

Readability Analysis of Patient-Facing Education Online Materials for Knee Preservation Surgery

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INTRODUCTION:

Knee preservation techniques including cartilage restoration, osteotomies, and biologic resurfacing have rapidly expanded over the past decade, mirroring the rising incidence of knee preservation surgery in the United States. These joint saving options are especially important for the growing population of young, athletic patients who wish to avoid or defer arthroplasty. Despite this growth, health-literacy data show that up to 43 % of US adults have basic or below-basic reading skills, with an average eighth-grade reading ability. The National Institute of Health and the American Medical Association recommend patient facing materials (PFMs) be written no higher than a 6th-grade level. Similarly, the Center of Disease Control (CDC) allows up to an 8th-grade level. However, orthopaedic patient materials routinely exceed these thresholds. Ensuring that knee preservation PFMs are readable is critical for informed decision making and optimal outcomes.

METHODS:

We identified PFMs pertaining to knee preservation surgery from the top 25 orthopaedic specialty institutions, as ranked by the 2025 U.S. News & World Report. Webpages were downloaded and converted into plain text format and assessed using validated readability formulas: Flesch-Kincaid Grade Level, Flesch Reading Ease, Gunning Fog Index, Coleman-Liau Index, Simple Measure of Gobbledygook (SMOG) Index, Automated Readability Index (ARI), Linsear Write Grade Level Formula, FORCAST, and New Dale-Chall Readability. Variance inflation factors (VIFs) were calculated to check for multicollinearity among these readability measures. We then used Spearman rank correlation to examine the association between the hospital's ranking and the readability of its PFMs. A multivariate analysis was also conducted to explore whether institutional characteristics geographic region, public versus private status or the inclusion of multimedia content, videos, and infographics had any significant relationship with readability scores.

RESULTS:

A total of 25 knee preservation surgery webpages from each of the top ranked orthopaedic hospitals were analyzed for readability. Only 2 pages (8%) met the NIH's sixth-grade reading-level target, and only 3 pages (12%) achieved the CDC's eighth-grade cutoff. Across all materials, the mean Flesch-Kincaid Grade Level (FKGL) was 10.8 (SD:2.3), The average Flesch Reading Ease score was 46 (SD: 14.2). Other readability indices showed similar results, uniformly suggesting high school to college-level complexity. The Gunning Fog Index averaged 13.1 (SD 2.2), the SMOG Index 10.4 (SD 1.6), the Coleman-Liau Index 12.9 (SD 2.9), the Automated Readability Index 11.6 (SD 2.7), the Linsear Write Formula 13.7 (SD 4.2), the FORCAST formula 11.3 (SD 1.1), and the New Dale-Chall score 21.6 (SD 8.0). Multimedia videos were present in 5 of the 25 webpages (20%). There was no significant relationship between a hospital's national rank and the readability of its webpage. The Spearman's rank correlation between U.S. News rank between rank and Flesch Reading Ease was $\rho = 0.22$ ($p = 0.29$), indicating no meaningful association. All the readability metrics were highly collinear (Pearson correlation $r > 0.8$), confirming that these patient materials uniformly exceeded recommended reading levels for the general adult population. Finally, a multivariate regression analysis (considering hospital geographic region, public vs. private status, and the presence of multimedia content on the page) found no significant predictors of readability ($p = 0.12$), suggesting that these institutional factors did not substantially influence the reading level of the knee preservation webpages.

DISCUSSION AND CONCLUSION:

Patient facing materials for knee preservation surgery provided by highly ranked orthopaedic institutions were well often written above the recommended 6th and 8th grade reading level. Such a disconnect may impede comprehension, patient engagement, and truly informed consent. Improving the readability of knee preservation PFMs will align institutional resources with national health literacy goals, ultimately fostering better shared decision making and understanding.

Table 1: Individual Reading Scores for Online Knee Preservation Patient Resources at Top Orthopaedic Institutions

Hospital Rank	Media Video	Automated Readability Index	Gunning Fog Index	Flesch-Kincaid Grade	Coleman-Liau Index	SMOG Index	Linsear Write Grade	FORCAST	New Dale-Chall Readability	Flesch Reading Ease
1	1	12.0	13.5	11.8	11.4	11.6	12.5	11.1	19.1	46
2	1	11.4	12.1	10.9	12.4	10.4	10.7	11.8	19.1	46
3	0	14.1	14.0	13.2	15.8	11.7	16.3	12.0	14.6	30
4	0	10.4	13.5	10.6	12.5	10.4	14.2	11.2	25.9	45
5	0	15.4	17.1	14.2	19.3	12.0	22.0	13.9	9.67	16
6	0	13.6	12.8	12.0	13.3	11.1	12.7	11.3	20.3	45
7	0	12.3	14.4	11.3	12.1	11.3	12.4	10.6	22.8	48
8	1	11.2	13.9	11.0	12.2	11.1	10.1	11.2	19.7	45
9	0	12.5	11.7	10.9	14.9	10.4	20.1	12.2	20.2	42
10	0	8.33	11.6	7.88	9.92	8.71	6.78	10.1	26.1	62
11	0	11.7	15.1	10.8	13.1	11.4	10.6	11.1	11.7	45
12	0	14.3	17.1	13.1	19.1	9.9	17.2	13.6	4.39	16
13	0	11.1	11.6	9.9	12.5	9.8	10.3	10.9	28.8	52
14	0	13.0	13.6	11.9	14.3	11.7	21.8	11.6	19.2	40
15	0	11.2	13.8	10.0	14.8	9.6	16.8	11.8	24.3	42
16	0	12.1	14.2	11.2	11.9	11.3	12.5	10.5	23.2	49
17	0	12.7	13.3	12.1	13.8	11.4	16.4	11.8	17.2	38
18	0	11.7	13.6	11.1	14.5	10.3	13.0	12.2	17.7	38
19	1	14.3	14.9	12.9	14.3	12.6	14.0	11.3	21.0	38
20	0	5.43	9.20	5.64	7.46	7.25	6.92	9.57	37.0	74
21	0	10.0	10.8	8.7	12.6	8.8	15.5	11.1	26.4	54
22	1	12.2	14.2	11.6	12.8	11.5	15.3	10.9	20.0	44
23	0	15.4	15.0	13.9	12.3	12.7	15.9	10.4	17.0	42
24	0	7.84	9.90	8.31	8.97	8.23	12.3	10.2	34.0	62
25	0	4.94	7.50	4.83	7.12	6.02	6.80	9.51	40.0	79
Mean (SD)		11.6(2.7)	13.1(2.2)	10.8(2.3)	12.9(2.9)	10.4(1.6)	13.7(4.2)	11.3(1.1)	21.6(8.0)	45.5(14.2)

