REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 5-A-25

Subject: Screening for Image Manipulation in Research Publications

Presented by: John T. Carlo, MD, MS, Chair

Referred to: Reference Committee E

INTRODUCTION

Resolution 506-A-24, Screening for Image Manipulation in Research Publications," introduced by the Medical Student Section was referred. It stated that "our American Medical Association support the creation of a nationally collaborative database of manipulated images from retracted publications to provide a test bank for researchers developing augmented intelligence-integrated image screening tools." While there was only limited testimony on this item, concerns around the feasibility and scope of the request resulted in its referral for further study. This report serves as the Council on Science and Public Health's response to that referral.

METHODS

English language articles were selected from searches of PubMed and Google Scholar using the search terms "image manipulation" and "AI image manipulation screening" and "generative adversarial networks." Additional articles were identified by manual review of the reference lists of pertinent publications. Web sites managed by government agencies and applicable organizations were also reviewed for relevant information.

BACKGROUND

In a time of rampant misinformation and disinformation around medical science, the integrity of academic journals is of the utmost importance and allegations of research misconduct should be taken very seriously. As artificial intelligence (AI) tools become more advanced and integrated into the toolkits of researchers, the potential role of AI in research fraud should also receive more scrutiny.

While retractions may be done for a variety of reasons that may not necessarily be caused by research misconduct, many publishers are alarmed by the increasing rate of fraudulent images resulting in retractions.[1,2] Per the publishing watchdog RetractionWatch, the retraction rate in 2014 was 3.5 retracted articles per 10,000 published articles and rose to 11.2 retractions per 10,000 in 2022, with over 10,000 papers being retracted in 2023.[3] Interestingly, the incidences of retractions are relatively centralized, with researchers in Saudi Arabia (30.6 retractions per 10,000 articles), Pakistan (28.1 per 10,000), Russia (24.9 per 10,000), and China (23.5 per 10,000) having more retractions than the global rate.[4] As a result, some countries, such as China, have initiated national audits of research integrity.[5] It should be noted, however, that these statistics reflect retractions for any cause, not just image manipulation.

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Generally, researchers with retractions will only have one retraction in their career, however there are a small-subset of serial offenders with more than ten retractions.[4] For publishers, the inverse appears to be true; in 2022, 51 percent of all retracted articles were published in the same 34 journals, sparking concerns of "paper mills," in which a publisher intentionally maintains low standards to increase publishing fees revenue, or malicious researchers have identified a deficiency in a publisher's review process and specifically target them for fraudulent articles.[3]

Beyond instances of malicious fraud, AI-generated images can also produce misleading or incorrect images in publications even if well-intended. For example, researchers have probed anatomical illustrations created by AI programs and found deficiencies in both their accuracy and level of detail.[6]

The Role of AI

AI can be a powerful tool for helping researchers communicate their message to a broader audience. For example, AI can help generate graphical abstracts, summarize data sets, or make images more readable.[7] As such, many journals maintain policies where authors must disclose where and when they used AI tools for the editors to adjudicate its appropriateness.[8-10]

While these tools are promising, advancements in AI, such as generative adversarial networks (GANs), pose a unique threat to image manipulation detection. GANs were introduced in 2014 and excel in generating highly realistic images known as "deepfakes" (a portmanteau of 'deep learning' and 'fake'). For example, researchers have found that even trained experts only correctly identify whether a Western blot image was real or AI-generated at a 50 percent rate, no better than a random guess.[11] A sample image has been provided in Appendix 1. Even prior to the introduction of GANs, the Department of Health and Human Service (HHS) Office of Research Integrity reported that 67 percent of their closed research misconduct cases between 2011 and 2015 were a result of manipulated images.[12] It is expected that as artificial image generation technology grows more sophisticated and more accessible, its use in research misconduct will similarly increase.

Given that these fraudulent images are not duplicated from existing images in the public domain, modern image integrity detection software may struggle at detecting deepfakes. GANs, and other AI tools, have been used to generate false images or video for a variety of applications beyond research misconduct, including financial fraud, sowing political discontent, and even pornography.[13,14] The programs used to make these images are generally accessible and usable on desktop computers and do not require any specialized equipment.[15]

CURRENT APPROACHES

The original resolution requested a "nationally collaborative database of manipulated images from retracted publications" for researchers developing tools to combat research misconduct. It should be noted that resources which may satisfy these requirements currently exist. For example, the HHS, Office of Research Integrity maintains publicly available resources on image forensics, academic publishers regularly share open-source databases, and non-profit entities such as RetractionWatch maintain searchable databases of retracted publications.[16-18] While these resources may not fully accomplish the goals of the original resolution, they do point to the generally available nature of manipulated images from retracted articles.

Additionally, nearly all major journal publishers currently utilize detection software, suggesting that there are currently market forces to push these kinds of research and development efforts.

While the use of AI technologies to conduct research fraud is new, the concept of manipulating images is not. As such, academic journals have generally been quick to adopt new technologies to keep up with the advances of malicious actors. For example, the AI image detection tool Proofig is currently partnered with journals published by Elsevier, Springer Nature, Science, the American Association of Cancer Research, the Royal Society of Chemistry, the American Society of Clinical Investigation, the Company of Biologists, Mary Ann Liebert, Inc., Compuscript Ltd, Sage Publishing, and the Taylor and Francis publishing group.[19] Proofig claims that approximately 25 percent of all manuscripts screened have been found to have some level of image manipulation, which can then be manually screened by an editor. Other tools, such as ImageTwin or Imachek, are also used by journal publishers to identify image manipulation. Other publishers, such as the PLOS family of journals, additionally require authors to submit raw image files prior to publication to detect image manipulation in their submissions.[20]

Finally, given the widespread accessibility of software to generate falsified images, it is unclear what value a centralized repository of retracted images would be. Technologies such as Deep AI are fully open source, meaning they are broadly available to the public for free use, or other programs such as DALL-E 3 or IMAGEN can be licensed at rates as low as 3 cents per image.[21,22] Particularly if a database were of specifically images from retracted publications, those are more likely to be generated using outdated technology, given the rapid rate of innovation in this space, or they were already detectable, given they were flagged for retraction. Additionally, it is unclear whether journal publishers retain the ownership rights for images after retraction, which may present intellectual property challenges for such a database.

Experts in the field of research misconduct describe the current publishing landscape as an "arms race," wherein generative software and detection software are both rapidly evolving to keep up with the developments of their counterpart.[23] This situation is likely unsustainable, and simply creating more sophisticated detection tools will likely only result in more sophisticated generation tools, and vice versa. Rather, some experts have argued that research misconduct is a symptom of the high pressures placed on researchers by the academic ecosystem, particularly the "publish or perish" mindset coming from the emphasis employers and funders place on academic publishing, and lack of interest in reproducibility.[24]

CURRENT AMA POLICY

Our AMA maintains robust policy on research misconduct, including through the Code of Medical Ethics. Full text of cited policies can be found in the appendix of this report.

Our AMA's opposition to research misconduct can be found in policy H-460.972, "Fraud and Misrepresentation in Science," which notes that "Our AMA supports the promotion, through AMA publications and other vehicles, of (a) A clear understanding of the scientific process, possible sources of error, and the difference between intentional and unintentional scientific misrepresentation. (b) Multidisciplinary discussions to formulate a standardized definition of scientific fraud and misrepresentation that elaborates on unacceptable behavior." This policy also notes that "Our AMA supports the development of specific standardized guidelines dealing with the disposition of primary research data, authorship responsibilities, supervision of research trainees, role of institutional standards, and potential sanctions for individuals proved guilty of scientific misconduct." Additionally, policy H-460.980, "Ethical and Societal Considerations in Research," states that "[e]ach institution should have a system both for monitoring the conduct of biomedical research and for investigating and reporting allegations of research misconduct."

Code of Medical Ethics, opinion 7.1.5, "Misconduct in Research," states "[b]iomedical and health research is intended to advance medical knowledge to benefit future patients. To achieve those goals physicians who are involved in such research maintain the highest standards of professionalism and scientific integrity." Additional opinions, including 7.1.1, "Physician Involvement in Research," ("[…] physicians who are involved in research should […] [a]dhere to rigorous scientific and ethical standards in conducting, supervising, and disseminating results of the research"), and 7.2.1, "Principles for Disseminating Research Results," ("[…] physicians should […] [r]eport the results of research accurately, including subsequent negative findings. This is particularly important where the findings do not support the research hypothesis") further emphasize the importance of proper conduct by physicians performing research.

CONCLUSION

Research misconduct undercuts trust and has a corrosive impact on the practice of medicine. While cases of fraud have happened infrequently in the past, rising rates of retractions have resulted in concerns that widespread access to AI tools which quickly generate text and images are causing fraud to become more commonplace. Our AMA's stance on research misconduct is clear, robust, and supports the use of a variety of means to reduce its prevalence. While it is possible that the creation of a repository of falsified images for researchers to use may improve AI detection tools, it is also clear that these efforts are already underway, being developed by commercial entities, and utilized by many, if not all major journal publishers.

RECOMMENDATIONS

The Council on Science and Public Health recommends that the following be adopted in lieu of Resolution 506-A-24, and that the remainder of the report be filed:

1. AMA Policy H-460.972, "Fraud and Misrepresentation in Science," be amended by addition to read as follows:

    1. Our American Medical Association supports the promotion of structured discussions of ethics that include research, clinical practice, and basic human values within all medical school curricula and fellowship training programs;
    2. Our AMA supports the promotion, through AMA publications and other vehicles, of
        a. A clear understanding of the scientific process, possible sources of error, and the difference between intentional and unintentional scientific misrepresentation.
        b. Multidisciplinary discussions to formulate a standardized definition of scientific fraud and misrepresentation that elaborates on unacceptable behavior.

    Our AMA supports the promotion of discussions on the peer review process and the role of the physician investigator.
    3. Our AMA supports the development of specific standardized guidelines dealing with the disposition of primary research data, authorship responsibilities, supervision of research trainees, role of institutional standards, and potential sanctions for individuals proved guilty of scientific misconduct.
    4. Our AMA supports the sharing of information about scientific misconduct among institutions, funding agencies, professional societies, and biomedical research journals
    5. Our AMA will educate, at appropriate intervals, physicians and physicians-in-training about the currently defined difference between being an "author" and being a "contributor" as defined by the Uniform Requirements for Manuscripts of the

International Committee of Medical Journal Editors, as well as the varied potential for industry bias between these terms.

6. Our AMA supports policies requiring authors to disclose the use of generative artificial/augmented intelligence programs to best allow for content to be reviewed for intentional and unintentional scientific misrepresentation.
7. Our AMA supports efforts to disseminate accurate and valid research findings, and to combat research and publication fraud, in the face of rapidly advancing technology. (Modify HOD Policy)

2. AMA Policy H-460.980, "Ethical and Societal Considerations in Research" be reaffirmed. (Reaffirm HOD Policy)

Fiscal Note: less than $1,000

RELEVANT AMA POLICY

AMA Publications G-630.090
Our American Medical Association policy on its publications includes the following:

1. JAMA and other AMA scientific journals should display a disclaimer in prominent print that the editorial views are not necessarily AMA policy.
2. Our AMA, in all of its publications and correspondence, will use the correct title for the medical specialist.
3. Our AMA recommends that medical journal articles using acronyms should have a small glossary of acronyms and phrases displayed prominently in the article.
4. The House of Delegates affirms that JAMA and The JAMA Network journals shall continue to have full editorial independence as set forth in the AMA Editorial Governance Plan.

Fraud and Misrepresentation in Science H-460.972

8. Our American Medical Association supports the promotion of structured discussions of ethics that include research, clinical practice, and basic human values within all medical school curricula and fellowship training programs;
9. Our AMA supports the promotion, through AMA publications and other vehicles, of
    a. A clear understanding of the scientific process, possible sources of error, and the difference between intentional and unintentional scientific misrepresentation.
    b. Multidisciplinary discussions to formulate a standardized definition of scientific fraud and misrepresentation that elaborates on unacceptable behavior.
10. Our AMA supports the promotion of discussions on the peer review process and the role of the physician investigator.
11. Our AMA supports the development of specific standardized guidelines dealing with the disposition of primary research data, authorship responsibilities, supervision of research trainees, role of institutional standards, and potential sanctions for individuals proved guilty of scientific misconduct.
12. Our AMA supports the sharing of information about scientific misconduct among institutions, funding agencies, professional societies, and biomedical research journals
13. Our AMA will educate, at appropriate intervals, physicians and physicians-in-training about the currently defined difference between being an "author" and being a "contributor" as defined by the Uniform Requirements for Manuscripts of the International Committee of Medical Journal Editors, as well as the varied potential for industry bias between these terms.

Ethical and Societal Considerations in Research H-460.980

1. Private organizations and academic institutions should jointly develop a means to continue and enhance broadly based study and discussion of ethical and societal issues in biomedical research.
2. The federal government should provide the resources to support new initiatives within the National Institutes of Health for the funding of research studies in bioethics. Existing federal programs that fund bioethical research studies should be preserved. Private foundations should be encouraged to provide resources to support research studies in bioethics.
3. A uniform set of federal regulations governing research with human subjects, based on the core regulations of the Department of Health and Human Services should be adopted by all federal agencies. Uniformity should not preclude additions to Department regulations that do not conflict with the core regulations or that enhance the protection of research subjects.

4. Associations of regional institutional review boards (IRBs) should be formed to enhance IRB performance through the development of educational site visits and local workshops.
5. Each institution should have a system both for monitoring the conduct of biomedical research and for investigating and reporting allegations of research misconduct.
6. All investigators involved in research projects should be responsible for the clear articulation and enforcement of standards that ensure the integrity of scientific data and conclusions. Regardless of whether the research project is a result of individual or collaborative efforts, investigators should thoroughly understand the data and conclusions in research publications and studies.
7. As part of their formal training in research investigation, graduate, medical and postdoctoral students should be instructed on the importance of adhering to the ethical and scientific requirements in research conduct and in the reporting of research results.
8. Our American Medical Association encourages study of the inclusion of Socioeconomic Status (SES) data in clinical and public health research identify appropriate minimum standards for the inclusion of such data in research studies.
9. Our AMA:
    a. opposes policies requiring scientific disclosures of confidential medical records consistent with Policy H-315.983, "Patient Privacy and Confidentiality".
    b. supports the use of all credible scientific data in the development of public policy while safeguarding confidentiality of patient information.

7.1.5 Misconduct in Research

Biomedical and health research is intended to advance medical knowledge to benefit future patients. To achieve those goals physicians who are involved in such research maintain the highest standards of professionalism and scientific integrity.

Physicians with oversight responsibilities in biomedical or health research have a responsibility to ensure that allegations of scientific misconduct are addressed promptly and fairly. They should ensure that procedures to resolve such allegations:

(a) Do not damage science.

(b) Resolve charges expeditiously.

(c) Treat all parties fairly and justly. Review procedures should be sensitive to parties' reputations and vulnerabilities.

(d) Maintain the integrity of the process. Real or perceived conflicts of interest must be avoided.

(e) Maintain accurate and thorough documentation throughout the process.

(f) Maintain the highest degree of confidentiality.

(g) Take appropriate action to discharge responsibilities to all individuals involved, as well as to the public, research sponsors, the scientific literature, and the scientific community.

7.1.1 Physician Involvement in Research

Biomedical and health research is intended to contribute to the advancement of knowledge and the welfare of society and future patients, rather than to the specific benefit of the individuals who participate as research subjects.

However, research involving human participants should be conducted in a manner that minimizes risks and avoids unnecessary suffering. Because research depends on the willingness of participants to accept risk, they must be able to make informed decisions about whether to participate or continue in a given protocol.

Physician researchers share their responsibility for the ethical conduct of research with the institution that carries out research. Institutions have an obligation to oversee the design, conduct, and dissemination of research to ensure that scientific, ethical, and legal standards are upheld. Institutional review boards (IRBs) as well as individual investigators should ensure that each participant has been appropriately informed and has given voluntary consent.

Physicians who are involved in any role in research with human participants have an ethical obligation to ensure that participants' interests are protected and to safeguard participants' welfare, safety, and comfort.

To fulfill these obligations, individually, physicians who are involved in research should:

(a) Participate only in those studies for which they have relevant expertise.

(b) Ensure that voluntary consent has been obtained from each participant or from the participant's legally authorized representative if the participant lacks the capacity to consent, in keeping with ethics guidance. This requires that:

(i) prospective participants receive the information they need to make well-considered decisions, including informing them about the nature of the research and potential harms involved;

(ii) physicians make all reasonable efforts to ensure that participants understand the research is not intended to benefit them individually;

(iii) physicians also make clear that the individual may refuse to participate or may withdraw from the protocol at any time.

(c) Assure themselves that the research protocol is scientifically sound and meets ethical guidelines for research with human participants. Informed consent can never be invoked to justify an unethical study design.

(d) Demonstrate the same care and concern for the well-being of research participants that they would for patients to whom they provide clinical care in a therapeutic relationship. Physician researchers should advocate for access to experimental interventions that have proven effectiveness for patients.
(e) Be mindful of conflicts of interest and assure themselves that appropriate safeguards are in place to protect the integrity of the research and the welfare of human participants.
(f) Adhere to rigorous scientific and ethical standards in conducting, supervising, and disseminating results of the research.

7.2.1 Principles for Disseminating Research Results

Physicians have an ethical responsibility to learn from and contribute to the total store of scientific knowledge. When they engage in biomedical or health research, physicians have obligations as scientists, which include disseminating research findings. Prompt presentation to scientific peers and publication of research findings are foundational to good medical care and promote enhanced patient care, early evaluation of clinical innovations, and rapid dissemination of improved techniques.

To fulfill their ethical responsibilities with respect to sharing research findings for the ultimate benefit of patients, physicians should:

(a) Advocate for timely and transparent dissemination of research data and findings. Physicians should not intentionally withhold information for reasons of personal gain.
(b) Report the results of research accurately, including subsequent negative findings. This is particularly important where the findings do not support the research hypothesis.
(c) Maintain a commitment to peer review.
(d) Disclose sponsorship and conflicts of interest relating to the research, in keeping with ethics guidance.
(e) Be responsible in their release of research results to the media, ensuring that any information the researcher provides is prompt and accurate and that informed consent to the release of information has been obtained from research participants (or participants' legally authorized representative when the participant lacks decision-making capacity) prior to releasing any identifiable information.

In rare circumstances, the potential for misuse of research results could affect the decision about when and whether to disseminate research findings. Physician-researchers should assess foreseeable ramifications of their research in an effort to balance the promise of benefit against potential harms from corrupt application. Only under rare circumstances should findings be withheld, and then only to the extent required to reasonably protect against misuse.

APPENDIX 1

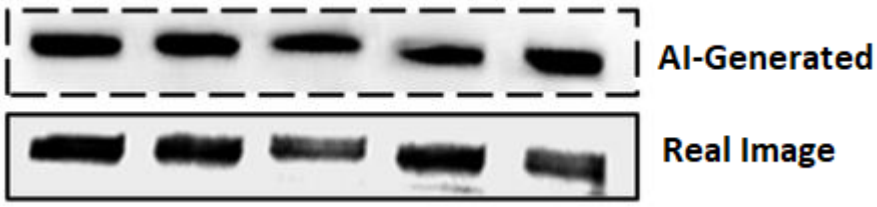

Figure 1. Sample of artificially generated (top) and real (bottom) Western blot images. When this specific image was provided to experts, only 4 of 23 participants were able to correctly identify the artificially generated image. For all images used in this study, experts had a 50 percent accuracy rate for detecting artificially generated images. Adapted from Qi et al.[11]

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