



Case study

Readability and health literacy level of post-exposure prophylaxis patient education materials offered after sexual assault



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ABSTRACT

Background: The link between readability of patient education materials and patient outcomes has been well established. Patients who experience sexual assault often present to the emergency department in an acute trauma response state. Stress interferes with memory and learning. Patients routinely receive medication to prevent sexually transmitted infections after sexual assault. HIV post-exposure prophylaxis (PEP) success is dependent on completing a 28-day course. Only 24% of sexually assaulted patients complete HIV PEP.

Methods: This descriptive study used three validated tools to assess readability and evaluate the understandability of HIV PEP patient education materials following sexual assault. Patient education materials (n = 21) were collected through a variety of databases, government sources, and secondary reference review. Each researcher independently scored all materials. Inter-rater reliability was assured after robust.

Discussion: Final scores were used to determine readability and health literacy levels.

Results: All educational materials far exceeded the recommended readability level (Range = 7th grade to college). Those with the highest readability included visual cues.

The Patient Education Materials Assessment Tool (PEMAT) understandability scores ranged from 38 to 94%, and actionability scores ranged from 40 to 100%. Using a cut score of 80%, approximately 57% of the educational materials were understandable, while only 14% were actionable.

Conclusions: Expert agencies recommend a sixth-grade or below reading level for patient education reading materials. Our data show that post-exposure patient education materials following sexual assault are difficult to understand. This mismatch between the patient education material's readability and health literacy levels and the recommended standards will likely limit the success of post-exposure prophylaxis course of treatment following sexual assault.

1. Introduction

HIV post exposure prophylaxis (PEP) is an emergent antiviral treatment for the prevention of HIV after a sexual assault exposure has occurred. HIV PEP is a time sensitive medication which must be administered to a patient within 72 h of the exposure. HIV PEP requires the patient to complete a full 28-day course. Patients often start this medication within the hospital or clinic setting and are given a prescription and discharge information to follow. In order for patients take action and complete the 28-day course, it is inherently necessary that the patient information materials are understandable. Given the low rates of HIV PEP completion, it is possible that patients do not understand the

discharge information provided. There is a critical need for HIV PEP patient educational materials to be explicit, clear, and understandable for patients to improve adherence. Research has shown nearly 36% of U. S. adults have low health literacy [1]. Stress reduces the ability to understand, process, and utilize information [2]. Patients who require HIV PEP after sexual assault have been potentially exposed to HIV, which can cause stress and anxiety. The aims of this descriptive study were to assess readability and evaluate the understandability of HIV PEP patient education materials that may be given to patients after sexual assault.

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2. Background

The link between readability of patient education materials and patient outcomes has been well established. The Agency for Healthcare Research and Quality (AHRQ) [3] summarized the state of the science related to health literacy and its impact on patient outcomes one decade ago. The reports states that health literacy is poorer health outcomes. It was recommended that patient education materials should be closely examined to determine their adherence with best practices; it calls for researchers and clinicians to update their practices so that health literacy is considered each time [3]. The CDC's *Simply Put* [4] publication provides a guide for creating patient education materials that are easy-to-understand and meet health literacy guidelines. The guidebook presents evidence-based suggestions for improving readability and understandability of patient education materials. Despite the availability of expert agency guidelines and evidence, patient education materials continue to fall short of recommendations. Zowalla et al. [5] reviewed 34 patient information documents related to cardiovascular disease in three countries. All the documents were in English. The researcher used a computer-based approach to check readability using five tools. Results indicated that none of the documents met the sixth grade reading level recommendation across the five tools. A study by Oliffe et al. [6] assessed the readability of 10 patient medication information sheets distributed to patients by rheumatologists in three countries using three readability tools then validated findings using with patient checks. All the documents were in English. The results indicated that all documents exceeded the recommended sixth grade reading level across the three tools. Patient understanding patient comprehension of these documents also poor with 79% failing to answer questions about medications after reading the medication information sheets. Worrall et al. [7] evaluated the readability of 20 COVID19-related information found online in four English speaking regions using four readability tools. Results indicated that all of the online COVID19 website pages were below the sixth-grade readability levels. None of these studies examined the patient education materials for compliance with health literacy standards.

Low health literacy is a serious concern that negatively impacts health outcomes and contributes to disease burden. The Patient Protection and Affordable Care Act of 2010, Title V, defined health literacy as "the degree to which an individual has the capacity to obtain, communicate, process, and understand basic health information and services to make appropriate health decisions" [8]. The need to differentiate between personal and organizational health literacy has become essential over the years as well as navigating and access to care components of health literacy, all of which can contribute to barriers to care. Personal health literacy is defined as literacy that is not only about comprehension but also includes how people access, understand, and apply health information to their own, unique situation. Organizational health literacy refers to the extent that organizations provide equal access to "find, understand, and use information and services" to allow patients to make informed decisions about their health [9].

Level of health literacy directly impacts a patient's ability to understand and use health information. Patients with low health literacy have been shown to have less engagement in healthy behaviors, non-adherence to medical treatments, increase in negative health outcomes, such as cardiovascular disease, and increased risk of death [10–12]. One study found that trauma patients with low health literacy were unable to recall their injuries, treatments, procedures, and surgeries [2]. A study by Swartz et al. (2020) found that trauma patients with low health literacy were less likely to follow their discharge instructions and less likely to follow-up with their healthcare provider [13]. In addition, patients with HIV and low health literacy have lower overall knowledge level about HIV, have difficulty understanding medication instructions, and have increased risk of non-adherence with medications and treatments [14].

Patients who seek care in an emergency department may have additional barriers to understanding health information. Patients

presenting to the emergency department in crisis or after a trauma-related injury are often under acute stress. This acute stress leads to the trauma stress response. During the trauma stress response physiological, cognitive, and hormonal systems are impacted. The stress response initially allows the patient to deal with the acute, traumatic stress [15]. The body responds and adapts to the stress of the trauma by activating the fight, flight, or freeze stress response [15]. During this response state, stress hormones, such as catecholamines and cortisol, are activated to respond to the acute trauma; the activation of these hormones impacts neurological functioning in both short- and long-term memory [16,17]. Patients who have had an exposure to HIV often present in acute trauma response state, such as those have sustained needle stick injuries, sexual assault, and other sexual exposures. Treatment with HIV PEP requires administration of antiviral medication within 72 h of exposure and a 28-day course [18]. HIV prophylaxis efficacy is dependent on completing the full 28-day course; missed or late doses often leads to lowered medication efficacy, which may result in HIV infection [18]. Stress reduces comprehension [4]. A meta-analysis by Scannell et al. [19] demonstrated that only 24% of patients who have experienced sexually assault complete HIV PEP. Additionally, patients who have been sexually assaulted are likely experiencing an acute trauma response, which can have compounding effects with low health literacy. Compliance with HIV PEP medication instructions may be much lower when both low health literacy and stress response are present simultaneously.

The readability and health literacy levels of patient educational materials can greatly impact understandability and subsequent action. The American Medical Association (AMA) recommends that educational materials are written at no higher than sixth grade levels. Health literacy guidelines are described by both the U.S. Department of Health and Human Services [8] and the Centers for Disease Control and Prevention [CDC] [4]. Two commonly used readability scales include the Flesch-Kincaid Readability Test Tool and the Simple Measure of Gobbledygook (SMOG) tool. Both tools provide an estimate of the grade level of written materials. The SMOG assessment tool allows the evaluator to hand-score educational materials by counting words of three or more syllabus in each of 10 sentences at the beginning, the middle, and the end of a document. An overall score is given after the number of syllables in each sentence are totaled and converted to a corresponding reading grade level score. The SMOG assessment tool estimates years of education required to understand written text [4,20]. The Flesch-Kincaid Readability Test Tool is a computer-based scoring tool. A document is uploaded into the web-based platform and automatically scored. The generated score estimates the grade level of the document. Research has shown that the Flesch-Kincaid tool tends to predict lower reading grade level scores when compared with other tools [21]. Using the two tools together allows the evaluator to better estimate reading levels, however, they cannot predict level of comprehension

Compliance with two components of health literacy, understandability and actionability, can be measured using the Patient Education Materials Assessment Tool (PEMAT). The PEMAT was developed by researchers working with the AHRQ and a panel of experts in health literacy, content creation, patient education, and communication (Agency for Healthcare Research and Quality [AHRQ], 201). Items within the PEMAT were based on existing tools and concepts provided within guides to assess and develop patient education materials. The PEMAT provides numeric scores for both understandability and actionability based on health literacy criteria for patient educational materials.

The need for HIV PEP patient information to be clear, understandable, and actionable is essential for patients to improve medication adherence after an exposure to HIV. The low compliance rate is very concerning. It is especially critical in a patient population that likely is experiencing neurobiological changes that impact memory and may have a low health literacy. The purpose of this study is to evaluate publicly available HIV PEP educational materials to determine the

readability and health literacy levels. The aims of this study were to evaluate the readability and understandability HIV PEP patient education materials that may be given to patients after sexual assault exposure.

3. Objectives

The objectives of this descriptive study were to (1) assess the readability and (2) evaluate the health literacy level of publicly available HIV post-exposure prophylaxis patient education materials following sexual assault.

4. Methods

4.1. Recruitment strategy

This descriptive study identified used patient educational materials as participants. Recruitment included the searching for and evaluating HIV PEP patient education materials for eligibility. Eligibility criteria included educational materials that focused on HIV post-exposure prophylaxis in a format intended to be distributed to patients in a clinical setting who have been prescribed HIV PEP medications and written in English. Patient educational materials about HIV post-exposure prophylaxis geared toward providers or in a language other than English were excluded. As the participants for this study were not human, the onus was on the investigators to search for eligible participants through independent searches. The investigators reviewed printed or printable patient education materials identified through online internet and database searches over the course of two weeks. Keywords assisted the investigators to maximize accurate retrieval of eligible materials. Keywords identified for the search for eligible materials included: HIV post-exposure prophylaxis discharge instructions, HIV post-exposure prophylaxis guidelines, HIV post-exposure prophylaxis handouts, and HIV post-exposure prophylaxis leaflets. Databases searched included Ovid, CINAHL, Google Scholar, PubMed, Medline Plus, government sources, such as the Centers for Disease Control and Prevention, National Health Services and HIV organizations. Lastly secondary references reviewed from published review articles. Online searches yielded 19 of the patient educational materials. Secondary review of references yielded an additional two.

All eligible patient education materials were selected if they met eligibility criteria and were written within the past 10 years. Three identified documents did not have any clear dates but were included after consultation with one of the researchers with expertise in this field. The researcher concluded that the information provided in the three documents without a date was current to national standards within their respective country. The final sample was 21 patient educational materials.

4.2. Health education material geographic origin

Patient educational materials originated in various countries, including the United States, Canada, England, Ireland, and Australia. Materials were derived from government-based health care authorities, such as the department or ministry of public health, public healthcare institutions, government-based sexual assault programs, and HIV/AIDS non-profit organizations. The target population for the educational materials varied. Some of the HIV PEP educational materials were developed for anyone with potential exposure to HIV, while other materials were targeted to specific circumstances, such as sexual exposure, sexual assault, needle stick injury, sharing needles with intravenous drug use, or occupational exposure in healthcare workers (see Table 1).

4.3. Instruments

Educational materials were analyzed using tools and guidelines to

Table 1
Patient Information Documents Descriptions.

Author Information	Location (Country)	Type of Organization	Target Population
Treatment After Exposure to HIV [22]	International	Non-profit organization in the U. S., Washington D.C.	Non-occupational exposure to HIV and sexual exposures, needles stick injuries and to prevent mother-infant transmission
PEP 101 [23]	United States	Government, National health authority	Anyone may have been exposed to HIV during sex, IVDU, or sexually assaulted
PEP 4 HIV Prevention [24]	United States	Government: New York State run Department of Health	Anyone exposed to HIV from sex, IVDU
A User's Guide to PEP [25]	United States	Government: New York City Department of Health	General statement for anyone exposed to HIV
HIV/STI Post-Sexual Exposure Prophylaxis [26]	United States	Government funded national educational training network	Sexual exposures, both consensual and non-consensual
HIV Post Exposure Prophylaxis Discharge Instructions [27]	United States	Government: Oregon State Health Authority	For victims of sexual assault
HIV NPEP Plan of Action for Victims of Sexual Assault in Kentucky [28]	United States	Government: Kentucky State	For victims of sexual assault
Information for the Patient HIV Post-Exposure Prophylaxis [29]	Canada	Government: Providence of British of Columbia	General statement for anyone exposed to HIV
Guidelines for the Management of Exposures to Blood and Body Fluids [30]	Canada	Government: Province of Saskatchewan	Statement referencing healthcare workers may need to take medication due to exposures to HIV
A Guide to – PESPE [31]	United Kingdom	Government based National Health Authority for the UK	General statement on need for medication due to HIV exposure with focus on unprotected sex
Information about the Post-Exposure Prophylaxis (PEP) Contained in This Pack [32]	United Kingdom	National Professional Healthcare Organization	General statement on need for medication due to HIV exposure
Prevention and Management of Clinical Sharps Injuries and Exposure to Blood and High Risk Body Fluids [33]	England	Government based healthcare system	General statement on need for medication due to HIV exposure
HIV Post Exposure Prophylaxis (PEP) Patient Information Leaflet [34]	England	Government based healthcare system	General statement on need for medication due to HIV exposure
Emergency Department post-exposure Prophylaxis [35]	England	Government based healthcare system	General statement on need for medication due to HIV exposure
Post-exposure prophylaxis following potential sexual exposure to	England	Government based healthcare system	General statement on need for medication due to HIV exposure

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Table 1 (continued)

Author Information	Location (Country)	Type of Organization	Target Population
blood borne viruses (PEPSE) [36]			
HIV Post Exposure prophylaxis: drug information Truvada & Raltegravir [37]	England	Government based healthcare system	General statement on need for medication due to HIV exposure
Information about the Post-Exposure HIV Prophylaxis Medication Contained in this 5-Day. University Hospital of Birmingham NHS	England	Government based healthcare system	General statement on need for medication due to HIV exposure
HIV Post-Exposure Prophylaxis (PEP) Information Leaflet [38]	Ireland	Government national health authority	General statement on need for medication due to HIV exposure
Australian National Guidelines Patient Information Sheet [39]	Australia	Government; National health authority	Anyone engaging in condomless sex or sharing needles
HIV Post Exposure Prophylaxis (nPEP) Information for Patients [40]	Australia	Government; State health authority	General statement on need for medication due to HIV exposure
PEP Information [41]	Australia	Government based healthcare system	General statement on need for medication due to HIV exposure

assess the readability and health literacy levels of the materials (Table 1). Health literacy level was assessed using The Patient Education Materials Assessment Tool (PEMAT) [42]. The PEMAT is best used in conjunction with a readability scoring tool. Two readability tools, the Simple Measure of Gobbledygook (SMOG) and the Flesch-Kincaid readability test were included in this study. The researchers chose two measures to assess readability as research has shown significant differences in results between the two tools [43]. A paired *t*-test was used to compare the SMOG and Flesch-Kincaid readability scores. A significance was assumed at an alpha value of 0.05.

The PEMAT was used to evaluate the health literacy level of the educational materials. The PEMAT has two domains, understandability and actionability. Understandability is defined as the degree to which people with low health literacy can interpret key messages within the educational material. Actionability is defined as the degree to which people take action, e.g., seek care or change behavior, based on the information provided by the educational material. The PEMAT User Guide was used to develop scoring criteria [42]. PEMAT has been found to be a valid and reliable measurement of understandability and actionability of written content. Scores of 70% or higher are regarded as understandable or actionable, whereas a score of 70% or below would be considered poorly understandable or actionable [44].

Three trained researchers independently scored all materials using PEMAT scoring criteria. Scores were shared among the group and discrepancies were resolved following robust discussion and consensus of the investigators. Inter-rater reliability was assured if raters agreed on interpretation of scoring criteria and final rating of each criterion. Final scores calculated were included to determine health literacy levels [42].

The Simple Measure of Gobbledygook (SMOG) tool determines grade level by assessing both word and sentence length [20]. Readability is calculated by selecting 10 consecutive sentences at the beginning, middle, and end of the written material, counting words with three or more syllables, computing the count's square root, and multiplying by three to determine the grade level. SMOG has been found to have good reliability and accuracy. The scored grade level indicates the grade level

to which someone one must reach to be able to understand the written material; a suitable level for readability has been established at a sixth-grade level [45,20].

The Flesch-Kincaid Readability Test Tool determines the grade level at which the written content can be understood by readers. It can be determined using the total number of words and syllables. The resulting value represents an estimated grade level in the United States. Higher scores imply greater difficulty understanding, whereas scores of 8 or less indicate a score of readability [45,46]. Calculation of the SMOG and Flesch-Kincaid was used with online calculator [45].

5. Results

A total of 21 HIV PEP patient educational materials were included in this study. Individual results are noted in Table 2 and mean scores noted in Table 3. The PEMAT understandability scores of patient education material ranged from 38 to 94% with an average of 78.86. Of the 21 documents, only three, A Guide to – PESPE, HIV NPEP Plan of Action for Victims of Sexual Assault in Kentucky, and HIV Post Exposure Prophylaxis Discharge Instructions, fell below the desired score of $\geq 70\%$ (69%, 57% and 38%, respectively). The PEMAT actionability scores ranged from 40 to 100% with an average score of 62.38%. Only three (14.3%) educational materials met the desired score of $\geq 70\%$, indicating difficulty in actionability for the majority of the patient education materials.

All the patient education materials scored above a 6th grade reading level on both the SMOG and the Flesch-Kincaid Grade Level scales (Range 7th grade to college). Average scores of the SMOG were 10.05 (95% CI 9.38 to 10.7) and Flesch-Kincaid was 10.29 (95% CI 9.54 to 11), reflecting a requirement of a 10th grade reading level to understand the material. A paired *t*-test was conducted to determine if there were any significant differences between the two tools SMOG and Flesch-Kincaid. Results indicated no significant differences between the two tools ($M = 10.5$ $SD = 1.56$ and $M = 10.29$, $SD = 1.74$, respectively, $p = .056$). A *t*-test was conducted to determine if there were any significant differences between the two tools scores and our finding indicated no significant finding between the two tools.

Nearly all (81%) of patient education materials fell within the desired understandability level ($\geq 70\%$). Four patient education materials scored highest on understandability, PEP 101; Information about the Post-Exposure HIV Prophylaxis Medication; PEP Information; and HIV Post Exposure prophylaxis: drug information Truvada & Raltegravir (88%, 94%, 94%, and 94%, respectively). Each of these patient educational materials used visual aids within the document to convey, which is highly recommended in health literacy guidelines [4,47].

6. Discussion

Expert agencies recommend patient education reading materials should be at or below a 6th grade reading level [4,47]. Materials at a higher reading level may reduce patient understanding of information. Health literacy includes understanding health information and having enough information to make a decision about necessary, next steps. Educational materials that score poorly on understandability or actionability may limit a patient's understanding of health information and which steps to take.

To our knowledge, this is the first study to examine the readability, understandability, and actionability of HIV PEP patient information. Our data showed that HIV PEP patient education materials are difficult to understand. None of patient education materials included in this study adhered to recommended reading levels. Adherence to health literacy guidelines was mixed. Most of the patient educational materials met understandability cut scores, while most patient education materials fell below actionability cut scores.

The high readability scores among our sample demonstrated that a higher level of education was needed to understand the HIV PEP patient education information included our sample. The SMOG and Flesch-

Table 2
Individual Results.

Author	Understandability (PEMAT) (%)	Actionability (PEMAT) (%)	SMOG (grade level)	Flesch Kincaid (grade level)
Treatment After Exposure to HIV [22]	77	40	9th	9th
PEP 101 [23]	88	60	8th	8th
PEP 4 HIV Prevention [24]	71	50	8th	8th
A User's Guide to PEP [25]	86	67	7th	7th
HIV/STI Post-Sexual Exposure Prophylaxis [26]	77	60	12th	College
HIV Post Exposure Prophylaxis Discharge Instructions [27]	38	60	10th	10th
HIV NPEP Plan of Action for Victims of Sexual Assault in Kentucky [28]	57	60	10th	10th
Information for the Patient HIV Post-Exposure Prophylaxis [29]	85	60	12th	12th
Guidelines for the Management of Exposures to Blood and Body Fluids [30]	85	60	11th	10th
A Guide to – PESPE [31]	69	60	9th	9th
Information about the Post-Exposure Prophylaxis (PEP) Contained in This Pack [32]	77	60	10th	11th
Prevention and Management of Clinical Sharps Injuries and Exposure to Blood and High Risk Body Fluids [33]	86	50	11th	12th
HIV Post Exposure Prophylaxis (PEP) Patient Information Leaflet [34]	85	60	9th	9th
Emergency Department post-exposure Prophylaxis [35]	77	60	11th	12th
Post-exposure prophylaxis following potential sexual exposure to blood borne viruses (PEPSE) [36]	77	60	11th	12th
HIV Post Exposure prophylaxis: drug	94	83	11th	11th

Table 2 (continued)

Author	Understandability (PEMAT) (%)	Actionability (PEMAT) (%)	SMOG (grade level)	Flesch Kincaid (grade level)
information Truvada & Raltegravir [37]				
Information about the Post-Exposure HIV Prophylaxis Medication Contained in this 5-Day. University Hospital of Birmingham NHS	94	80	11th	11th
HIV Post-Exposure Prophylaxis (PEP) Information Leaflet [38]	85	60	8th	8th
Australian National Guidelines Patient Information Sheet [39]	69	60	11th	11th
HIV Post Exposure Prophylaxis (nPEP) Information for Patients [40]	85	60	College	College
PEP Information [41]	94	100	9th	10th

Table 3
Mean Scores.

	Mean	SD	95% Confidence Interval
PEMAT readability	78.86	13.20	(95% CI 73.2 to 84.5)
PEMAT actionability	62.38	12.37	(95% CI 57.1 to 67.7)
SMOG Reading level	10.05	1.56	(95% CI 9.38 to 10.7)
Flesch-Kincaid Reading level	10.29	1.74	(95% CI 9.54 to 11)

Kincaid readability tools indicated reading levels higher than the recommended 6th grade level (Range 7th grade to college) [4,47] for 100% of our sample. Materials that require a higher reading level, such as the examples in this study, may reduce patient understanding of information resulting in misinformation.

In terms of health literacy, nearly all (81%) of patient education materials included in this study met the desired understandability level ($\geq 70\%$). However, although the educational materials scored at a high literacy level, there were several notable differences among the materials. Only four of the patient educational materials used visual aids within the document to convey information [23,48,41,37]. Three of the educational materials used pictures of the antiviral medications, illustrating exactly how the medication should appear, [41,37].

In this study, the mean actionability score (62.38) was well below the desired level of 70% or higher. In total, only three of the 21 patient education documents were considered actionable. A few patient education materials included in this study show how the likelihood of actionability can be improved, i.e., visual aids such as pictographs or the use of a chart, and can be used as a guide. Of note, the three highest actionability scores of the of the educational materials all used pictures of the antiviral medications, illustrating exactly how the medication

should appear, [41,37].

The materials with visual aids scored the highest in both understandability (94%) and actionability (Range 80–100%) despite their poor readability (Range 9th–11th grade). Of note, the CDC document used visual aids to highlight information and showed a picture of a small medication bottle where information on medication was provided. These instructions ranked highest in readability, with a score of 88%. Higher scores in readability and health literacy among educational materials that used visual aids highlights the importance of including visual aids or pictographs. Picture-based health-education can be a helpful tool in educating patients regarding their medications. Research has shown an increase in the ability of patients to recall and understand medication instructions when pictographs are used [49]. Healthcare providers should include pictures to enhance understandability and actionability of educational materials when available.

The use of tangible tools was generally lacking within our sample; however, one document provided an exemplar. The NYC patient education document illustrates how a tangible tool can be used. A 28-day chart appears within the patient education document. The chart can be used by patients to mark each day medications are taken. The NYC patient education document also ranked at the lowest reading grade level, which is preferred.

The Oregon Attorney General Sexual Assault Task Force NPEP discharge instructions scored the lowest in understandability (38%) [27]. The Oregon discharge instructions included high-level medical terminology, which could have been replaced with everyday language. The document also used a passive voice. An active voice is recommended for ease of reading. Additionally, the information was not broken into well-defined sections, nor did it have clear headings or a summary, all of which improve readability.

Patients seeking or requiring HIV PEP are often in an acute stress after a trauma-related event in which exposure to HIV is likely, such as a sexual assault. The stress of the event can impact how patients comprehend information. Lower health literacy further complicates the capacity to understand information [50]. Much of our sample was not specific to post-exposure education following sexual assault, and, instead, contained general information about post-exposure prophylaxis resulting from a variety of exposures. The two patient education materials with the lowest scores were specifically indicated for patients who have been sexually assaulted and required to receive HIV PEP [28,27]. These two educational materials [28,27] scored the lowest in understandability (38% and 57%, respectively) and had the highest readability level (10th grade), indicating difficulty with understanding. This raises a concern a particular concern in patients who have been sexually assaulted, and may, in part explain the low compliance rate among this group (BLINDED FOR REVIEW et al., 2018).

Contrary to previous findings, the *t*-test used to test for significant differences between the SMOG and Flesch-Kincaid readability tools scores indicated no significant finding between the two tools in our study. Other studies have indicated significant differences between these tools [43,51].

Healthcare providers should be aware of patient vulnerabilities and provide patient information that can increase health literacy such as clear headings or summaries, information in specific well-defined sections and with an active voice. Another measure healthcare providers can take to increase the understanding of information is using a tangible tool. Although the use of tangible tools was generally lacking within our sample; one document provided an exemplar on tangible tools. The NYC patient education document illustrates how a tangible tool can be used. A 28-day chart appears within the patient education document. The chart can be used by patients to mark each day medications are taken. The NYC patient education document also ranked at the lowest reading grade level, which is preferred.

7. Limitations

This study has several limitations. This study only used publicly available HIV PEP information documents and may not be reflective of all HIV PEP patient information within different healthcare settings and organizations. Although documents from public healthcare centers located in Canada, England and Australia were included, there was none from the private sector in any of the countries. Therefore, it is difficult to determine if patient information documents differ within the private sector in these countries. Only patient educational materials from official government health departments and governmental organizations were included. These differences limit the generalizability of our findings. Specific healthcare organizations may have patient information documents that have readability, understandability, and actionability levels that differ from the results found in this study. Another limitation was the use of English-only patient education materials. The results may differ in countries or areas where other languages are spoken.

The PEMAT tool has some limitations. Although the PEMAT tool scores on both understandability and actionability, it does not indicate level of accuracy. Information scored and understandable or actionable may be inaccurate. The PEMAT User's Guide recommends using readability assessments in conjunction with, but not in substitution for, the PEMAT [44]. However, the readability tools have some additional limitations. Both readability tools, SMOG and Flesch-Kincaid, provide an estimate of level of education required to read a text document. Neither tool provides an indication of comprehension, nor do they allow for cultural context, language skills, and other socio-cultural variables [52].

8. Conclusion

Expert agencies recommend a sixth-grade or below reading level for patient education reading materials. Our data show that post-exposure patient education materials following sexual assault are difficult to understand. This mismatch between the patient education material's readability and health literacy levels and the recommended standards will likely limit the success of post-exposure prophylaxis course of treatment following sexual assault. Patient education materials that are too complex in readability, understandability, actionability, or any combination of these will reduce the likelihood that patients will adhere to recommended treatment plans. It is important for healthcare providers to review their current HIV PEP patient education materials for readability, understandability, and actionability in order to improve HIV PEP care.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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