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Assessing Perceived Usability: Different Types of Hospital Discharge Instructions for College Students

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Abstract

Discharge instructions constitute a critical communication link between doctor and patient, and the usability of these instructions is critical. When a patient is discharged from a hospital, the responsibility for care is transferred from the clinical care team to the patient. Discharge instructions describe actions that the patient must perform once they leave the hospital and provide critical information about emergent conditions under which the patient should return for care. These instructions are given to the patient upon discharge, often on physical paper.

The authors of this paper conducted a study examining the impact of three design elements in discharge instructions for college students: 1) the length of the text, 2) the type of images, and 3) the method of generation (pre-printed instructions or physician forms filled in by hand to communicate critical instructions at the time of discharge).

For the population in this study, the results indicated that text length impacted the perceived usability of hospital discharge instructions. There was no evidence of an effect for the factors of image type or method of generation. The findings in this paper provide medical professionals with guidance for creating usable discharge instructions.

Keywords

usability, discharge instructions, patient care, medical human factors

Introduction

Each year, approximately 11.3% of the general population in the United States has undergone some form of inpatient or outpatient surgery (Bicket et al., 2024). Surprisingly, rates for younger individuals (under 34) have been about 8.8% (Bicket et al., 2024), and rates for specific groups of college students, such as athletes, have been reported to be as high as 25.9% (Bradley, et al., 2008; Mehran et al., 2016).

When a patient is discharged from the hospital or surgical center, a great deal of responsibility for care can be transferred from the clinical care team to the patient using documents called hospital discharge instructions. With medical advances allowing patients to leave the hospital sooner, self-care requirements in the home have become more complex and can lead to discharge paperwork that is long, complicated, and difficult for patients to interpret without advanced medical knowledge (Chugh et al., 2009). When these documents have been too complex or otherwise did not meet the patient’s needs, the patient became vulnerable to lapses in care safety and quality (Coleman et al., 2013). This effect has been particularly harmful for patient populations with limited health literacy, such as those with historically limited access to healthcare and education as well as non-English-speaking patients (Winokur et al., 2019).

Moreover, there has been no standardized format for these documents across medical institutions, leading to significant variation in how information has been presented to patients. Each medical institution, and sometimes departments therein, has been responsible for developing its own set of discharge instruction documents for each specific condition (Mennuni et al., 2017). This has led to fragmentation in the information provided to patients and also mental models that are not functional for patients attempting to interpret and use information from such documents. In contrast, pharmacy leaflets have become highly standardized documents used to convey information to the patient (Mottram et al., 1997).

Because of a lack of widespread standards regarding the type of information presented in hospital discharge instructions, the presentation of this information has varied. For physical paper mediums, some formats have included paragraphs, bullet points, photographs, drawings, diagrams, and fill-in-the-blank forms the physician should complete (DeSai et al., 2021). Some medical practices chose to use video or conversation- and demonstration-based techniques to replace traditional paper discharge instructions (Hoek et al., 2020). Focusing specifically on paper discharge instructions, the techniques currently used to convey key discharge concepts to patients have not always been based on scientific research findings and principles, which can further decrease the usability of the instructions.

In this study, we measured the perceived usability of a number of different printed hospital discharge instructions using the modified System Usability Scale (SUS, Brooke, 1996). Although this evaluation tool has often been considered for websites, software, and consumer products, the SUS has been a versatile, technology-agnostic measurement instrument that has been used to measure the perceived usability of numerous paper-based systems as well. For example, the SUS measured the usability of paper-based instruction for tasks such as guiding workers in an assembly job (Dorloh et al., 2023), paper-based training material (Werrlich et al., 2018), textbooks (Kortum et al., 2014), and paper ballot voting instructions (Byrne et al., 2007).

Cognition of Text and Images

Discharge instructions have been presented in various formats, but they do not necessarily align with cognitive principles that optimize comprehension. The most common dimension across which sets of discharge instructions have been analyzed is readability, typically by assessing reading level (DeSai et al., 2021; Naik et al., 2017). Though average reading levels for the general population have been around an eighth-grade level, many hospital discharge instruction documents are far beyond this level (Naik et al., 2017). This misalignment with the needs of the general population has presented just one of many unmet needs regarding patients’ cognition of hospital discharge instructions. Simplified instructions have obvious benefits for low literacy readers, yet the National Institutes of Health (NIH) has suggested that high literacy readers (like college students) also benefit from simple and easy-to-understand instructions (2025).

Research by Britton et al (1978) suggested that simpler texts are generally compatible with human cognitive capacity. Further, longer texts at higher reading levels have been more likely to result in comprehension errors. This effect can be especially problematic for discharge instruction sets that rely primarily on text, that is, without the use of pictures, drawings, or videos to supplement the written text.

When hospital discharge instruction documents have included photos or drawings, the instructions have been more likely to support user cognition based on the Cognitive Theory of Multimedia Learning (Mayer, 2005). This theory was informed by three principles of cognition: (1) the dual-channel assumption, or the notion that verbal and pictorial representations are processed in different pathways; (2) the limited-capacity assumption, or the notion that these aforementioned pathways are limited in the amount of information they can process at a given moment; and (3) the active processing assumption, or the notion that learning and comprehension requires a coordinated set of cognitive processes to be carried out. Based on these principles, this theory stated that multimedia learning, or learning through both pictorial and textual inputs, has supported more efficient cognition and yielded more meaningful impacts than learning through text alone (Mayer, 2005; van Beusekom, 2016). As a result, it can be expected that hospital discharge instructions containing both pictorial and textual information should be easier to use and understood more fully by patients and their families. The implications of cognition, comprehension, and learning associated with these documents have informed the documents' usability and, in turn, can have important impacts on patient outcomes.

Although similar documents have been assessed, such as post-emergency department visit summaries, research on hospital discharge instructions has been limited (Barton et. al, 2023). This gap has presented an opportunity to expand hospital discharge instructions research through investigation of the documents' usability.

This study sought to determine which design elements of hospital discharge instructions most impact their perceived usability. In this study, we examined how the length of the instructions (short, medium, or long), the use of images (no images and text-only, diagrams, or photos), and the method of generation (pre-printed instructions or physician forms filled in by hand to communicate critical instructions at the time of discharge) impact perceived usability.

Methods

Participants

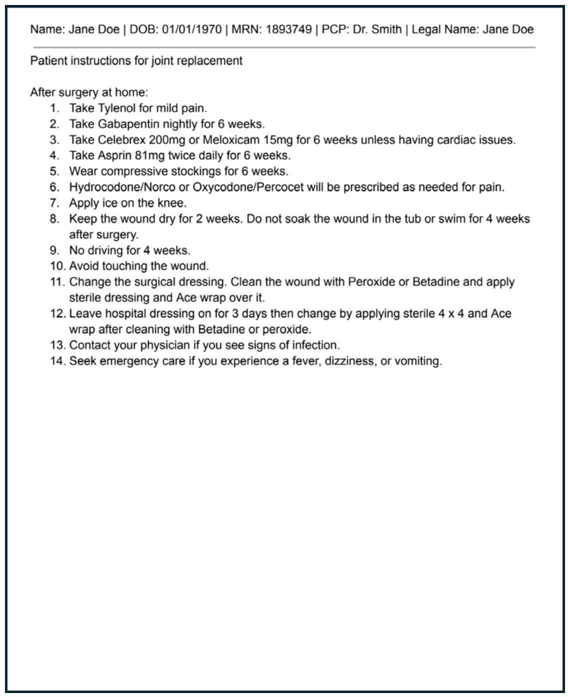
This IRB-approved study recruited participants from the undergraduate research participant pool at Rice University. Student participation was optional, and those who signed up for the study received partial class credit. All participants were over 18 years of age and provided informed consent. Thirty-eight participants completed the study, and a priori power analysis was performed using G*Power software to ensure sufficient statistical power to detect an effect, if one was present. The mean age of the participants was 20 years, with a range from 18-21. Seventy-six percent of student participants indicated they were female, and 24% indicated male. Of the group, 52% indicated they were Asian or Pacific Islander, 28% multiracial or biracial, 10% Hispanic or Latino, 7% white or Caucasian, and 3% black or African American.

Apparatus and Materials

The authors conducted the study using Qualtrics™, an online platform that allows researchers to create materials like surveys, administer studies, and collect data.

Discharge instructions were presented to participants online. Because it was critical to consider which medical condition would be used for this study's patient discharge instructions, we considered conditions with a relatively high frequency of occurrence and aftercare that would be conducive to the variety of modes and presentation methods reflected in hospital discharge instruction literature. Accordingly, for this research project, we chose the condition of a total knee replacement; we developed the discharge instructions based on an actual set of hospital discharge instructions for post-operative knee surgery care.

Based on a review of the extant literature, we chose three discharge instruction design variables for investigation: 1) text length (long text, medium text, or short text [Figures 1-3]), 2) type of visual materials (no images and text-only, diagrams, or photographs [Figures 2, 4-5]), and 3) method of generating instructions (computer generated using a template and pre-printed [Figure 2] or a form filled in by hand by the physician [Figure 6]). Considering the published literature, we anticipated that the medium text instruction set (Figure 2) would have the highest usability ratings. Accordingly, the materials were developed and the study designed so that each participant would assess a long (Figure 3), medium (Figure 2), and short text (Figure 1) instruction set—each without images—as a manipulation check to ensure the medium text instruction set, in fact, had the highest usability ratings across the levels. The medium text length instruction set (Figure 2) was then used as a template to develop the other instruction sets, such as the type of visual materials (Figure 4 and Figure 5) and the method of generation (Figure 6). Care was taken to include photographs and diagrams of the same items to assess the usability of the image type instead of the graphic itself.



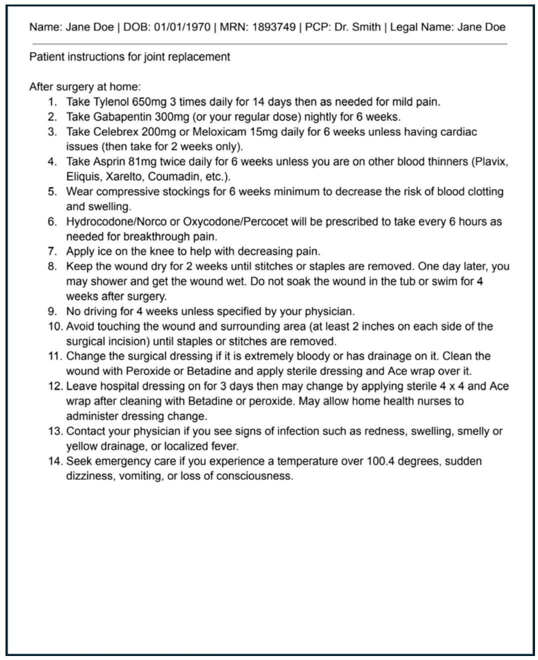
Name: Jane Doe | DOB: 01/01/1970 | MRN: 1893749 | PCP: Dr. Smith | Legal Name: Jane Doe

Patient instructions for joint replacement

After surgery at home:

1. Take Tylenol for mild pain.
2. Take Gabapentin nightly for 6 weeks.
3. Take Celebrex 200mg or Meloxicam 15mg for 6 weeks unless having cardiac issues.
4. Take Asprin 81mg twice daily for 6 weeks.
5. Wear compressive stockings for 6 weeks.
6. Hydrocodone/Norco or Oxycodone/Percocet will be prescribed as needed for pain.
7. Apply ice on the knee.
8. Keep the wound dry for 2 weeks. Do not soak the wound in the tub or swim for 4 weeks after surgery.
9. No driving for 4 weeks.
10. Avoid touching the wound.
11. Change the surgical dressing. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it.
12. Leave hospital dressing on for 3 days then change by applying sterile 4 x 4 and Ace wrap after cleaning with Betadine or peroxide.
13. Contact your physician if you see signs of infection.
14. Seek emergency care if you experience a fever, dizziness, or vomiting.

Figure 1. The short text, no-image discharge instructions.



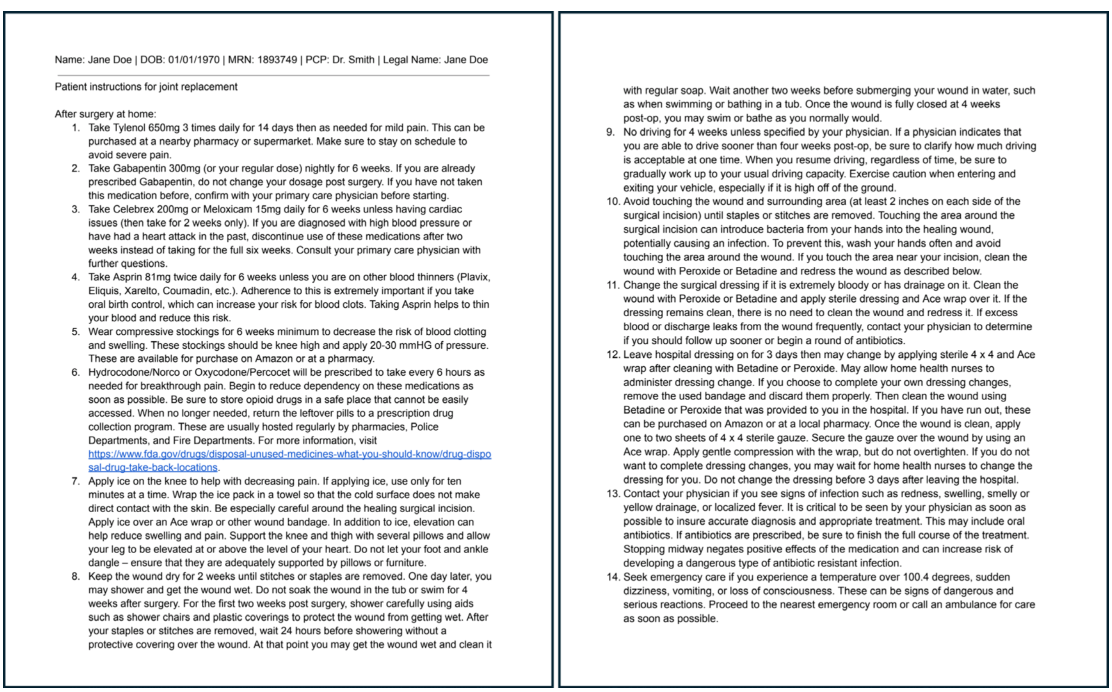
Name: Jane Doe | DOB: 01/01/1970 | MRN: 1893749 | PCP: Dr. Smith | Legal Name: Jane Doe

Patient instructions for joint replacement

After surgery at home:

1. Take Tylenol 650mg 3 times daily for 14 days then as needed for mild pain.
2. Take Gabapentin 300mg (or your regular dose) nightly for 6 weeks.
3. Take Celebrex 200mg or Meloxicam 15mg daily for 6 weeks unless having cardiac issues (then take for 2 weeks only).
4. Take Asprin 81mg twice daily for 6 weeks unless you are on other blood thinners (Plavix, Eliquis, Xarelto, Coumadin, etc.).
5. Wear compressive stockings for 6 weeks minimum to decrease the risk of blood clotting and swelling.
6. Hydrocodone/Norco or Oxycodone/Percocet will be prescribed to take every 6 hours as needed for breakthrough pain.
7. Apply ice on the knee to help with decreasing pain.
8. Keep the wound dry for 2 weeks until stitches or staples are removed. One day later, you may shower and get the wound wet. Do not soak the wound in the tub or swim for 4 weeks after surgery.
9. No driving for 4 weeks unless specified by your physician.
10. Avoid touching the wound and surrounding area (at least 2 inches on each side of the surgical incision) until staples or stitches are removed.
11. Change the surgical dressing if it is extremely bloody or has drainage on it. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it.
12. Leave hospital dressing on for 3 days then may change by applying sterile 4 x 4 and Ace wrap after cleaning with Betadine or peroxide. May allow home health nurses to administer dressing change.
13. Contact your physician if you see signs of infection such as redness, swelling, smelly or yellow drainage, or localized fever.
14. Seek emergency care if you experience a temperature over 100.4 degrees, sudden dizziness, vomiting, or loss of consciousness.

Figure 2. The medium-text, no-image discharge instructions.



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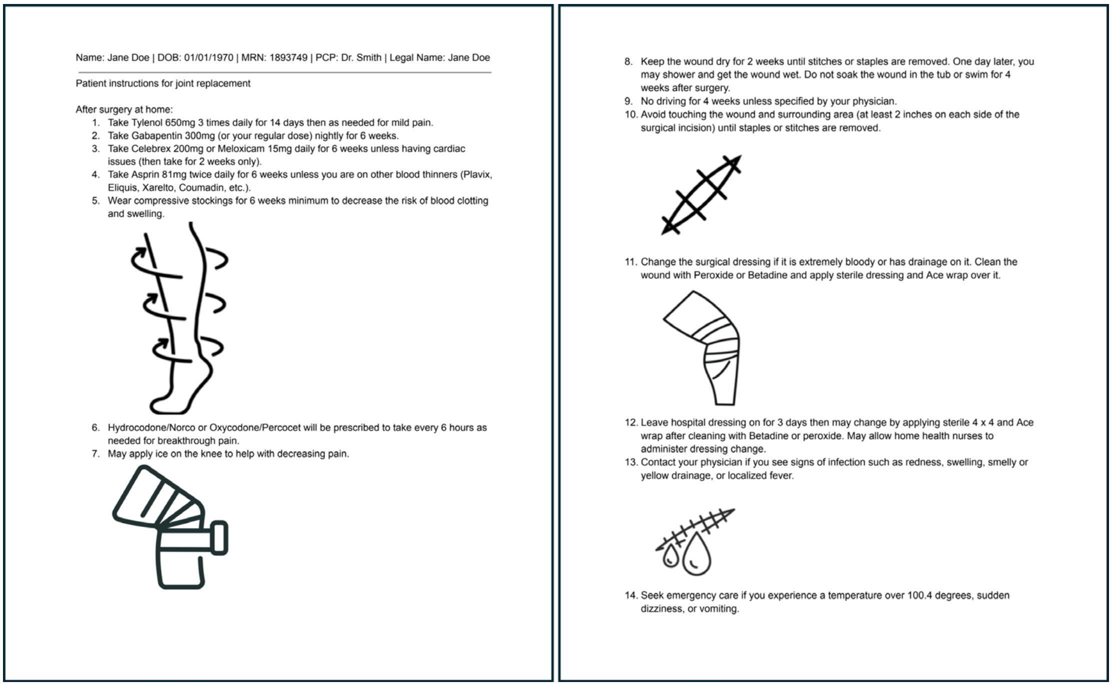
Patient instructions for joint replacement

After surgery at home:

1. Take Tylenol 650mg 3 times daily for 14 days then as needed for mild pain. This can be purchased at a nearby pharmacy or supermarket. Make sure to stay on schedule to avoid severe pain.
2. Take Gabapentin 300mg (or your regular dose) nightly for 6 weeks. If you are already prescribed Gabapentin, do not change your dosage post surgery. If you have not taken this medication before, confirm with your primary care physician before starting.
3. Take Celebrex 200mg or Meloxicam 15mg daily for 6 weeks unless having cardiac issues (then take for 2 weeks only). If you are diagnosed with high blood pressure or have had a heart attack in the past, discontinue use of these medications after two weeks instead of taking for the full six weeks. Consult your primary care physician with further questions.
4. Take Asprin 81mg twice daily for 6 weeks unless you are on other blood thinners (Plavix, Eliquis, Xarelto, Coumadin, etc.). Adherence to this is extremely important if you take oral birth control, which can increase your risk for blood clots. Taking Asprin helps to thin your blood and reduce this risk.
5. Wear compressive stockings for 6 weeks minimum to decrease the risk of blood clotting and swelling. These stockings should be knee high and apply 20-30 mmHG of pressure. These are available for purchase on Amazon or at a pharmacy.
6. Hydrocodone/Norco or Oxycodone/Percocet will be prescribed to take every 6 hours as needed for breakthrough pain. Begin to reduce dependency on these medications as soon as possible. Be sure to store opioid drugs in a safe place that cannot be easily accessed. When no longer needed, return the leftover pills to a prescription drug collection program. These are usually hosted regularly by pharmacies, Police Departments, and Fire Departments. For more information, visit https://www.fda.gov/drugs/disposal-unused-medicines-what-you-should-know/drug-disposal-drug-take-back-locations.
7. Apply ice on the knee to help with decreasing pain. If applying ice, use only for ten minutes at a time. Wrap the ice pack in a towel so that the cold surface does not make direct contact with the skin. Be especially careful around the healing surgical incision. Apply ice over an Ace wrap or other wound bandage. In addition to ice, elevation can help reduce swelling and pain. Support the knee and thigh with several pillows and allow your leg to be elevated at or above the level of your heart. Do not let your foot and ankle dangle – ensure that they are adequately supported by pillows or furniture.
8. Keep the wound dry for 2 weeks until stitches or staples are removed. One day later, you may shower and get the wound wet. Do not soak the wound in the tub or swim for 4 weeks after surgery. For the first two weeks post surgery, shower carefully using aids such as shower chairs and plastic coverings to protect the wound from getting wet. After your staples or stitches are removed, wait 24 hours before showering without a protective covering over the wound. At that point you may get the wound wet and clean it with regular soap. Wait another two weeks before submerging your wound in water, such as when swimming or bathing in a tub. Once the wound is fully closed at 4 weeks post-op, you may swim or bathe as you normally would.
9. No driving for 4 weeks unless specified by your physician. If a physician indicates that you are able to drive sooner than four weeks post-op, be sure to clarify how much driving is acceptable at one time. When you resume driving, regardless of time, be sure to gradually work up to your usual driving capacity. Exercise caution when entering and exiting your vehicle, especially if it is high off of the ground.
10. Avoid touching the wound and surrounding area (at least 2 inches on each side of the surgical incision) until staples or stitches are removed. Touching the area around the surgical incision can introduce bacteria from your hands into the healing wound, potentially causing an infection. To prevent this, wash your hands often and avoid touching the area around the wound. If you touch the area near your incision, clean the wound with Peroxide or Betadine and redress the wound as described below.
11. Change the surgical dressing if it is extremely bloody or has drainage on it. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it. If the dressing remains clean, there is no need to clean the wound and redress it. If excess blood or discharge leaks from the wound frequently, contact your physician to determine if you should follow up sooner or begin a round of antibiotics.
12. Leave hospital dressing on for 3 days then may change by applying sterile 4 x 4 and Ace wrap after cleaning with Betadine or Peroxide. May allow home health nurses to administer dressing change. If you choose to complete your own dressing changes, remove the used bandage and discard them properly. Then clean the wound using Betadine or Peroxide that was provided to you in the hospital. If you have run out, these can be purchased on Amazon or at a local pharmacy. Once the wound is clean, apply one to two sheets of 4 x 4 sterile gauze. Secure the gauze over the wound by using an Ace wrap. Apply gentle compression with the wrap, but do not overtighten. If you do not want to complete dressing changes, you may wait for home health nurses to change the dressing for you. Do not change the dressing before 3 days after leaving the hospital.
13. Contact your physician if you see signs of infection such as redness, swelling, smelly or yellow drainage, or localized fever. It is critical to be seen by your physician as soon as possible to insure accurate diagnosis and appropriate treatment. This may include oral antibiotics. If antibiotics are prescribed, be sure to finish the full course of the treatment. Stopping midway negates positive effects of the medication and can increase risk of developing a dangerous type of antibiotic resistant infection.
14. Seek emergency care if you experience a temperature over 100.4 degrees, sudden dizziness, vomiting, or loss of consciousness. These can be signs of dangerous and serious reactions. Proceed to the nearest emergency room or call an ambulance for care as soon as possible.

Figure 3. The long-text, no-image discharge instructions.



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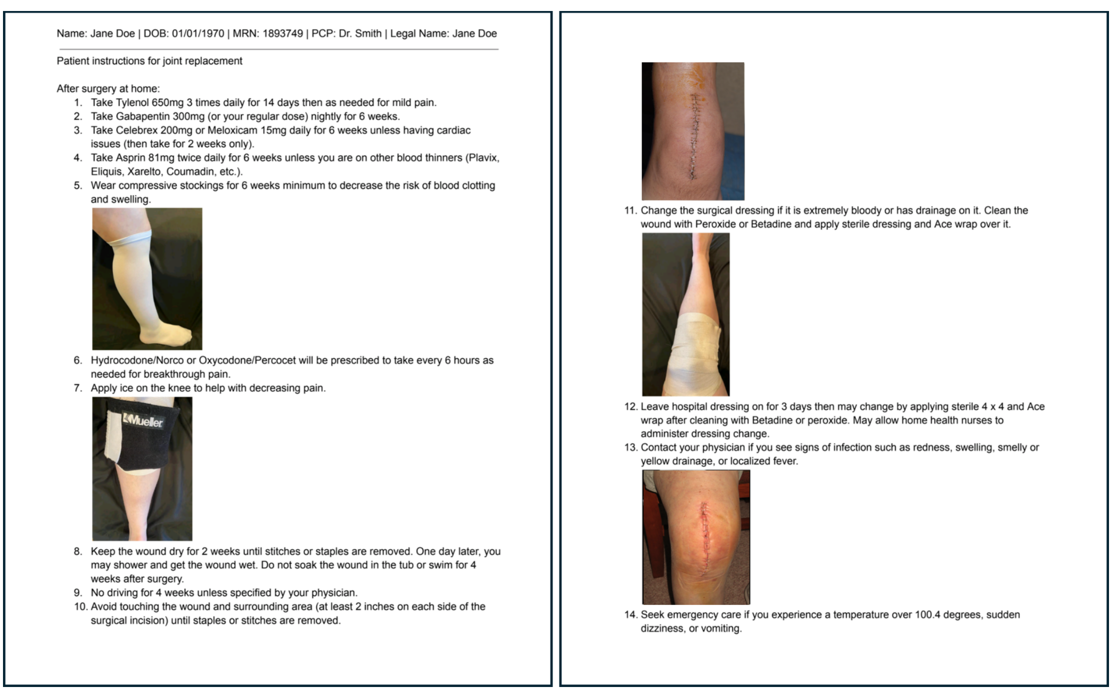
Patient instructions for joint replacement

After surgery at home:

1. Take Tylenol 650mg 3 times daily for 14 days then as needed for mild pain.
2. Take Gabapentin 300mg (or your regular dose) nightly for 6 weeks.
3. Take Celebrex 200mg or Meloxicam 15mg daily for 6 weeks unless having cardiac issues (then take for 2 weeks only).
4. Take Asprin 81mg twice daily for 6 weeks unless you are on other blood thinners (Plavix, Eliquis, Xarelto, Coumadin, etc.).
5. Wear compressive stockings for 6 weeks minimum to decrease the risk of blood clotting and swelling.
6. Hydrocodone/Norco or Oxycodone/Percocet will be prescribed to take every 6 hours as needed for breakthrough pain.
7. May apply ice on the knee to help with decreasing pain.
8. Keep the wound dry for 2 weeks until stitches or staples are removed. One day later, you may shower and get the wound wet. Do not soak the wound in the tub or swim for 4 weeks after surgery.
9. No driving for 4 weeks unless specified by your physician.
10. Avoid touching the wound and surrounding area (at least 2 inches on each side of the surgical incision) until staples or stitches are removed.
11. Change the surgical dressing if it is extremely bloody or has drainage on it. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it.
12. Leave hospital dressing on for 3 days then may change by applying sterile 4 x 4 and Ace wrap after cleaning with Betadine or peroxide. May allow home health nurses to administer dressing change.
13. Contact your physician if you see signs of infection such as redness, swelling, smelly or yellow drainage, or localized fever.
14. Seek emergency care if you experience a temperature over 100.4 degrees, sudden dizziness, or vomiting.

Figure 4. The diagram version of discharge instructions based on the medium text condition. The images were designed to be parallel to those in the photograph condition.



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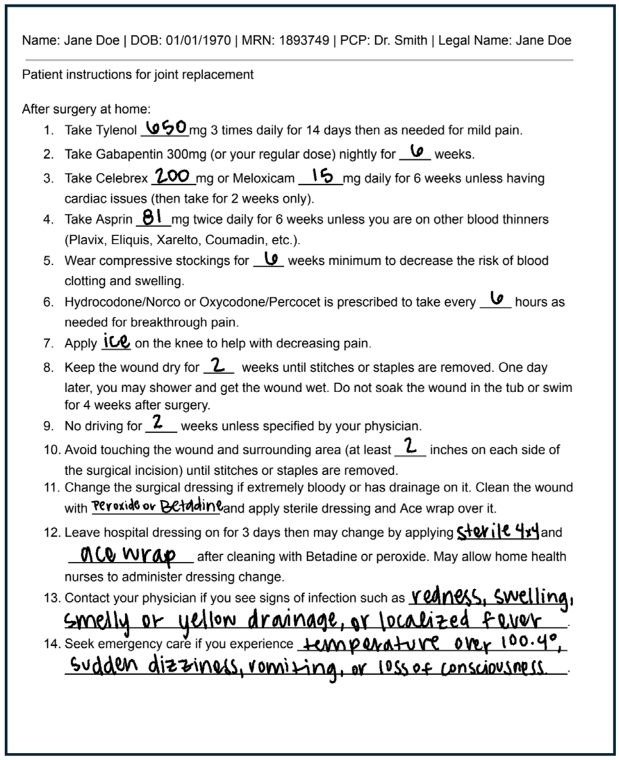
11. Change the surgical dressing if it is extremely bloody or has drainage on it. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it.
12. Leave hospital dressing on for 3 days then may change by applying sterile 4 x 4 and Ace wrap after cleaning with Betadine or peroxide. May allow home health nurses to administer dressing change.
13. Contact your physician if you see signs of infection such as redness, swelling, smelly or yellow drainage, or localized fever.
14. Seek emergency care if you experience a temperature over 100.4 degrees, sudden dizziness, or vomiting.

Figure 5. The photograph version of the discharge instructions based on the medium text condition. The photographs were designed to be parallel to those in the diagram condition. (Step 11: Photo by James Glendinning used under CC BY-SA 3.0. Step 14: Photo by RaveDave used under CC BY-SA 3.0.)



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4. Take Asprin 81 mg twice daily for 6 weeks unless you are on other blood thinners (Plavix, Eliquis, Xarelto, Coumadin, etc.).
5. Wear compressive stockings for 6 weeks minimum to decrease the risk of blood clotting and swelling.
6. Hydrocodone/Norco or Oxycodone/Percocet is prescribed to take every 6 hours as needed for breakthrough pain.
7. Apply ice on the knee to help with decreasing pain.
8. Keep the wound dry for 2 weeks until stitches or staples are removed. One day later, you may shower and get the wound wet. Do not soak the wound in the tub or swim for 4 weeks after surgery.
9. No driving for 2 weeks unless specified by your physician.
10. Avoid touching the wound and surrounding area (at least 2 inches on each side of the surgical incision) until stitches or staples are removed.
11. Change the surgical dressing if extremely bloody or has drainage on it. Clean the wound with Peroxide or Betadine and apply sterile dressing and Ace wrap over it.
12. Leave hospital dressing on for 3 days then may change by applying sterile 4x4 and ace wrap after cleaning with Betadine or peroxide. May allow home health nurses to administer dressing change.
13. Contact your physician if you see signs of infection such as redness, swelling, smelly or yellow drainage, or localized fever.
14. Seek emergency care if you experience temperature over 100.4°, sudden dizziness, vomiting, or loss of consciousness.

Figure 6. The form version of the discharge instructions in which a physician filled in a printed form by hand, based on the medium-length condition.

For the 6 different instruction sets, both lexical density and the Flesch-Kincaid reading level were assessed (Uhr, 1971). Lexical density has been defined as the ratio of the number of lexical items (content words) to the total number of words in a text, which is used as a measure of the informational content of the language. The formula for lexical density is the number of content words divided by the total number of words, with this quotient then multiplied by 100. In this study, the mean lexical density score was 58%, with a range of 56% (representing the long instruction set) to 60% (representing the short text and physician-completed form sets). As a comparison, the typical lexical density of news articles has been 55-65%; this study's instruction sets fell within this range. This lexical density measure helped to monitor consistency across instruction sets.

The Flesch-Kincaid reading level is a readability metric used to indicate how easy or difficult a text is to understand. It can be used to ensure that content is appropriate for its intended audience. The Flesch-Kincaid grade level can be calculated using the following formula: $0.39 \times (\text{total words} / \text{total sentences}) + 11.8 \times (\text{total syllables} / \text{total words}) - 15.59$. This study's 6 instruction sets had a mean grade level of 8.67, with a range of 6.27 (representing the short instruction set) to 9.30 (representing both the medium text and physician-completed form). This indicated an average reading level associated with an age range of 11-14 years old. This measure also helped us to aim for consistency across instruction sets during their development.

Other materials presented to participants included a brief set of task instructions. We presented these instructions online and outlined the user's goal to review a set of medical discharge instructions following a total knee replacement and answer a question related to the information contained in the document. Questions covered the information presented in the instruction set to ensure participants engaged with and used the instructions to complete a task. The questions asked varied across instruction sets, ensuring that no participant encountered the same question more than once.

Perceived usability was evaluated using the modified System Usability Scale (SUS) (Bangor, Kortum, & Miller, 2008; Brooke, 1996). The SUS has been a widely used tool for assessing the usability of systems, products, environments, and services. The scale consists of 10 items rated on a 5-point Likert scale, ranging from strongly disagree to strongly agree. Responses to the survey are used to calculate a SUS score, which ranges from 0-100, with higher SUS scores indicating higher perceived usability.

A short demographic survey collected basic demographic information including age, race and ethnicity, and gender.

Design

In a within-subjects design, each participant interacted with the 6 different discharge instruction sets and answered a set of questions about each. A manipulation check for the usability of different text lengths included three lengths: short text, medium text, or long text. As noted, based on our literature review, we anticipated that the medium-length discharge instructions would have the highest perceived usability. The medium-length discharge instructions without images, pre-printed by computer, served as the template for the instruction sets used to assess other variables (Figure 7).

The next variable of concern to this study was visual image type, with three levels: no images and text only, diagrams, or photographs. The no-image, text-only instruction set was the same as the medium-text instruction set.

The third variable was instruction generation method, with two levels: discharge instructions pre-printed by a computer or a physician form completed by hand. The pre-printed instruction set was the same as the medium-text-length discharge instructions.

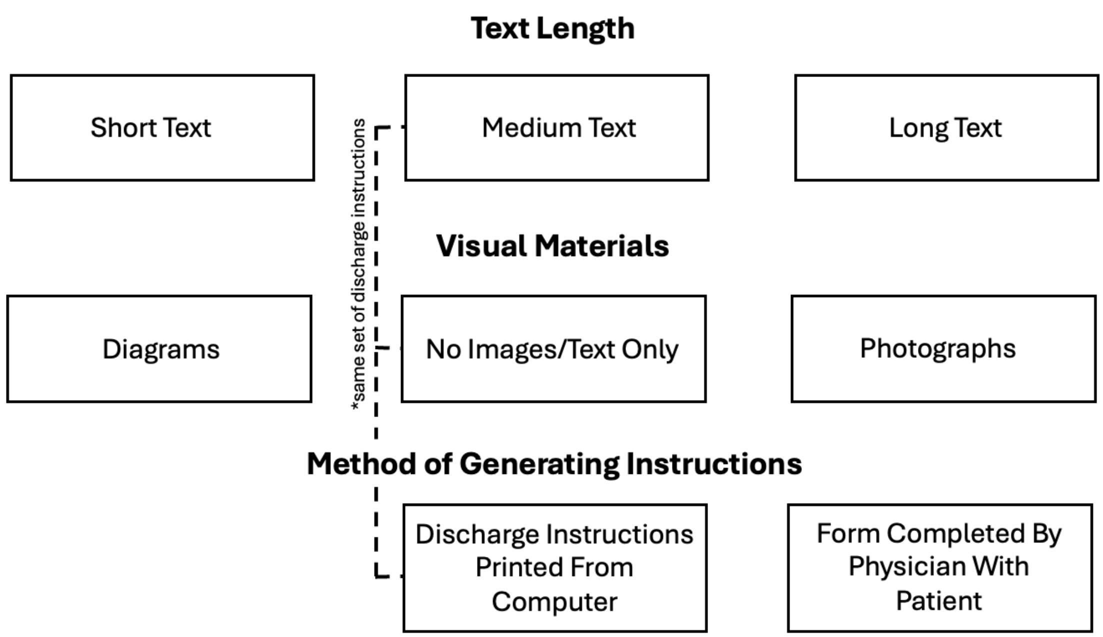

Figure 7. Study design including the three variables assessed and their associated levels.

In Figure 7, the medium text instruction set did not have images, was developed on a computer, and then pre-printed. Accordingly, the same instruction set was also used for the other two variables' assessments to limit the number of assessed materials and the time required to complete the study. For this reason, each participant viewed 6 different sets of instructions.

Procedure
We used Qualtrics to conduct the study online. After completing informed consent, each participant viewed a brief set of task instructions for the study. Next, the participants viewed 1 of the 6 sets of instructions, along with a question about the instructions' directives. The question differed for each instruction set, so participants did not see the same probe question twice. Participants were then asked to complete the SUS with only the previous instruction set in mind. This process was repeated for each of the remaining instruction sets until the 6 sets were presented and assessed by each participant. Qualtrics randomized the order of instruction set presentation for each participant. Following the presentation of all instruction sets and the collection of the corresponding SUS data, participants completed a brief demographic survey. Finally, participants were debriefed and thanked for their time.

Results

All participants who answered the probe questions for each instruction set provided a response based on the material presented. This indicated participants used the hospital discharge instructions as directed to answer a question about the material presented.

We performed a manipulation check on perceived usability, or SUS ratings, for the length of the discharge instructions. Figure 8 shows the mean SUS ratings across text lengths, revealing that the medium-length instructions have the highest SUS scores. There was an effect of text length, $F(2, 74) = 11.7$, $MSE = 545$, $p < .001$, with partial eta squared being .241. Paired t-tests that were Bonferroni corrected revealed a statistical difference between the short and long text length versions of the instructions, $t(37) = 3.10$, $p = .004$. Accordingly, participants perceived the short instructions to be more usable than the long instructions. There was also a statistical difference between the medium and long text versions of discharge instructions, $t(37) = 5.58$, $p < .001$. This indicated the medium text length instructions were perceived to be more usable than the long text instructions.

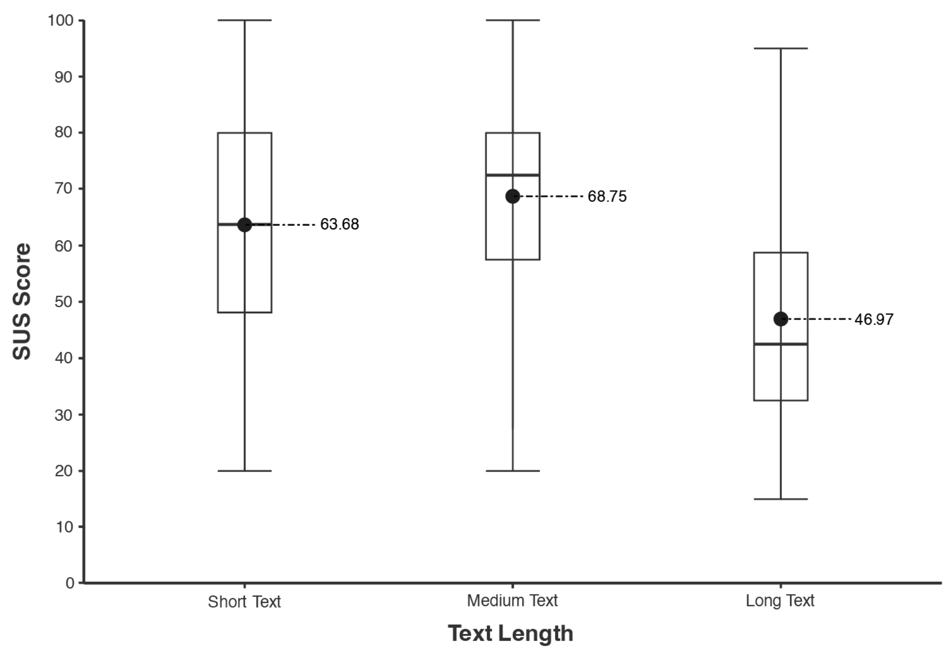

Figure 8. SUS scores as a function of text length, with the black dot indicating the mean for each condition.

There was no evidence for an effect of image type (no images, text-only, diagrams, or photographs), $F(2, 74) = 1.57$, $MSE = 377$, $p = .215$, and a partial eta squared of .041. There was also no evidence for an effect of generation method (pre-printed by computer versus a physician form completed by hand), $F(1, 37) = 1.15$, $MSE = 274$, $p = .289$.

Discussion

The results of this study reasonably present unambiguous findings that, for college student users, discharge instructions that are lengthy are judged to be harder to use than short and medium-length instruction sets. There is no evidence that other variables like image type or the method of generation impact perceived usability of instruction sets. The implications of these findings for UX designers are clear: Avoid lengthy, highly verbose text in discharge instructions. Further, the inclusion of pictorial representations (any type) does not seem to be a required component of usable instructions, provided the text is appropriate and sufficiently descriptive for the task.

Although these results provide concrete suggestions for the generation of discharge instructions, there are several areas that should be pursued in future research to further clarify what comprises optimal discharge instructions:

- Further investigation into the use of alternate forms of diagrams and images could potentially yield important findings. For example, instead of using static pictures, as was done in this study, research into pictures that show detailed sequential or temporal instructional information (rather than a single end-state picture) could result in a greater perceived usability.
- Exploring the threshold at which the length of text of hospital discharge instructions begins to hinder perceived usability should also be examined. Even the long text condition used in this study did not contain every detail and could have been expanded further.
- One limitation of the study is that it only explored a small subset of potential hospital discharge instructions. There may be cases in which text-only presentations are best, because graphics add little to the clarity of the instructions (for example, a discharge after a hospital stay for pneumonia). Alternatively, there may be instances in which graphical representations are better suited to the usability of complex visual sequences (such as how to insert a catheter). Future research should explore a broader range of discharge conditions to determine if the results in this paper generalize to those cases.
- This study focused on discharge instructions to be given after a knee procedure. In today’s world, however, patients and hospitals might not be limited to this delivery method, and so alternate forms, including video and audio delivery, should be further explored.

Generalizability to Broader Populations

The current study focused on the usability of discharge instructions for a young, college-aged, high-literacy population. Although a significant portion of this population undergoes surgery and uses these kinds of discharge instructions at rates that are similar to those of the general population, it remains to be seen whether these results could have general applicability in the broader population.

Certainly, age is one important factor that needs to be considered, because increasing age relates to increasing perceptual and cognitive deficits that might impact the ability to effectively use these different forms of instruction. Perceptual limitations due to decrements in vision and cognitive limitations due to the general aging process might play a role. The instructions used in the study used 12-point fonts, below the 14-point minimum recommended for elderly users. A study involving a broader population might require the use of larger fonts in order to accommodate elderly users.

More concerning is user literacy. The results found in this paper suggest that diagrams and photographs do not substantially add to the perceived usability of the instructions for this population. However, that may be due to the high literacy of the tested population. In a broader population, we would expect lower literacy rates, which could lead to a higher reliance on pictures and diagrams to convey the information to the user. Therefore, it would not be unreasonable to expect that graphical forms of the instructions might exhibit increased usability for a low literacy population. The instruction sets used in the experiment had an average Flesch-

Kincaid grade level of 8.6; although that level is considered standard, sixth-grade reading levels and less have been reported in up to 60% of the adult population in the U.S. (Cowan, 2004).

Because college students generally have high literacy, future studies should expand the demographic beyond college students to determine if these findings are generalizable to the greater population. Further, the reading levels of the instructions should be evaluated and potentially reduced to accommodate lower literacy users.

Care should be exercised in generalizing these findings beyond the studied population and task, but it seems reasonable to suggest that the findings regarding decreased usability with increasing text length could have broader applicability to other forms of critical instructions, in that instructions should tell the user what to do in a straightforward way, without too many words.

Conclusion

The results of this study indicate that, for the studied population, text length is likely a significant hindrance to perceived usability in hospital discharge instructions, based on the dimensions examined. As such, we recommend that physicians and other medical professionals avoid lengthy, complex text in hospital discharge instructions. The details included should be those most relevant to the patient's care, as too much detail can create verbose text and thereby negatively impact perceived usability. Photographs and diagrams did not significantly improve perceived usability, yet they did not hinder it either. Visual aids have a neutral effect in this study and should be considered if document creators feel that specific images clarify care processes and add value to verbal descriptions. Finally, the method of generation did not provide evidence for an impact on perceived usability, indicating that any benefit noted from jointly created hospital discharge instructions may be due to the process itself and not the visual state of the document.

Tips for User Experience Practitioners

- Physicians and other medical professionals should avoid lengthy, complex text when constructing hospital discharge instructions. Concise, explicit instructions lead to higher perceived usability. This general finding likely has broader applicability beyond hospital discharge instructions and should apply to other critical instruction sets provided to users.
- For patients who are college students, the use of pictures generally should be reserved for those situations in which a visual representation adds significant clarity, is needed for an accurate representation of a procedure, or shows a specific condition which would be difficult to interpret with words alone. The use of pictures simply for the sake of visual interest does not appear to add value.
- Preprinted computer discharge instructions, rather than hand-completed physician forms, should be used, as no usability difference was observed, and hand-completed instructions have the potential to suffer from miscommunication due to issues like poor handwriting or errors of omission.

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