An analysis of state health department COVID-19 information for the public

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Abstract

Background: In response to the current COVID-19 crisis, public health departments across the U.S. have created, distributed, and shared COVID-19 health information. The extent to which information is understandable and actionable can be examined by use of validated health literacy and readability tools. Health information must be actionable, simple, and straightforward, particularly for health messages in times of urgency or during a health crisis.

Objective: This study aimed (1) to use three validated health literacy tools to assess the understandability, actionability, clarity, and readability of COVID-19 health information created for the public by U.S. state public health departments; (2) to examine the correlations between understandability, actionability, clarity, readability, and material types; (3) to propose potential strategies to improve public health messaging.

Methods: Based on CDC statistics on June 30, 2020, we identified the top 10 U.S. states with the highest number of COVID-19 cases. We visited the 10 state public health department websites and selected materials related to COVID-19 prevention according to a pre-defined eligibility criteria. Two raters independently assessed the materials by Patient Education and Materials Assessment Tool (PEMAT) and Clear Communication Index (Index). One rater generated the Flesch-Kincaid Grade Level (FKGL) score. Statistical analyses included (1) interrater reliability (IRR) by Cohen's kappa; (2) the mean, median, standard deviation, range, minimum, maximum, and frequency scores associated with PEMAT, Index, and FKGL; (3) statistical significance of the correlation between PEMAT, Index, FKGL, and Material Type.

Results: Of 42 materials in this study, (1) inter-rater reliability was 0.94. (2) The mean PEMAT (n=42) understandability was 88.67% (SD±17.69%), with a media of 94% and a range between 21% and 100%; the mean of PEMAT actionability was 88.48% (SD±14.3%), with a media of 100% and a range between 40% and 100%; the mean Index scores was 78.32 (SD±13.03), with a media of 78.35 and a range between 50 and 100. The mean of FKGL of the materials (n=34) was 7.11 (SD±2.60), with a media of 7.3 and a range between 1.7 and 12.5. (3) Correlations were significant (P<0.01) and positive between PEMAT understandability and actionability, PEMAT understandability and Index scores, PEMAT actionability and Index scores, PEMAT understandability and Material Type, PEMAT actionability and Material type. Correlations were significant (P<0.01) and negative between PEMAT understandability and FKGL scores, PEMAT actionability and FKGL scores, Index and FKGL scores, and FKGL and Material Types. No correlation was detected between Index scores and Material types (P>0.05).

Conclusions: COVID-19 health information provided by states for the public were easy to understand and act upon but could be improved in terms of readability and clear communication. The positive correlation identified between material types and PEMAT understandability/PEMAT actionability/Index scores respectively led to our recommendation on using more infographics and video format for public health messaging. Clinical Trial: N/A

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Conclusions: COVID-19 health information provided by states for the public were easy to understand and act upon but could be improved in terms of readability and clear communication. The positive correlation identified between material types and PEMAT understandability/PEMAT actionability/Index scores respectively led to our recommendation on using more infographics and video format for public health messaging.

Keywords: Health literacy; communication; information design; covid-19; public health; consumers; health information; infodemic; state health department; patient education

Introduction

Since its emergence in December 2019, the COVID-19 pandemic has had far-reaching implications for global public health, one of which is access to quality health information that is understandable by the public. Director General Tedros Adhanom Ghebreyesus of the World Health Organization (WHO) recognized in February 2020 that the current global health crisis is also an information crisis, or infodemic [1]. An infodemic is characterized by an over-abundance of information, both accurate and inaccurate, “that that makes it hard for people to find trustworthy sources and reliable guidance when they need it” [2]. As noted by Ottosen, Mani, & Fratta [3], “the ubiquitous nature of health information is both a benefit and burden for health consumers.” While greater access to information exists, the overwhelming supply and nature of information can be complex to navigate and evaluate which can impede individuals’ ability to understand and act on it.

Health literacy and clear health communication have become a public health challenge along with access to credible and actionable health information. Health literacy is “the use of a wide range of skills that improve the ability of people to act on information in order to live healthier lives. These skills include reading, writing, listening, speaking, numeracy, and critical analysis, as well as communication and interaction skills” [4]. It is estimated that approximately 90 million people, nearly half of all American adults, have difficulty understanding and acting upon health information [5]. Clear health communication is more than simply providing information in an understandable manner. Health information must be actionable and appropriate for people with a wide range of health literacy skills. It must also be simple and straightforward, particularly for health messages in times of urgency or during a health crisis. The American Medical Association recommends that easy-to read materials are written at or below the sixth-grade level, using mostly one-or two-syllable words [6]. However, a study on the readability of online COVID-19 information provided by WHO, CDC, and governments of 15 countries found that the information exceeded the 6-8th grade reading level and used medical jargon, which shows that this is a global issue. The study also found that COVID-19 information on 137 webpages from federal and state sources, were an average of three grades higher than the recommended reading level by existing guidelines for clear communication and averaged over the 11th grade reading level [7].

In the months since the WHO declared COVID-19 a global pandemic, experts have called for the application of health literacy principles to the creation of COVID-19 communications, as “health literacy is vital to slowing down the spread of the virus and mitigating the impact and effects of COVID-19" [8]. Much of the public health messaging around COVID-19 focuses on effecting behavior change such as hand washing, social distancing, and wearing face masks, but in order for this information to be actionable, the recommended behaviors must apply clear communication and health literacy principles [9,10]. To this end, Okan et al [11] recommend that health literacy should be considered as a component of the COVID-19 public health response framework. The infodemic management framework developed from a WHO technical consultation calls for scientific evidence to be translated into “actionable behavior-change" messages that are understood and accessible to all individuals in WHO Member States [12]. Likewise, in order to persuade people to follow public health advice, the CDC Field Epidemiology Manual recommends that messages be tailored to ensure that they are written in plain language and to ensure that messages to the media and the public resonate [13].

In response to the current COVID-19 crisis, public health departments across the U.S have created,

distributed, and shared COVID-19 health information. The extent to which information is understandable and actionable can be examined by use of validated health literacy and readability tools. Our study examined COVID-19 information created for the public by state public health departments to determine how understandable and actionable this information is for the public. In this study we aim to identify: (1) whether materials produced by public health departments meet the recommended reading level, (2) the extent to which COVID-19 messaging is understandable, actionable, and clear; (3) whether there is a relationship between reading grade level and understandability and actionability, and (4) potential strategies to improve creation of public health messaging.

We applied three validated tools to assess readability, understandability, and actionability of documents created by state public health departments. All three tools have been applied to assess consumer and patient health documents [14–18]. The Patient Education Materials Assessment Tool (PEMAT), from the Association of Healthcare Research and Quality (AHRQ) is used to systematically evaluate and compare the understandability and actionability of patient materials [19]. The full version (PEMAT-P) is for printed materials such as brochures, pamphlets, PDFs, etc., and a modified version (PEMAT-A/V) is used for audiovisual materials, including videos and multimedia. The CDC Clear Communication Index (Index) is a tool that identifies the most important communication characteristics that help to clarify and understanding of public health messages and materials [20]. It is used to assess the clarity and understandability of public messages and materials and was created for CDC staff to develop and assess communication products for CDC's audiences, but is also used by those who create public health communication materials. Some strengths of the Index as a clear communication tool are that it addresses health, science, and risk communication and reduces subjectivity [21]. Readability was determined via use of the Flesch-Kincaid Grade Level (FKGL) score. The FKGL is a widely used, validated tool and is considered a useful guide for measuring complexity of text. Readability tests are useful for quickly measuring how easily people can understand a piece of text [22].

Most studies that apply the PEMAT or Index use them to assess patient education materials [15–18]. There are fewer studies on the application of these tools to public health messaging. Because the COVID-19 pandemic is still unfolding, there also limited research on health literacy and COVID-19 public health messaging. At the time of writing (August 2020), one study had applied the PEMAT and three readability scales to assess COVID-19 information for the public [14]. Among their sample of COVID-19 materials they identified on major search engines, researchers found deficiencies in readability, actionability, and understandability. Additionally, most assessments of patient education materials applied only one of these two tools; there are only four studies that applied both the PEMAT and Index to assess patient education materials [15–18]. Of these studies, one used the PEMAT and Index [16] and three applied the PEMAT and Index in combination with one or more readability tools [15,17,18]. Therefore, our study which applied multiple tools (PEMAT, Index, and FKGL) to determine understandability, actionability, and readability of public health messages about COVID-19 fills a gap in the current research.

Methods

Health Literacy & Readability Assessment Tools

A multi-pronged approach was utilized to review materials using the PEMAT-P, PEMAT-A/V, Index,

and FKGL tools. We selected these tools because they have been validated and are “intended for use by untrained reviewers” [15]. Using this combination of tools provides a “multi-faceted assessment of how patient education material content and format affect a patient’s ability to comprehend the presented information” and allowed us to holistically evaluate the materials [15,17].

First, we assessed the understandability and actionability of each material using the Patient Education and Materials Assessment Tool (PEMAT) [23]. Understandability items determine whether readers with varying backgrounds and levels of health literacy can process and explain key messages. The main subsections of understandability are content, word choice and style, the use of number, organization, layout and design, and the use of visual aids. Actionability items appraise whether readers will know how to use or apply the information presented. A percentage score is calculated for both understandability and actionability. The higher the score, the more understandable or actionable the materials are regarded [23]. The PEMAT-P consists of 17 items measuring understandability, and 7 items measuring actionability while the PEMAT-A/V only has 13 items measuring understandability and 4 items measuring actionability. Each PEMAT item has either two choices (i.e., Disagree=0, Agree=1) or three choices (i.e., Disagree=0, Agree=1, N/A) for the rater. For both understandability and actionability, the higher the PEMAT score, the more understandable or actionable the material is regarded. In addition, a score of 70% has been used as a benchmark for materials to be considered highly understandable or actionable and any score below 70% indicates poor understandability or actionability [15,24,25].

Second, we assessed the extent to which each material provided clear communication via the Clear Communication Index (Index) which assesses “the clarity and ease of use of an already released communication product” [20]. The Index can be used to both inform the design and development of new communication and to assess the clarity and usability of existing messages. The Index evaluates materials in 7 areas: main message and call to action, language, information design, state of the science, behavioral recommendations, numbers, and risk [26]. For public communication materials using the regular format (e., print text/infographic), the Index-Full assesses the clarity using 20 research-based items for 7 areas: main message and call to action, language, information design, state of the science, behavioral recommendations, numbers, and risk. For “short form and oral communication materials” (e.g., Facebook posts, Twitter messages, and videos), CDC developed a Modified Clear Communication Index Score Sheet (Index-Mod) which has 13 items addressing 4 areas: main message and call to action, language, behavioral recommendations, numbers, and risk. Both Index- Full and Index-Mod score sheets’ items are rated using a numerical score of 0 or 1. Individual scores for each item are converted to an overall score on a scale of 100, where 90 or higher is considered passing, or “easy to read” [15,16,20].

Third, we calculated readability of included materials using the FKGL score [27]. The FKGL test is one of the most commonly adopted readability measures for patient education materials [28–32] or online consumer health information [33–35]. The FKGL score reports readability as a grade equivalent reading level [6]. The score is produced using a mathematical formula based on two factors: 1) sentence length – average number of words in a sentence, and 2) word length – average number of syllables in a word. The rationale behind the score is that sentences that contain a lot of words are more difficult to follow than shorter sentences and likewise, words that contain a lot of syllables are harder to read than words that use fewer

Material source and inclusion criteria

Due to the rapidly changing nature of reported COVID-19 cases across the country, for the purposes of this study, we identified the top 10 states with the highest number of COVID-19 cases based on CDC reported cases in the U.S. on June 30, 2020 [36]. Due to variation in how states created or implemented guidelines, no single source of information could be reviewed such as the CDC COVID-19 related information sources. Since state guidelines differed; so did their public health messaging. For these reasons, we selected to review public health messaging directly from state public health department web sites. We reviewed each state department's health website along with their online public communication materials. Materials were included in the study if they were (1) written in English; and (2) about COVID-19 preventions including how to protect yourself and others, wear face masks and coverings, minimize risks, wash hands, stop the spread of germs, self-monitor and practice social distancing, etc. For each included material, an identification number was manually assigned which starts with the state acronym, such as CA-1 or NY-3. The following attributes of all included materials were recorded in a Microsoft Excel Spreadsheet [Appendix A] and used to facilitate the health literacy, communication, and readability assessment process: Material Identification Number, Material Title, Material Type, and Material URL.

Rating Process

Two raters (NM, TO) reviewed each material, and independently assessed its understandability, actionability, and communication clarity using PEMAT and Index. Once independent scoring of all items was complete, both raters met to discuss any inconsistencies found until discrepancies were resolved and consensus was achieved [14–16]. In addition, one rater (TO) generated the FKGL score for included materials using ReadablePro [37]. Final scores of each material assessed using the three tools were recorded in the master Excel Spreadsheet, which was subject to statistical operations. (Supplement A)

Statistical Analysis

We performed Statistical analyses on the assessment scores in the master Excel Spreadsheet using SPSS [38]. The statistical measures were produced and tested including (1) interrater reliability (IRR) by Cohen's kappa [15,19]; (2) the mean, median, standard deviation, range, minimum, maximum, and frequency scores associated with PEMAT, Index, and FKGL; (3) statistical significance of the correlation between PEMAT, Index, FKGL, and Material Type (Note, to facilitate statistical operations, Material Types were coded as ordinal scores: 1=web page, 2=Infographic, 3=Video). Both Pearson and Spearman Correlation tests were 2-sided [19,39].

Results

A total of 42 materials from 10 U.S. State health departments (Supplementary Table 1) were reviewed and evaluated for this study (Figure 1). These materials addressed COVID-19 prevention topics in terms of handwashing, mask wearing, and social distancing. The reviewed materials consist of Webpages (n=19), Infographics (n=19), and Videos (n=4). In addition, among 42 materials, two health literacy and one readability tool were used for scoring: PEMAT-P (n=38 materials), PEMAT-A/V (n=4), Index-Full (n=19), Index-Mod (n=23), and FKGL (n=34). interrater reliability K was = 0.94 for both PEMAT and Index rating.

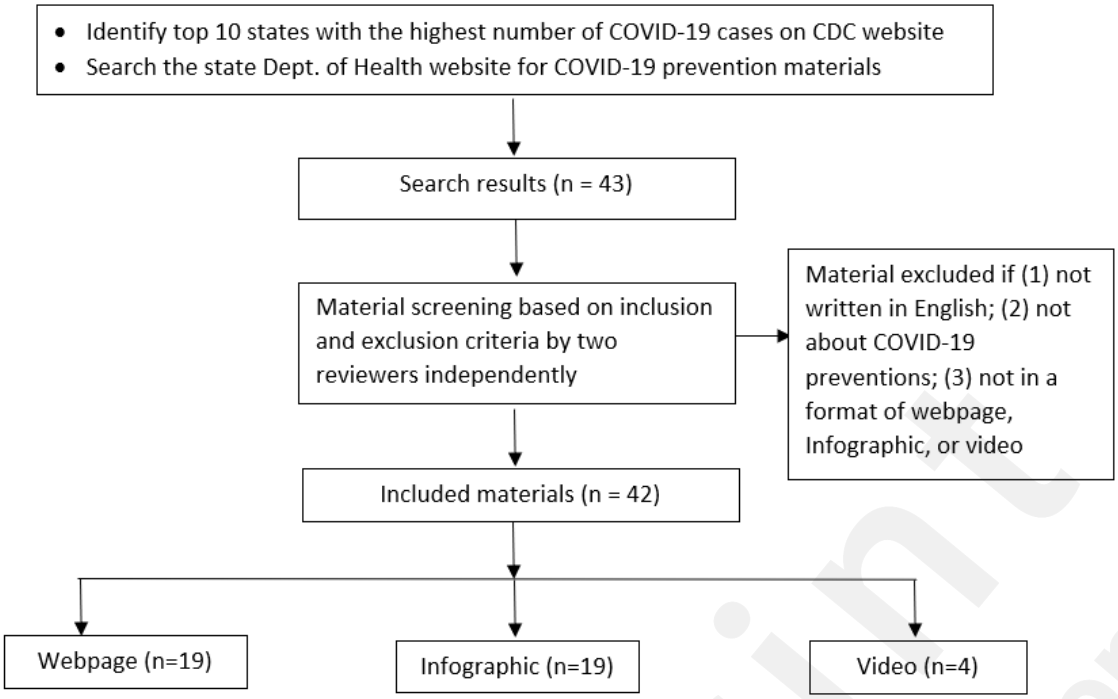

Figure 1. Process of material search, screening, and selection

PEMAT

Understandability

Rated by either PEMAT-P or PEMAT-A/V, Table 1 shows that, >50% of reviewed materials (n=42) were rated “agree” for all measures in PEMAT topics (i.e., content, word choice & style, use of numbers, information organization, layout & design, and use of visual aids). Particularly, all materials were rated “agree” for “The material makes its purpose completely evident” (item 1) and “The material does not expect the user to perform calculations” (item 7). However, 39% of materials were rated “disagree” for “The material uses visual aids whenever they could make content more easily understood” (item 15) and “The material uses visual aids whenever they could make it easier to act on the instructions” (item 26); 25% of materials were rated “disagree” for “Text on the screen is easy to read” (item 13) and “The material allows the user to hear the words clearly” (item 14). In addition, 21% of materials were rated “disagree” for “The material does not include information or content that distracts from its purpose” (item 2).

Table 2 shows that the average of PEMAT-P (n=38) for understandability is 88.18% (SD±18.16%), with a range between 21% and 100% while the average of PEMAT-A/V (n=4) is 93.25% (SD±13.50%) with a range between 73% and 100% (Table 2). The majority (i.e., 92%) of the reviewed materials by PEMAT-P (n=38) have understandability scores above 70%, while all reviewed materials by PEMAT-A/V (n=4) have understandability scores above 70% (Figure 2).

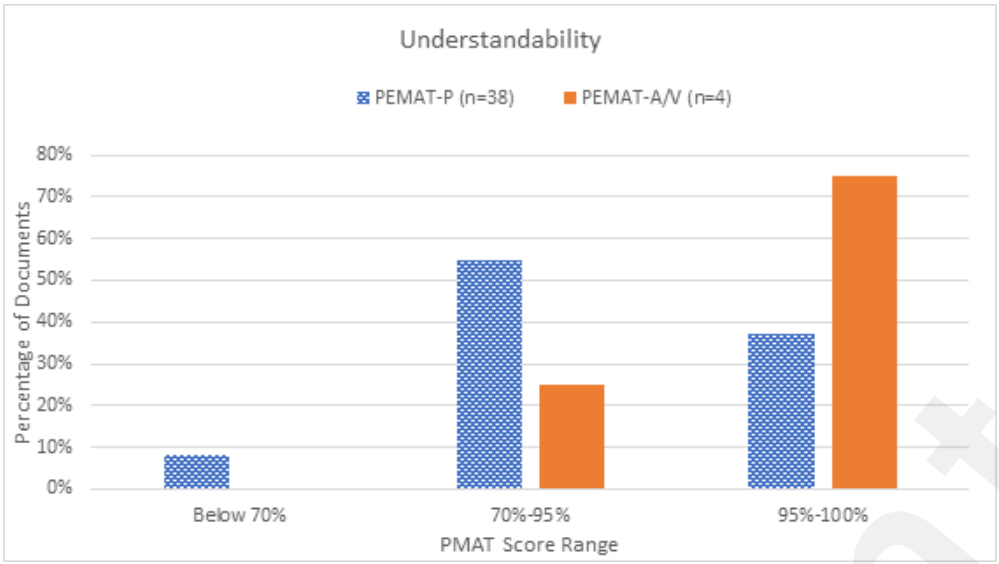

Figure 2. The distribution of materials upon understandability assessment

Actionability

Rated by either PEMAT-P or PEMAT-A/V, the majority of reviewed materials (>70%) were scored "agree" for appliable actionability items 20-23 (Table 1). Particularly, 100% of materials were rated "agree" for "The material clearly identifies at least one action the user can take" (item 20). However, 39% of materials were rated "disagree" for using "The material uses visual aids whenever they could make it easier to act on the instructions" (item 26).

Table 2 shows that the average of PEMAT-P is 87.26% (SD±14.51%), with a range between 40% and 100% while the average of PEMAT-A/V is 100% with (SD±0%). Eighty-nine percent of the materials by PEMAT-P have actionability scores above 70%, while all reviewed materials by PEMAT-A/V have perfect actionability scores, which is 100% (Figure 3).

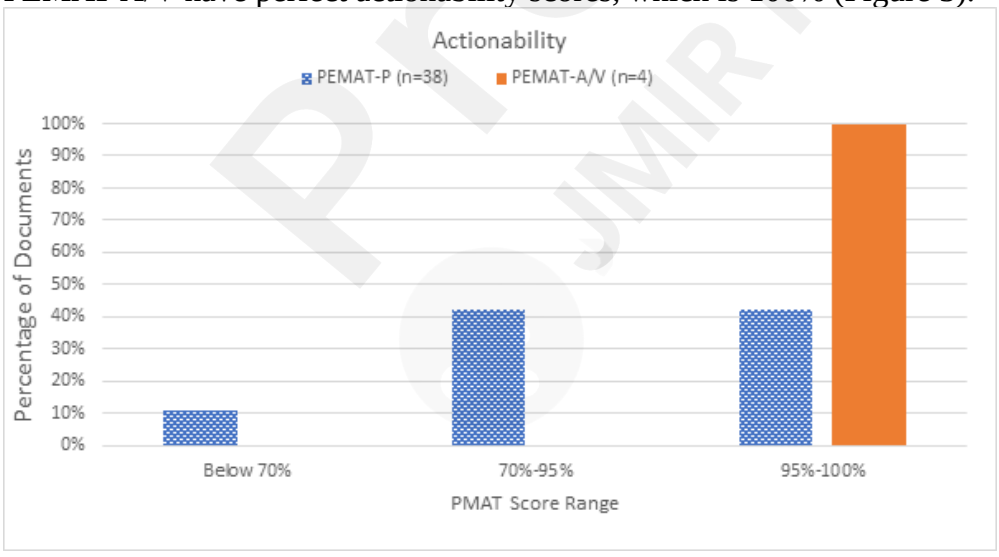

Figure 3. The distribution of materials upon actionability assessment

Figure 2: The distribution of materials upon actionability assessment

Index

Rated by either Index-Full or Index-Mod, >50% of materials were rated "Yes" for most index items (Table 3). Particularly, 100% of materials were rated "Yes" for containing calls to action for primary

audience (item 5) and giving specific directions for performing the behavior (item 14). However, 92% of materials were rated “disagree” for explaining what authorities know and do not know (item 11); 60% of materials were rated “disagree” for explaining the nature of risk (item 18); 43% of materials were rated “disagree” for addressing both risks and benefits of recommended behaviors (item 20).

The average of Index-Full (n=19) is 73.57 (SD±14.22), with a range between 50 and 100 while the average of Index-Mod (n=23) is 82.24 (SD±10.74), with a range between 58.3 and 100 (Table 2). Eleven percent of the materials by Index-Full have scores above 90 while 35% of materials by Index-Mod have scores above 90 (Figure 4).

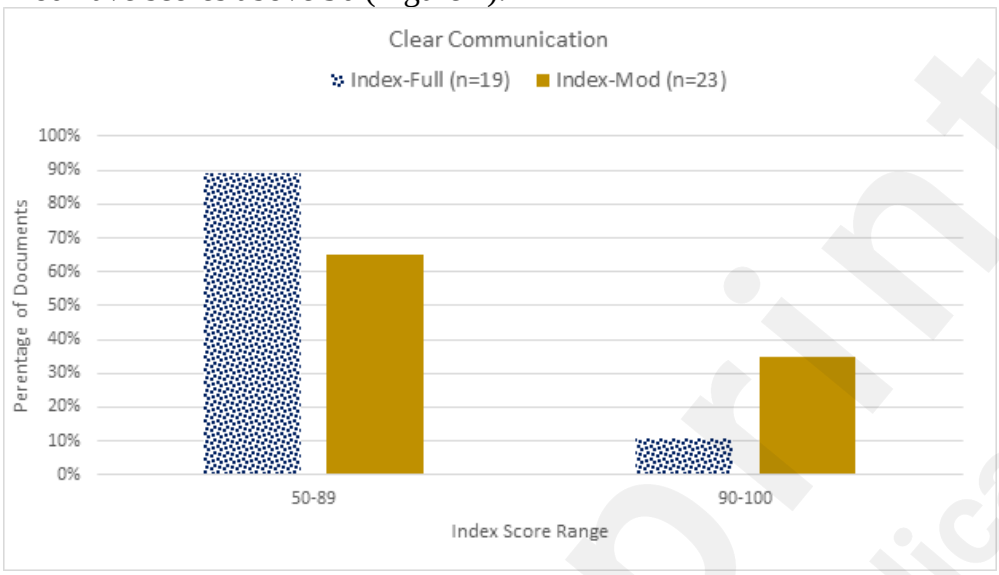

Figure 4. The distribution of materials upon communication clarity assessment using Index

FKGL

Among 42 materials, only 34 received FKGL scores; 4 materials are too short to calculate FKGL scores, and 4 were in video format which FKGL does not apply to (Figure 4). The average of Flesch-Kincaid scores is 7.11 (SD±2.60), with a range between 1.7 and 12.5 (Table 2). Approximately 36% of materials have reading levels below or equal to 6^{thth} grade while 31% of reviewed materials have reading levels between 7th and 9th grade level. The reading levels of 14% materials are equal to or above 10th grade level (Figure 5).

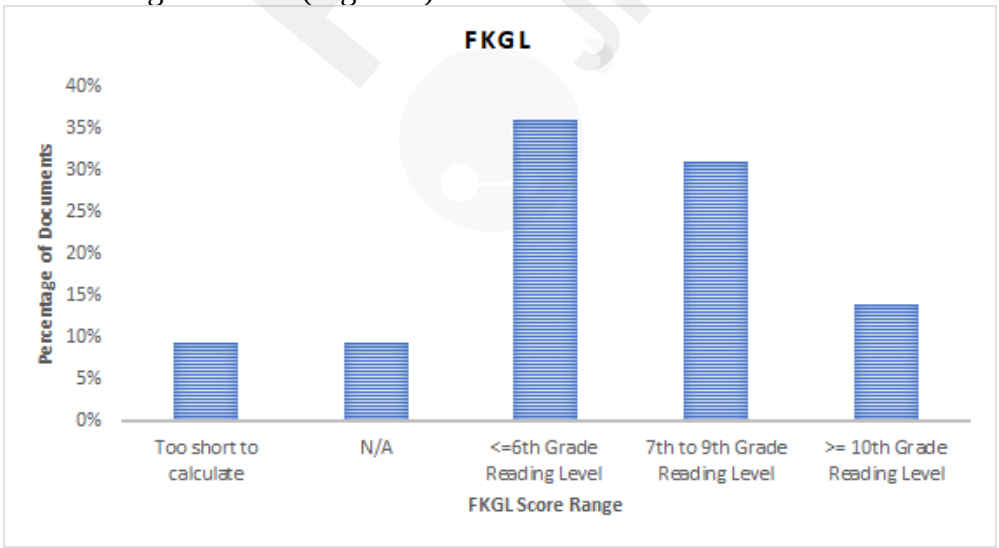

Figure 5. The distribution of materials upon readability assessment using FKGL

Table 1. PEMAT Measure Scoring

PEMAT Measures	Materials scored "Agree" (%)	Materials scored "Disagree" (%)	Materials scored "N/A" (%)
UNDERSTANDABILITY			
TOPIC: CONTENT			
1. The material makes its purpose completely evident	100%	0%	0%
2. The material does not include information or content that distracts from its purpose	79%	21%	0%
TOPIC: WORD CHOICE & STYLE			
3. The material uses common, everyday language	86%	14%	0%
4. Medical terms are used only to familiarize audience with the terms. When used, medical terms are defined	93%	7%	0%
5. The material uses the active voice	90%	10%	0%
TOPIC: USE OF NUMBERS			
6. Numbers appearing in the material are clear and easy to understand	76%	0%	24%
7. The material does not expect the user to perform calculations	100%	0%	0%
TOPIC: ORGANIZATION			
8. The material breaks or “chunks” information into short sections	90%	5%	5%
9. The material’s sections have informative headers	88%	7%	5%
10. The material presents information in a logical sequence	95%	5%	0%
11. The material provides a summary	81%	10%	10%
TOPIC: LAYOUT & DESIGN			
12. The material uses visual cues (e.g., arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points	88%	10%	2%
13. Text on the screen is easy to read	50%	25%	25%
14. The material allows the user to hear the words clearly (e.g., not too fast, not garbled)	75%	25%	0%
TOPIC: USE OF VISUAL AIDS			
15. The material uses visual aids whenever they could make content more easily understood (e.g., illustration of healthy portion size)	61%	39%	0%

16. The material's visual aids reinforce rather than distract from the content	61%	3%	37%
17. The material's visual aids have clear titles or captions	58%	5%	37%
18. The material uses illustrations and photographs that are clear and uncluttered	64%	2%	33%
19. The material uses simple tables with short and clear row and column headings	12%	0%	88%
ACTIONABILITY			
20. The material clearly identifies at least one action the user can take	100%	0%	0%
21. The material addresses the user directly when describing actions	95%	5%	0%
22. The material breaks down any action into manageable, explicit steps	93%	7%	0%
23. The material provides a tangible tool (e.g., menu planners, checklists) whenever it could help the user take action	87%	13%	0%
24. The material provides simple instructions or examples of how to perform calculations	3%	0%	97%
25. The material explains how to use the charts, graphs, tables, or diagrams to take actions	2%	0%	98%
26. The material uses visual aids whenever they could make it easier to act on the instructions	61%	39%	0%

Table 2. Understandability, actionability, communication clarity, and readability of public materials by the Dept. of Health of 10 U.S. state governments using PEMAT and Index.

Health Literacy Tool	# Materials	Mean (SD)	Median	Minimum	Maximum
PEMAT-P Understandability	38	88.18% (SD±18.16%)	94%	21%	100%
PEMAT-P Actionability	38	87.26% (SD±14.51%)	83%	40%	100%
PEMAT-A/V Understandability	4	93.25% (SD±13.50%)	100%	73%	100%
PEMAT-A/V Actionability	4	100% with (SD±0%)	100%	100%	100%
PEMAT- All Understandability	42	88.67% (SD±17.69%)	94%	21%	100%
PEMAT- All Actionability	42	88.48% (SD±14.30%)	100%	40%	100%
Index-Full	19	73.57 (SD±14.22)	73.7	50	100

Index-Mod	23	82.23 (SD±10.74)	81.8	58.3	100
Index- All	42	78.32 (SD±13.03)	78.35	50	100
FKGL	34	7.11 (SD±2.60)	7.30	1.7	12.5

Table 3. Index Item Scoring

CCI Item	Materials scored "Yes" (%)	Materials scored "No" (%)	Materials scored "N/A" (%)
Contains call to action for primary audience	100%	0%	0%
Gives specific directions for performing the behavior	100%	0%	0%
Does not ask audience to do math	97%	3%	0%
Main message and call to action use active voice	95%	5%	0%
Gives specific directions for performing the behavior	95%	5%	0%
One main message statement	90%	10%	0%
Uses short bulleted or numbered lists	89%	11%	0%
Organized in chunks with headings	89%	11%	0%
Most important information summarized in first section	88%	12%	0%
Main message at top/front	86%	14%	0%
Always explains what numbers mean	83%	17%	0%
Always uses numbers the primary audience uses	82%	18%	0%
Always uses words that primary audience uses	81%	19%	0%
Explains why behavioral recommendation is important for primary audience	79%	17%	5%
Main message emphsized with visual cues	63%	37%	0%
Contains visual reinforcing main message	61%	39%	0%
Explains the nature of risk	40%	60%	0%
Addresses both risks and benefits of recommended behaviors	17%	43%	40%
Explains what authorities know and do not know	8%	92%	0%
Numeric risk probability explained with words or a visual	0%	0%	100%

Statistical testing of the relationships between assessment scores and material types

- There is a statistically significant relationship between PEMAT Understandability and PEMAT- Actionability scores (n=42, Pearson r = 0.486, Spearman's rho r = 0.583, p<0.01). The correlation is positive.
- There is a statistically significant relationship between PEMAT-Understandability and Index scores (n=42, Pearson r=0.619, Spearman's rho r= 567, p<0.01). The correlation is positive.
- There is a statistically significant relationship between PEMAT-Actionability and Index scores (n=42, Pearson r=0.511, Spearman's rho r= 0.514, p<0.01). The correlation is positive.
- There is a statistically significant relationship between PEMAT-Understandability and FKGL scores (n=34, Pearson r= -0.606, Spearman's rho r=-0.584, p<0.01). The correlation is

negative.

- There is a statistically significant relationship between PEMAT-Actionability and FKGL scores (n=34, Pearson r= -0.525, Spearman rho r= -0.591, p<0.01). The correlation is negative.
- There is a statistically significant relationship between Index and FKGL scores (n=34, Pearson r= -0.522, Spearman rho r= -0.545, p<0.01). The correlation is negative.
- There is a statistically significant relationship between (1) PEMAT Understandability and Material Type (n=42, Pearson r = 0.422, Spearman rho r=0.601, p<0.01); (2) PEMAT Actionability and Material Type (n=42, Pearson r = 0.557, Spearman rho r= 0.644, p<0.01). The correlation is positive.
- There is no statistically significant relationship between Index scores and Material types (n=42, Pearson r = 0.168, Spearman rho r= 0.266, p > 0.05).
- There is a statistically significant relationship between FKGL scores and Material types (n=34, Pearson r= -0.672, Spearman rho r= -.0.704, p<0.01). The correlation is negative.

Discussion

This study assessed the understandability, actionability, clarity, and readability of COVID-19 prevention materials which are publicly available at 10 U.S. state health department websites. Two raters independently scored each material using PEMAT and Index, and the inter-rater reliability is near perfect. One rater calculated FKGL scores using Readable. Although the evaluated materials can do better in using visual aids whenever they could make content more easily understood (PEMAT item 15) or easier to act upon (PEMAT item 26), overall, these public materials achieved good understandability and actionability which were indicated by the average PEMAT scores being above the benchmark, 70%. However, despite slightly more than one third of materials being at or below the sixth-grade reading level, 45% of the reviewed materials rated at reading levels above the seventh-grade are considered to be of either “average difficulty” or “difficult” to read [14,40]. In addition, the average Index score of the materials is below 90, also suggesting these COVID-19 prevention materials are not “easy to read” [15,16,20]. This can be explained by the fact that the Index is intended to be a tool to guide the revision of materials [41]. Overall, the results of this study showed that COVID-19 health information provided by the state government is good for the public to understand and act upon, but they need to be improved in terms of readability and clear communication.

This is the first study that systematically examined the significance of correlations between three types of health literacy assessment scores (PEMAT, Index, & FKGL) as well as between assessment scores and Material Type. Our findings confirmed results from a few previous studies. For example, we found that there was a negative correlation between the PEMAT understandability and FKGL by both Pearson and Spearman rho Correlation Coefficients, which is consistent with Shoemaker’s [19] and Vishnevetsky’s [39] results. Shoemaker measured the correlation between PEMAT understandability and readability by Pearson Correlation Coefficient and Vishnevetsky used Spearman rho. Other significant negative correlations were found between PEMAT Actionability and FKGL scores, and between Index and FKGL scores. Therefore, if the reading level of a material is low, we can be confident that the understandability, actionability, and clear communication of this material will score high, and vice versa. Moreover, this study discovered positive correlations between understandability, actionability, and clear communication scores. Therefore, if a material can achieve high in any of the three assessment categories, its scores for the other two categories can be expected high as well.

In addition, for the first time, the health literacy of three commonly used public material types (text-based Webpage, infographic, and video) were assessed together by different tools in one study. Significant positive correlations were detected between PEMAT understandability scores and Material Type, between PEMAT Actionability and Material Type, between Index scores and Material Type. Particularly, materials in video format and infographics have better understandability, actionability, and readability than materials in text (webpage) format. Our findings can be used to guide the design of public health education materials.

While using readability formulas can help gauge readability of materials, it is important not to write strictly to the formulas. The National Institutes of Health emphasize that readability scores and grade levels are not the "be-all and end-all of plain language" and the main consideration is whether the message is communicated clearly [42]. Readability formulas are based on the average length of words and sentences, and do not measure comprehension or reading ease [40]. They are most useful as a component of material evaluation when supplemented with additional clear communication assessments such as the PEMAT or Index. Use of the PEMAT and the Index can greatly assist those developing health messages and patient education materials by incorporating scoring items from the Index, such as having one main message, positioning the main message at the top, beginning, or front of the material, using visual cues to emphasize the main message, and including one or more calls to action. Other considerations such as whether the materials are understandable and actionable include the use of common, everyday language, i.e. plain language, using informative headers, breaking information into "chunks," using active voice and drawing attention to key points using arrows, boxes, bullets, bolding, highlighting, etc. can help ensure information is effective, understandable, and actionable.

Additionally, when developing materials, it is important to test them with the intended target audience. Clarity of message and readability are especially important for populations at high risk for limited health literacy such as older adults and minorities, as they are at higher risk of the worst effects of COVID-19 [14]. Encouraging a human-centered approach, design teams should work with focus groups to test materials throughout the design and development phases of information creation prior to public consumption [43]. In addition, a tool such as the Index can help support an iterative design process by helping to identify in what areas modifications could be made to support understandability, actionability, and readability.

In our study, many of the lower scoring materials failed to use plain language or provide steps and visual aids. Those developing health messaging should ensure that medical terminology is defined the first time if used and to avoid medical jargon or wording that is not commonly understood. Another area that should be considered is use of infographics and short videos. In this study, infographics and videos scored better than web pages since people retain visual information much easier than information read. Both simple and complex information is more understandable and actionable in these formats, rather than long blocks of text. Compared with text alone, pictures improve comprehension when closely linked with text or spoken words. This was found particularly true for those with lower health literacy. Use of images can also increase attention, recall of information, and adherence [44]. While federal agencies are required to use language that the public and use and understand, states are not required to follow federal regulations for clear communication in the Plain Writing Act of 2010; however, those developing information and health messaging for state health department websites and other state agencies, could benefit in complying with these [7].

With pervasive use and reliance on technology, this often results in placing greater emphasis on

providing public health information using a variety of technological platforms (i.e., web sites, social media, mobile apps). While these delivery modes are important, it is necessary to remember that a digital divide still exists [45–47].There are significant gaps in access to technology that can prevent the public from accessing critical information. Information barriers can be insurmountable to individuals living in areas with low bandwidth, for those who do not have technology, or have familiarity with using various technologies. For these reasons, it is critical to consider multiple modes of information delivery; especially during a health crisis.

Limitations

There are some possible imitations in this study. First, this review did not include usage data attributed to the frequency by which materials were accessed, viewed, or downloaded. The extent to which information is accessed could be helpful in understanding which communication mechanisms are critical to address when examining how the public are using information. The second limitation concerns the review of materials which included four themes and excluded state department social media messaging, television commercials, or print materials. Further review of additional themes and modes of communication could be considered to see in what ways our findings are consistent or generalizable to other informational themes and U.S states and territories. Finally, although our interrater reliability was high, both the PEMAT and Index are subjective tools, so results may differ when reviewed by other experts.

Conclusions

As different guidelines and approaches have been taken in response to the pandemic, it behooves us to consider how a similar analysis might be replicated or built upon when examining public health messaging from an international lens. In this regard, questions such as: what modalities are optimal when communicating with the public?, are tools such as the PEMAT and Index useful from a global lens?, to what extent does cultural context impact information design?, and in resource limited settings (i.e., areas with low bandwidth) how is information shared and what are some strategies to employ to encourage a human-centered approach to design are questions that necessitate further examination.

The research team conducted an analysis of COVID-19 health information provided by state public health departments using the PEMAT, Index, and FKGL tools to help identify whether public health messaging is understandable, actionable, and readable by the public. Approaching the design and development of public health messaging using a human-centered approach, where information is created keeping individuals at the center of how messaging is created and interpreted, is crucial for effective public health messaging. As can be seen with the infodemic surrounding us, the importance of crafting clear communication, especially in times of public health crisis cannot be understated.

Conflicts of Interest

“none declared”.

Abbreviations

CDC: Centers for Disease Control and Prevention
FKGL: Flesch-Kincaid Grade Level
Index: CDC Clear Communication Index
JMIR: Journal of Medical Internet Research
PEMAT: Patient Education Materials Assessment Tool

WHO: World Health Organization

Appendix

Supplement A: Material Review Scoring including PEMAT, CCI, and Flesch-Kincaid
Supplement B: Sample PEMAT Scoring Sheet
https://www.ahrq.gov/sites/default/files/publications/files/pemat-p.pdf
Supplement C: Sample CCI Scoring Sheet:
https://www.cdc.gov/ccindex/pdf/modified-index-scoresheet.pdf
Supplement D: Sample CCI Scoring Sheet for Social Media
https://www.cdc.gov/ccindex/pdf/modified-index-scoresheet.pdf
Supplement E: Flesch-Kincaid Scoring Tool

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Supplementary Files

Multimedia Appendixes

Scoring of all materials using the three tools: PEMAT, Index, and FKGL.
URL: https://asset.jmir.pub/assets/ebda109aa135363cac6c65f999f211c6.xlsx