Quality and Accessibility of Liquid Biopsy Information

Henry K. Litt, MD; Emma Greenstreet-Akman, BA; Evelin Trejo, PhD; Narjust Florez, MD; Ana I. Velazquez, MD, MSc

Introduction

Circulating tumor DNA assays, known as liquid biopsies, are increasingly used to genotype cancers, guide therapy selection, and identify resistance mechanisms to cancer therapy.1 As more patients undergo liquid biopsies, it is essential that they can understand the benefits and limitations. Patients often obtain medical information on the internet or social media. Because online medical information can be inaccurate, biased, and difficult to comprehend,2 we evaluated the quality, accessibility, and understandability of online information about liquid biopsies.

Methods

We performed an online search of liquid biopsy using a search engine (Google; Alphabet) and social network (YouTube; Alphabet) and conducted a cross-sectional analysis of the top videos and web page results. Videos over 5 minutes, scientific articles, and non–English language content were excluded. The University of California, San Francisco Institutional Review Board approved this cross-sectional study and waived the informed consent requirement as the work was not human participant research. We followed the STROBE reporting guideline.

Two independent reviewers (H.K.L., E.G.A.) evaluated each video for characteristics, perceived speaker identities and roles, and health information presented. Understandability and quality of consumer health information were evaluated using validated tools (PEMAT [Patient Education Materials Assessment Tool], DISCERN).3,4 Interobserver agreement between reviewers was 87%. Disagreements (n = 26) were resolved by another independent reviewer (E.T.).

Web pages were evaluated for accessibility (visual aids, languages available, reading level), quality of information (authors, citations, publication year, indications, limitations), discussion of cost or insurance coverage, and presence of commercial bias. Reading level was evaluated using validated indices: Flesch-Kincaid Grade Level, Gunning Fog, and Simple Measure of Gobbledygook (SMOG) Index.5 Commercial bias included disclosure of conflicts of interest, primary company websites, and presence of branding or funding from for-profit corporations.

Descriptive statistics were calculated using Stata, version 17 (StataCorp LLC). Analyses were performed between November 2022 and February 2023.

Results

We analyzed 100 liquid biopsy videos, with median (IQR) views per video of 190 (75-719). Video speakers lacked diversity, with 82 (65.6%) perceived as male and 39 (31.2%) as female and 98 (78.4%) as non-Hispanic White (Table 1). These videos were complex and of low quality. Only 9.0% of videos were understandable (PEMAT score: ≥70%), and 8.0% presented moderate to high quality health information (DISCERN score: 3-5).

We reviewed 100 web pages about liquid biopsies, of which none had reading levels of sixth grade or lower, as recommended by medical society guidelines2 (Table 2). Median (IQR) Flesch-Kincaid Grade Level, Gunning Fog Index, and SMOG Index readability scores were 14.1 (12.1-15.8), 16.4 (14.4-18.6), and 15.9 (13.9-16.9), respectively, which are equivalent to college-level education. Web
pages rarely promoted accessibility through visual aids (20.0%) or multiple languages (5.0%).
Sixty-one percent of web pages had commercial biases, and less than half included author names
(42%), citations (29%), and mentions of indications (36%) or limitations (35%) of liquid biopsies.

**Discussion**

We found that liquid biopsy videos and web pages had extensive shortcomings as sources of patient
health information. Consistent with previous research assessing cancer-related online materials,²
most patients need help understanding online content about liquid biopsies and may be more
confused after searching online. Health literacy plays an important role in patient experiences and
outcomes. Patients with cancer often report knowledge gaps about their care and may be unable to
clarify their concerns with clinicians, necessitating accessible resources to make informed decisions.⁶

**Table 1. Characteristics of Liquid Biopsy Videos and Featured Speakers**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of videos</td>
<td>100</td>
</tr>
<tr>
<td>No. of featured speakers</td>
<td>125</td>
</tr>
</tbody>
</table>

**Understandability or quality measures**

- Understandable (PEMAT score: ≥70%)⁷ 9 (9.0)
- Moderate to high quality (DISCERN score: 3-5)⁸ 8 (8.0)

**Video creator**

- Academic journal or society 38 (38.0)
- Media organization 29 (29.0)
- Health care industry company 12 (12.0)
- Hospital system 11 (11.0)
- Other ¹⁰ 10 (10.0)

**Intended audience**

- Health care practitioner or scientific community 72 (72.0)
- General public 28 (28.0)

**Type of speaker or narrator**

- Physician 77 (61.6)
- Basic science researcher 26 (20.8)
- Industry 9 (7.2)
- Media group 6 (4.8)
- Patient 4 (3.2)
- Other or unknown ¹⁵ 3 (2.4)

**Perceived race and ethnicity of speaker**

- Asian 22 (17.6)
- Black 1 (0.8)
- Hispanic or Latino 1 (0.8)
- Non-Hispanic White 98 (78.4)
- Unknown 3 (2.4)

**Perceived sex of speaker**

- Male 82 (65.6)
- Female 39 (31.2)
- Unknown 4 (3.2)

Abbreviation: PEMAT, Patient Education Materials Assessment Tool.

- PEMAT score range: 0%-100%, with the highest score indicating perfect understandability.
- DISCERN score range: 0-5, with the highest score indicating minimal shortcomings as a source of patient information.
- Other video creator included research organization and general population.
- Other type of speaker or narrator included general population.
It is crucial that patients understand emerging technologies, such as liquid biopsies, as their potential benefits, costs, and unintended adverse effects are being discovered.\(^1\)

Study limitations include lack of longitudinal evaluation of available information, exclusion of lengthy and non-English language content, lack of blinding of reviewers to the study's purpose, and potential reviewers' biased perceptions of speaker demographics (vs self-identification). With increasing propagation of medical misinformation online, efforts must be made to ensure that unbiased, high-quality information about novel diagnostic technologies and treatments is understandable and easily accessible to patients and caregivers.

### Table 2. Characteristics of Liquid Biopsy Web Pages

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of web pages</td>
<td>100</td>
</tr>
<tr>
<td>Web page creator</td>
<td></td>
</tr>
<tr>
<td>Health care industry company</td>
<td>35 (35.0)</td>
</tr>
<tr>
<td>Academic society or journal</td>
<td>19 (19.0)</td>
</tr>
<tr>
<td>Hospital system</td>
<td>18 (18.0)</td>
</tr>
<tr>
<td>Media organization</td>
<td>18 (18.0)</td>
</tr>
<tr>
<td>Other</td>
<td>10 (10.0)</td>
</tr>
<tr>
<td>Accessibility</td>
<td></td>
</tr>
<tr>
<td>Visual aid present</td>
<td>20 (20.0)</td>
</tr>
<tr>
<td>Multiple languages available</td>
<td>5 (5.0)</td>
</tr>
<tr>
<td>Quality</td>
<td></td>
</tr>
<tr>
<td>Authors' names present</td>
<td>42 (42.0)</td>
</tr>
<tr>
<td>Citation present</td>
<td>29 (29.0)</td>
</tr>
<tr>
<td>Publication year present</td>
<td>57 (57.0)</td>
</tr>
<tr>
<td>Indications mentioned</td>
<td>36 (36.0)</td>
</tr>
<tr>
<td>Limitations mentioned</td>
<td>35 (35.0)</td>
</tr>
<tr>
<td>Cost or insurance coverage mentioned</td>
<td>16 (16.0)</td>
</tr>
<tr>
<td>Commercial bias</td>
<td>61 (61.0)</td>
</tr>
<tr>
<td>Corporation brand mentioned</td>
<td>50 (50.0)</td>
</tr>
<tr>
<td>Liquid biopsy company website</td>
<td>29 (29.0)</td>
</tr>
<tr>
<td>Company logo present</td>
<td>27 (27.0)</td>
</tr>
<tr>
<td>Conflict of interest mentioned</td>
<td>5 (5.0)</td>
</tr>
<tr>
<td>Funded by liquid biopsy company</td>
<td>3 (3.0)</td>
</tr>
<tr>
<td>Reading level, median (IQR) text readability</td>
<td></td>
</tr>
<tr>
<td>Flesch-Kincaid Grade Level</td>
<td>14.1 (12.1-15.8)</td>
</tr>
<tr>
<td>Gunning Fog Index</td>
<td>16.4 (14.4-18.6)</td>
</tr>
<tr>
<td>SMOG Index</td>
<td>15.9 (13.9-16.9)</td>
</tr>
</tbody>
</table>

Abbreviation: SMOG, Simple Measure of Gobbledygook.

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Author Contributions: Drs Litt and Velazquez had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Litt, Florez, Velazquez.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Litt, Greenstreet Akman, Florez.

Critical review of the manuscript for important intellectual content: All authors.

Statistical analysis: Litt, Greenstreet Akman.

Administrative, technical, or material support: Florez, Velazquez.

Supervision: Velazquez.

Conflict of Interest Disclosures: Dr Florez reported receiving grants from Genentech, DSI, and Pfizer and personal fees from AstraZeneca, Janssen, Neogenomics, Mirati, and Sanofi outside the submitted work. Dr Velazquez reported receiving grants from National Institute of Aging, National Cancer Institute, AACR, LUNGevity Foundation, and Conquer Cancer; former stock ownership in Corbus Pharmaceuticals; and personal fees from American Society of Clinical Oncology, AstraZeneca, Merus, Novocure, Cadence Communications & Research, MJH Life Sciences, BioAscend, Curio Science, and Optum Health Education outside the submitted work. No other disclosures were reported.

Data Sharing Statement: See the Supplement.

REFERENCES


SUPPLEMENT.

Data Sharing Statement