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Patient-oriented online resources in pediatric surgery: Are we failing the readability test?☆,☆☆

James M. Prieto [a,b], Cassidy West-Santos [c], Agnes S. Montgomery [c], Utsav Patwardhan [b], David A. Lazar [a], Hariharan Thangarajah [a], Stephen W. Bickler [a], Eunice Y. Huang [d], Timothy J. Fairbanks [a], Romeo C. Ignacio [a,*]

[a] Division of Pediatric Surgery, Rady Children's Hospital San Diego, Department of Surgery, University of California San Diego, San Diego, CA
[b] Department of Surgery, Naval Medical Center San Diego, San Diego, CA
[c] Uniformed Services University of the Health Sciences, Bethesda, MD
[d] University of Tennessee Health Science Center, Memphis, TN

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ABSTRACT

Background: The study aim was to evaluate the readability of patient-oriented resources in pediatric surgery from children's hospitals in the US.
Methods: The websites of 30 children's hospitals were evaluated for information on 10 common pediatric surgical procedures. Hospitals of varying characteristics including bed number, geographic location and ACS Children's Surgery Verification (CSV) were selected for the study. Readability scores were calculated using validated algorithms, and text was assigned an overall grade level.
Results: Of 195 patient-oriented resources identified, only three (2%) were written at or below the recommended sixth grade level. Larger hospitals provided patient information at a higher grade level than medium and smaller sized centers (10.7 vs 9.3 vs 9.0 respectively, $p < 0.001$). Hospital size also correlated with availability of information, with large and medium sized hospitals having information more often. Hospitals with ACS CSV had information available more often, and written at a lower grade level, compared to nonverified centers (78% vs 62%, $p = 0.023$; 9.0 vs 10.0, $p = 0.013$).
Conclusion: Most hospital provided patient-oriented resources in pediatric surgery are written at a grade level well above the national guidelines. Centers with ACS CSV status have improved availability and readability of this material, while larger hospitals have improved availability, but decreased readability.
Type of study: Modeling study.
Level of evidence: III

Patient education is a critical component in every field of health care. In the pediatric population, the process involves not only the patient but also his or her caretaker. In addition to verbal provider–patient communication, reading material is often provided for further review. The internet has become a key source for this type of information [1]. The web offers a litany of material on surgical procedures, all with varying formats and quality. Furnishing inaccurate online information can lead to unnecessary patient confusion and concern, potentially compromising the provider–patient relationship [2]. Children's hospitals often offer clinical information on their websites, providing a reputable source that patients and caregivers can turn to for answers.

The American Medical Association (AMA) recommends that educational material be written at or below a sixth grade reading level in order to optimize patient comprehension [3]. The readability of patient-oriented resources has been studied in several specialties including general surgery, dermatology and ophthalmology [4–6]. However, there are few recent data regarding the quality of online resources for common pediatric surgical procedures. This study was intended to evaluate the reading level of online patient information for the most commonly performed pediatric surgical procedures in the United States.

1. Methods

Using the Children's Hospital Directory, 30 hospitals within the United States were selected based on size and location. Hospital size

Abbreviations: NIH, National Institutes of Health; AMA, American Medical Association; ACS, American College of Surgeons; CSV, Children's Surgery Verification.

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* Corresponding author at: Division of Pediatric Surgery, Rady Children's Hospital San Diego, 3020 Children's Way, MC 5136, San Diego, CA 92123. Tel.: +1 858 966 7711; fax: +1 858 966 7712.
E-mail address: rignacio1@rchsd.org (R.C. Ignacio).

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Table 1
Information availability by procedure type.

Pediatric Surgery Procedure	Information Available, *n* (%)
Appendectomy	23 (77%)
Central venous access	18 (60%)
Pyloromyotomy	21 (70%)
Burn debridement or grafting	16 (53%)
Cholecystectomy	17 (57%)
PDA ligation	22 (73%)
Bladder or ureteral reconstruction	18 (60%)
Antireflux procedure	19 (63%)
Inguinal hernia repair	24 (80%)
Gastrostomy tube	17 (57%)

was defined by the number of hospital beds and further categorized as large (>401 beds), medium (201–400 beds), and small hospitals (51–200 beds). Ten institutions were chosen from each category. In addition, hospitals were further classified based on geographic location (Northeast, Midwest, South, and West) to ensure that all regions in the United States were well represented.

Two investigators independently reviewed each hospital's official website for patient information on the 10 most commonly performed inpatient pediatric surgical procedures in the United States (Table 1) [7]. A total of 300 searches were completed by each investigator. To be included in the study, clinical information must have been accessible through the hospital's homepage search engine or health library. Duplicate articles, shared by different hospitals, were included. Materials were excluded if they were strictly in pictorial or video format, had insufficient text to analyze (less than 3 sentences or 150 words), or were not written in English.

Prior to calculating readability scores, investigators individually copied each article into Microsoft Word documents in plain-text format. The text was then further edited in an effort to avoid underestimation of the actual readability level, as suggested by the Flesch reading ease formula [8]. This process included deletion of unrelated information (e.g., copyright notice, disclaimers, author information, and appointment scheduling) and removal of all numbers, decimals, bullets, colons/semicolons, paragraph breaks, and dashes.

Readability scores were calculated using open-source software available at: https://readabilityformulas.com. This resource calculates overall reading level using seven validated tests: Flesch Reading Ease formula, Flesch–Kincaid Grade Level, Simple Measure of Gobbledygook (SMOG) Index, Coleman–Liau Index, Gunning–Fog Index, Automated Readability Index, and Linsear Write Formula. Data were analyzed using chi-squared, Students t-, Fisher's exact, and one-way ANOVA with post hoc Tukey tests where appropriate. P-values <0.05 were considered significant. Analysis was performed using IBM SPSS Statistics 25.

2. Results

Of the 300 searches performed, 199 sites with at least one form of patient-oriented information were found. Four links were excluded for having insufficient text to analyze. The remaining 195 links were included for analysis. Nine sites had video content in addition to text; however, for the purposes of this study only the text was analyzed. The availability of information for each procedure queried is depicted in Table 1. Overall, inguinal hernia repair was the procedure most likely to have information available, while burn debridement or grafting procedures were the least (80% vs 53%). Table 2 depicts the availability of information by hospital size and region. Large and medium-sized hospitals were more likely to have information available on their respective webpages compared with small institutions (76% vs 74% vs 45%, $p < 0.001$). There was no difference in the amount of information available by hospital region.

Table 2
Information availability by hospital size and region.

	Information Available, *n* (%)	*p*
Size		
Large	76 (76%)	
Medium	74 (74%)	<0.001
Small	45 (45%)	
Region		
Northeast	51 (64%)	
South	42 (60%)	
Midwest	53 (76%)	<0.183
West	49 (61%)	

Of the 195 resources analyzed, only three (2%) were written at or below the recommended sixth grade reading level. The mean grade level of all reading material was 9.8 ± 2.1. The mean grade level of information from each procedure is depicted in Fig. 1. Information for central line placement was written at the lowest grade level (8.8) while bladder reconstruction was written at the highest (10.9). However, there were no statistically significant differences between individual procedures.

Material from large hospitals was written at a higher grade level compared with medium and small centers (10.7 vs 9.3 vs 9.0, $p < 0.001$). Articles from hospitals in the South and Northeast were written at a higher reading level compared with those in the West and Midwest (Table 3).

Lastly, hospitals with and without American College of Surgeons (ACS) Children's Surgical Verification (CSV) were compared with respect to the readability and availability of educational material (Table 4). Five hospitals in our cohort were verified children's surgery centers compared with 25 who were not. Hospitals with CSV had increased availability of information (78% vs 62%, $p = 0.023$) compared to those without. Additionally, verified centers had material that was written at a lower grade level than those without verification (9.0 vs 10.0, $p = 0.013$).

3. Discussion

Health literacy is defined by the National Library of Medicine as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions." [9] Health literacy has been recognized as

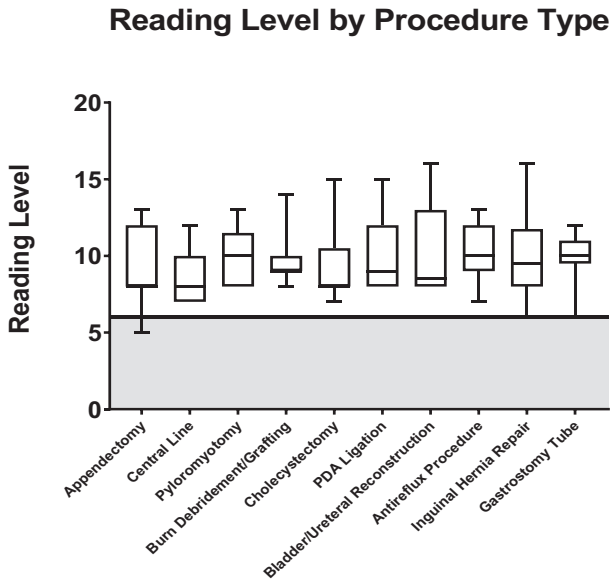

Fig. 1. Box-plot of the reading level of information for each procedure. Each box represents the interquartile range and contains a line signifying the median reading level. The reference line indicates the recommended sixth grade reading level.

Table 3
Reading level by hospital size and region.

	Reading level, mean (SD)	*p*
Size		
Large	10.7 (2.1)	
Medium	9.3 (2.0)	<0.001
Small	9.0 (1.8)	
Region		
Northeast	10.2 (2.1)	
South	10.2 (2.5)	0.046
Midwest	9.2 (1.7)	
West	9.7 (2.0)	

a public health problem both within the U.S. and abroad. In fact, a 2003 analysis by the U.S. Department of Education reported that only 12% of adults have a proficient level of health literacy [10]. Furthermore, a 2012 report by the Program for the International Assessment of Adult Competencies determined that literacy skills generally change very little over time and confirmed the overall low proficiency level of the general population [11].

While health literacy encompasses many aspects of a patient's interaction with a provider, written educational materials play a critical role in aiding in the understanding of a diagnosis or procedure. For parents whose child needs a surgical procedure, the process can be emotionally overwhelming and often times intimidating. Recent studies show that increasing numbers of patients and their caretakers are using the internet as a source of educational information [12,13]. It is consequently becoming increasingly important that educational materials are readily available, and written in a way that is easily understood. Readability is a well-established method to evaluate these resources to ensure that they maximize patients' understanding and involvement in their surgical care.

This study demonstrates that online pediatric surgical resources from almost all included hospitals were written well above the recommended sixth grade reading level. This finding is concerning considering the wide variability in literacy reported within the United States. Furthermore, this disproportionately affects lower socioeconomic populations with poorer literacy levels [14]. Our findings are consistent with contemporary literature from other medical specialties demonstrating patient educational material is consistently written above the recommended reading level for the majority of the U.S. population [15,16]. Interestingly, our study found that larger hospitals were more likely to have information written at a higher grade-level, thus exposing a larger proportion of patients to more difficult reading material than the overall results would suggest.

Our study demonstrated higher reading levels in patient resources from hospitals in the Northeast and South. This trend is worth noting, as it runs in contrast to the reported patterns of regional health literacy in the United States. Demographic characteristics including age, education level, race, and income all play a role in determining literacy levels by region [10]. Adults living in the Northeast and South have been shown to have consistently lower average proficiency levels as compared to those in the West and Midwest [17]. These regional differences in health literacy should be considered by individual hospitals when preparing patient-oriented resources.

Hospital size also correlated with the availability of patient information for each procedure, with large and medium-sized hospitals more likely to have material available. Decreased resources at these smaller hospitals may contribute to lower availability of online resources. Procedures lacking available information were not limited to any particular specialty, as general surgery, burn surgery, and urology procedures were all frequently absent from hospital websites. Previous studies have demonstrated that variability in available hospital web-based resources exists internationally as well [18]. As parents continue to utilize the internet as a source of information for pediatric surgical diseases, increasing the availability of web-based resources would be a simple and important step towards improving health literacy in this population [1].

Table 4
Comparison of hospitals with and without ACS children's surgery verification.

	ACS CSV ($n = 5$)	Non ACS CSV ($n = 25$)	*p*
Reading level, mean (SD)	9 (2.1)	10 (2.1)	0.013
Information available, n (%)	39 (78%)	156 (62%)	0.023

ACS, American College of Surgeons; CSV, children's surgery verification.

We also chose to evaluate our population with respect to ACS Children's Surgery Verification status. In 2015 the American College of Surgeons instituted this program in an effort to define the resources needed to provide appropriate surgical care to children, and to stratify hospitals based on the availability of these resources [19]. With the program still in an early stage of development, there has been little research into its impact thus far. We found that those centers with CSV were more likely to have patient-oriented resources available, and this material was written at a lower grade level. One of the major tenets of the verification program focuses on public outreach and education. Verified children's surgery centers are mandated to engage in public education and "help improve outcomes through the public and professional dissemination of information and by facilitating access to clinical and educational resources." [20] An increased focus on community engagement and education may play a role in the increased readability and availability of web-based patient resources at these institutions.

Improving online access to credible, reading-level appropriate information has been a focus of study across a wide range of medical specialties [21,22]. The most important components determined by readability calculators include sentence length and the number of complex words [23]. Other factors not accounted for by these calculators include paragraph structure, headings, and spacing [24]. By focusing on these areas, hospitals could work to decrease the grade-level of available information on surgical procedures. Furthermore, the National Institutes of Health recommends using terms in a consistent manner and providing pronunciation guides in addition to decreasing sentence length and the number of complex words [25]. Additionally, materials could be reviewed by patient advocates or patients and their families to confirm that they are well-received and understood. Improvements in these areas would help meet the national guidelines for readability of patient-oriented resources. Currently, there is a joint multiorganizational endeavor, led by the American Pediatric Surgical Association, American Academy of Pediatrics and the American College of Surgeons, to produce patient handouts (termed "articles") that contain optimal information for parents and caregivers of children with pediatric surgical disorders. This collaborative effort will ideally produce widely available patient information at an acceptable readability level.

The limitations of this study include a selection bias inherent in the method used to choose the included hospitals. We attempted to provide an equal sampling of hospital size and geographic region to compare various institutions; however, the process was not randomized. As a result, our conclusions regarding the relationship between hospital size and the readability of patient-oriented information may be subject to selection bias. The small sample size also makes it difficult to draw a definitive conclusion on the effect of hospital CSV status. While we have shown an association, we are unable to prove causation between CSV and the readability and availability of information. Additionally, only 10 procedures were chosen and this small sample size may not provide an accurate representation of a hospital's web-based resources as a whole. The readability calculators used vary in their assessments of reading materials, and multiple calculation methods exist. Previous research has demonstrated significant variability between different calculation methods, specifically with respect to the analysis of healthcare-related information [26]. While this is a limitation of the study, the tool used for analysis included seven different readability calculators, which may help to limit the effect of the variability. Readability of text is only one way of analyzing patient information and does not account

for illustrations, video-based educational material, and the formatting or layout of a web page. However, the authors do feel that having grade-level appropriate information is essential, and readability provides a common tool to improve patient education and comfort with pediatric surgical procedures. Additionally, age-specific resources also exist for helping young children understand and prepare for surgical procedures. Analysis of these resources was outside the scope of this study. Lastly, this study does not include resources written in non-English languages. This is becoming increasingly important, and is a potential area for further study.

4. Conclusions

As the internet becomes increasingly used for its open resource, patient-oriented information, the readability of pediatric surgical material is critical. Currently, hospitals' web-based resources in pediatric surgery are written far above the recommended reading level for the population utilizing these sites. Improving access to online resources and optimizing the readability of this information may result in an increase in patient education and comfort, and are potential areas of improvement for children's hospitals throughout the country.

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