effectively educate families whose children are discharged with multicomponent regimens to ensure comprehension; it is possible, for example, that education for these families may require additional time, innovative modalities (eg, video instructions), or different communication techniques. Furthermore, additional interventions to ensure adherence in this high-risk group should be studied further. Delivering medications to bedside, coordinating appointments, and a postdischarge phone call may lead to improved adherence.

Low parent health literacy was also associated with overestimation of comprehension. This finding is consistent with other work indicating that patients and caregivers with low health literacy are more likely to make errors in comprehension of and adherence to care regimens.<sup>20,21</sup> Health literacy-informed interventions reduce medication errors after ED discharge<sup>16</sup>; future work should apply these principles to the inpatient setting and across domains of care. Experts recommend communicating with all families as if they have low health literacy, otherwise known as a universal precautions approach, as opposed to screening for health literacy.<sup>30</sup> Additional health literacy-informed communication strategies that all individuals may benefit from include limiting information provided, chunking information into easy-to-understand segments, and use of plain language.<sup>31</sup>

While it is important to ensure that parents can comprehend discharge instructions, it is unclear who is best suited to do so. Lack of time and competing priorities are barriers for physicians and nurses to provide adequate discharge education.<sup>32</sup> Providers lack training in discharge communication techniques<sup>33</sup> and seldom utilize recommended counseling strategies.<sup>7</sup> Systems-level changes in care delivery, often more easily adopted under value-based payment models, may ease the burden on providers and improve patient outcomes. Examples include use of a discharge facilitator to educate families, hiring care coordinators, and implementing postdischarge calls or home visits.<sup>32,34</sup> Future work should examine the impact of incorporating these systems-level changes on patient comprehension of instructions and costs.

Our study has limitations. Generalizability may be limited as we performed our study at a single site and primarily enrolled immigrant, Latino parents with low health literacy and public insurance. While most of our surveys were performed in-person at discharge, some were performed by phone based on research staff availability. All assessments, however, were performed within 12 hours of discharge, and mode/timing of assessment did not affect outcomes (data not shown). While over 80% of parents overestimated comprehension of  $\geq 1$  instruction, some errors are likely more impactful. Other studies have linked poor comprehension of medication dose<sup>35</sup> and side effects<sup>29</sup> with adverse events; future work should determine the impact of other domain-specific errors. In addition, few discharge plans contained information on side effects and restrictions, even for surgical diagnoses when one would expect bathing and/or activity restrictions. Even when side effects and restrictions were not included in multivariable analyses, overall associations between plan complexity and health literacy with overestimation of comprehension were unchanged. It is possible that other factors, such as locus of control or self-efficacy, may impact overestimation of comprehension; these factors should be examined further. Finally, we acknowledge that multiple nurses and physicians may provide verbal counseling throughout hospitalization that is not documented in written instructions and may even be contradictory. However, errors made by parents were typically consistent with a lack of knowledge, such as reporting that they did not know. Future work will include observations of discharge counseling.

In conclusion, our study shows that perceived comprehension was not consistently associated with actual parent comprehension of discharge instructions. Routine use of measures that assess perceived comprehension of discharge instructions may therefore not be sufficient. As parents whose children had complex discharge plans were more likely to overestimate comprehension, additional time for discharge education may be needed when this risk factor is present. Future research should focus on the design and evaluation of interventions that utilize health literacy-informed communication strategies, such as teachback, to ensure that parents actually comprehend instructions. Additional research is needed to determine if our findings are applicable in other settings (eg, neonatal intensive care unit, ambulatory clinic). Discharge processes should be standardized to ensure that parents are provided with education in all domains of care in the language that they speak.

## ACKNOWLEDGMENTS

We acknowledge the NYU Family Advisory Council for their input and assistance.

*Financial statement:* This work was supported by the National Institutes of Health/National Center for Advancing Translational Sciences (grant numbers 5KL2TR001446 and UL1TR001445), DHHS/HRSA (grant number T32HP22238), Academic Pediatric Association, the Committee of Interns and Residents/Service Employees International Union, and KiDS of NYU. The sponsors had no role in the study design, collection/analysis/interpretation of data, writing of the manuscript, or the decision to submit the manuscript for publication.

## SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.acap.2020.01.002>.

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