

# Artificial Intelligence as a Triage Tool during the Perioperative Period: Pilot Study of Accuracy and Accessibility for Clinical Application

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**Background:** Given the dialogistic properties of ChatGPT, we hypothesized that this artificial intelligence (AI) function can be used as a self-service tool where clinical questions can be directly answered by AI. Our objective was to assess the content, accuracy, and accessibility of AI-generated content regarding common perioperative questions for reduction mammoplasty.

**Methods:** ChatGPT (OpenAI, February Version, San Francisco, Calif.) was used to query 20 common patient concerns that arise in the perioperative period of a reduction mammoplasty. Searches were performed in duplicate for both a general term and a specific clinical question. Query outputs were analyzed both objectively and subjectively. Descriptive statistics, *t* tests, and chi-square tests were performed where appropriate with a predetermined level of significance of *P* less than 0.05.

**Results:** From a total of 40 AI-generated outputs, mean word length was 191.8 words. Readability was at the thirteenth grade level. Regarding content, of all query outputs, 97.5% were on the appropriate topic. Medical advice was deemed to be reasonable in 100% of cases. General queries more frequently reported overarching background information, whereas specific queries more frequently reported prescriptive information (*P* < 0.0001). AI outputs specifically recommended following surgeon provided postoperative instructions in 82.5% of instances.

**Conclusions:** Currently available AI tools, in their nascent form, can provide recommendations for common perioperative questions and concerns for reduction mammoplasty. With further calibration, AI interfaces may serve as a tool for fielding patient queries in the future; however, patients must always retain the ability to bypass technology and be able to contact their surgeon. (*Plast Reconstr Surg Glob Open* 2024; 12:e5580; doi: 10.1097/GOX.0000000000005580; Published online 2 February 2024.)

## INTRODUCTION

Artificial intelligence (AI) has been one of the most rapidly evolving technologies and is eagerly awaiting integration into healthcare. Recent literature details the ethical implications of its utilization, theoretical use cases, and descriptions of AI-driven tools with a variety of applications.<sup>1-7</sup> As many may have different working knowledge of this technology, Oleck and colleagues provide a useful

introduction to NLP AI technology.<sup>8</sup> Given the nascency of this technology, innumerable opportunities for its utilization are being explored within plastic surgery. Still, there remains a dearth of inquiry into the utility of AI for direct patient care. The current literature using AI describes various attempts to integrate various functions into preoperative surgical planning, patient education, and assessment of outcomes.<sup>9-16</sup> No study to our knowledge has assessed the feasibility of a patient interactive AI program for answering questions, troubleshooting complications, and providing clinical recommendations during the perioperative period.

One of the capabilities of AI is the ability to serve as a natural language processor (NLP). This functionality enables AI to understand, synthesize, manipulate, and

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Received for publication November 13, 2023; accepted December 5, 2023.

Presented at Plastic Surgery The Meeting in Austin, Texas 2023.

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DOI: 10.1097/GOX.0000000000005580

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on [www.PRSGlobalOpen.com](http://www.PRSGlobalOpen.com).

generate language. AI tools with this capability are intrinsically dialogic.<sup>17</sup> Given this property, our goal was to assess if this AI function can be used as a patient-directed self-service tool whereby patients can have their clinical questions directly answered by an AI interface. Several studies have established a high working medical knowledge of various NLP platforms with AI performing at the level of medical students and plastic surgery residents on board and in-service examinations, respectively.<sup>18–21</sup> There remain appropriate concerns over the limitations of AI programs, including imperfect accuracy of generated outputs and the potential of AI programs working with out-of-date information.<sup>22–24</sup> Although no plastic-surgery-specific AI tool has been developed, various companies have produced generative AI tools that are readily accessible by the general public. The long-term aim of this research is to determine the functionality and reliability of incorporating AI as a clinical tool to help manage patient questions and clinical concerns in the perioperative period. Although such tools introduce complex medico-legal questions, our objective was to assess the content, accuracy, and accessibility of AI-generated content regarding common perioperative questions and complications for a common plastic surgery procedure.

### METHODS

AI interface ChatGPT (OpenAI, San Francisco, Calif.) is publicly accessible and was chosen as the AI program to be used in this study, given its widespread availability at the time of conducting the study. ChatGPT was accessed in February of 2023 and used to query 20 common patient questions or complications that arise in the perioperative period of a reduction mammoplasty. Questions were informed by common clinical questions based on the senior author’s clinical experience. Searches were

### Takeaways

**Question:** Is artificial intelligence (AI)-generated advice for postsurgical concerns accurate and readable?

**Findings:** AI produces accurate responses for basic questions and concerns following a reduction mammoplasty procedure. The reading levels of these outputs were higher than recommended for the general US population.

**Meaning:** Currently available AI tools can provide recommendations for common perioperative questions and concerns for breast reduction procedures. Clinical integration requires further calibration, and patients must always retain the ability to bypass technology and contact their surgeon directly.

performed in duplicate (Table 1), where a query was performed for a general term (“breast reduction bleeding”) and repeated with a specific clinical question (“I had a breast reduction yesterday and now I have bleeding. What should I do?”). A new module was created for each query so that natural learning or bias from prior inputs would not affect the resulting output. Query outputs were analyzed for both objective and subjective metrics. Objective metrics included output length, sentence structure, and readability scores. Readability scores were assessed by validated instruments, including the Flesch reading ease and Flesch-Kincaid grade level assessments, which have both been widely used to assess text intended for patients to read.<sup>25,26</sup> Both tools calculate a readability score based on the word length and sentence length of a text. For Flesch reading ease, readability is scored on a scale from 1 to 100, where a score of 100 is classified as the most readable. This validated tool is regularly used to assess the readability of patient facing medical literature. The Flesch-Kincaid grade

**Table 1. Inputs into ChatGPT (a General Statement and a Specific Question Posed to the AI Program)**

Question Number	General Inquiry	Specific Inquiry
1	Breast reduction bruising	I had a breast reduction yesterday and now I have bruising. What should I do?
2	Breast reduction bleeding	I had a breast reduction yesterday and now I have bleeding. What should I do?
3	Breast reduction drains	I had a breast reduction yesterday and now I have drains. What should I do?
4	Breast reduction swelling	I had a breast reduction yesterday and now I have swelling. What should I do?
5	Breast reduction soreness	I had a breast reduction yesterday and now I have soreness. What should I do?
6	Breast reduction exercise	I had a breast reduction yesterday. When can I exercise?
7	Breast reduction driving	I had a breast reduction yesterday. When can I drive?
8	Breast reduction restarting medication	I had a breast reduction yesterday. When can I restart my normal medications?
9	Breast reduction pain	I had a breast reduction yesterday and now I have pain. What should I do?
10	Breast reduction showering	I had a breast reduction yesterday. When can I shower?
11	Breast reduction dressings	I had a breast reduction yesterday. What do I do with the dressings?
12	Breast reduction pain medication	I had a breast reduction yesterday. What should I take for pain medication?
13	Breast reduction drainage	I had a breast reduction yesterday and now I have drainage. What should I do?
14	Breast reduction diet	I had a breast reduction yesterday. What can I eat?
15	Breast reduction sleeping	I had a breast reduction yesterday. How can I sleep?
16	Breast reduction recovery	I had a breast reduction yesterday. How long is the recovery?
17	Breast reduction bra	I had a breast reduction yesterday. When can I wear a bra?
18	Breast reduction antibiotics	I had a breast reduction yesterday. Do I need antibiotics?
19	Breast reduction breast and nipple sensation	I had a breast reduction yesterday. Will I still have breast and nipple sensation?
20	Breast reduction follow-up appointment	I had a breast reduction yesterday. When is my follow-up appointment?

level is likewise a validated tool used for similar purposes but helps delineate what level of education is necessary to appropriately understand a given text. For example, a Flesch-Kincaid grade level of 8 signifies that someone who has completed up to eighth grade should be able to comprehend the text. AI-generated outputs were subjectively assessed by two authors (C.B. and T.S.) for tone, content, and accuracy. Microsoft Excel (Version 7, Seattle, Wash.) was used for performing descriptive statistics, *t* tests, and chi-square tests where appropriate, with a predetermined level of significance of *P* less than 0.05.

## RESULTS

A total of 40 AI-generated outputs were analyzed. Mean word length of AI-generated outputs was  $191.8 \pm 52.6$  words, with a mean of  $998.9 \pm 275.9$  characters in total per output. There was an average of  $4.8 \pm 2.5$  paragraphs per output with  $2.2 \pm 1.1$  sentences per paragraph on average. There was a mean of  $22.8 \pm 3.4$  words per sentence with an average of  $5.1 \pm 0.2$  characters per word. Passive sentence structure was used in 13.7% of sentences. Comparing general inquiry prompts versus specific questions, general inquiry prompts were significantly longer (207.1 versus 176.6 words, *P* = 0.03). Mean Flesch-Kincaid grade level was the thirteenth grade, with grade levels ranging from the ninth grade to seventeenth grade. The average Flesch reading ease was  $39.7 \pm 10.0$ . There was no significant difference between the mean Flesch-Kincaid grade level (13.6 versus 13.0 grade level, *P* = 0.17) or the average Flesch reading ease (39.4 versus 40.1 readability score, *P* = 0.42) between general or specific prompts provided to ChatGPT (Table 2).

Regarding content, out of all query outputs 97.5% were on the appropriate topic. The singular instance where ChatGPT did not provide a response on the topic of interest, it was for a general inquiry (Table 1, prompt 17) and ChatGPT provided a response based on related information. Lack of specificity in the prompt was determined as the issue for inappropriate response in this case. Considering

those AI outputs on the appropriate topic, medical advice was deemed to be reasonable in 100% (*n* = 39) of cases. General queries more frequently (16 of 20) reported overarching background information, whereas specific queries more frequently reported prescriptive information (18 of 20) (*P* < 0.0001). When specific questions were asked, ChatGPT recommended discussion with the surgeon in 100% of cases, whereas general queries recommended the same advice in 95% of cases. AI outputs explicitly recommended following surgeon provided postoperative instructions in 82.5% of instances (Table 2). Notable interesting responses included an instance of a congratulations and an apology offered in the AI output. The complete responses from ChatGPT can be found within the supplemental material (See Supplemental Digital Content 1, ChatGPT-generated responses to prompts regarding frequent concerns following a reduction mammoplasty, <http://links.lww.com/PRSGO/D51>).

## DISCUSSION

Novel AI tools are constantly emerging and demonstrate newfound potential and functions within healthcare. NLP capable AI tools allow exciting opportunities as they have the ability to collect, synthesize, and produce language in an interactive manner.<sup>27</sup> There has been minimal investigation into the clinical application of these tools, as many remain hesitant to implement them, given the well-founded limitations of current platforms. Despite these concerns, the results of the present analysis suggest that AI interfaces can provide medically sound recommendations to patients for common perioperative questions and concerns regarding breast reduction procedures.

Medical advice was assessed for 20 common perioperative questions after a breast reduction. Advice was determined to be medically reasonable in all instances. Interestingly, ChatGPT qualified nearly every response with a recommendation to follow surgeon-issued instructions and to contact a healthcare provider in case of an

**Table 2. ChatGPT-generated Outputs Assessed for Objective and Subjective Parameters\***

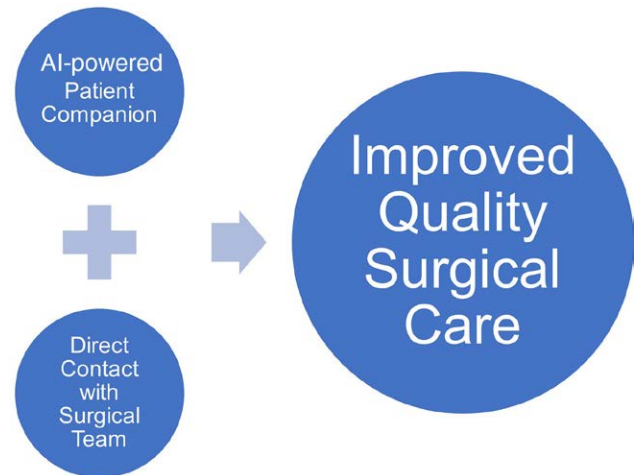
Variable	Generic Prompts (n = 20)	Specific Prompts (n = 20)	<i>P</i>
<b>Structure</b>			
Word count (mean)	207.1 ± 58.4 words	176.6 ± 42.0 words	0.03
Characters (mean)	1084.7 ± 314.7 characters	913.1 ± 204.2 characters	0.02
Paragraphs (mean)	5.05 ± 3.1 paragraphs	4.6 ± 1.8 paragraphs	0.27
Sentences (mean)	8.3 ± 2.4 sentences	8.3 ± 2.9 sentences	0.50
Sentences per paragraph (mean)	2.5 ± 1.5 sentences per paragraph	1.8 ± 0.2 sentences per paragraph	0.03
Words per sentence (mean)	23.7 ± 2.8 words per sentence	21.8 ± 3.7 words per sentence	0.04
Characters per word (mean)	5.1 ± 0.2 characters per word	5.1 ± 0.3 characters per word	0.50
<b>Readability</b>			
Flesch-Kincaid grade level (mean)	13.6 ± 1.8 grade	13.0 ± 2.0 grade	0.17
Flesch reading ease (mean)	39.4 ± 10.5 score	40.1 ± 9.8 score	0.42
<b>Content</b>			
Appropriate topic	19 (95%)	20 (100%)	0.95
Reasonable medical advice	19 (100%) (n = 19)	20 (100%)	1.0
Background information	16 (80%)	2 (10%)	<0.0001
Prescriptive information	4 (20%)	18 (90%)	
Discussion with surgeon	19 (95%)	20 (100%)	0.95
Follow postoperative instructions	15 (75%)	18 (90%)	0.21

\*Significant differences were noted in both the content and structure of generic versus specific prompts.

emergency. These inclusions may provide confidence to surgeons considering integrating this technology into their practices. Patients may be reassured in situations where concerns are minor and nonurgent, but simultaneously they may be recommended to escalate concerns that are more pressing. Inappropriate reassurance of a patient concern or inaccurate advice remain the largest challenges to integrating a patient-interactive AI triage tool. Among the greatest concerns include a potential delay in patients seeking urgently or emergently needed medical attention following surgery. Legal liability from errors in judgement or delays in care attributed to an AI triage tool may dissuade surgeons from integrating such technology into their practices. These concerns, however, are not unique to an AI NLP interface, but are similar to concerns present when training new or inexperienced clinical staff that may be triaging patient phone calls or messages.<sup>28</sup> Ultimately, the surgeon will remain responsible for all care and counsel provided—whether by a human or an AI interface. Overall, medical recommendations provided by ChatGPT were measured and included concise explanations. Although it is impossible to assess the performance of ChatGPT in every clinical scenario, this initial pilot study demonstrates that it has the capability of providing safe, appropriate medical recommendations for at least one plastic surgery procedure. Such findings and proof of its working knowledge base are corroborated by its successful performance on examinations in plastic surgery and other specialties.<sup>15,18,19,29</sup>

In addition to the integrity and accuracy of medical advice, accessibility is an important concern. Baseline health literacy levels have been demonstrated to be inadequate amongst plastic surgery patients.<sup>30</sup> Taking such concerns into consideration, the American Medical Association and the United States Department of Health and Human Services recommend that medical information intended for patients be written at the sixth grade level.<sup>31</sup> The reading level of the ChatGPT outputs in this study were substantially higher (at the college level) than this recommendation, posing a limitation to the accessibility of the AI-generated outputs to the general public of the United States. Educational materials with a higher than recommended reading level is a well-described issue within the plastic surgery literature.<sup>32–35</sup> Such discrepancies have the capacity to detract from the patient-provider relationship.<sup>36,37</sup> Thus, this remains a potential limitation to successful integration of an AI-powered chatbot triage tool for plastic surgery patients.

Although the reading level of these outputs were higher than ideal, this represents a first step in integrating an interactive AI application that can serve as a supplemental resource for patients undergoing surgery. It is important that the relationship between patient-facing AI interactive technology and direct healthcare provider contact should not be viewed as isolated silos. The value of direct communication with the surgeon, advanced practice providers, and nursing and office staff will never be replaced. Instead, patient interactive AI applications can provide a useful adjunct to address common patient concerns in real time, thereby preventing delays from accessing the surgical team. Furthermore, an AI-driven digital companion for patients



**Fig. 1.** Symbiosis between technology-driven solutions to patient care and continual direct communication with the surgical team has the potential to enable higher quality care for surgical patients.

may decrease the time demands placed on office staff answering routine questions so that time can be devoted to more critical questions and concerns.<sup>27</sup> Nonetheless, continual quality assessment and surveillance should be performed by the surgical team to ensure the integrity and soundness of advice and instructions provided. Moreover, patients must always retain the ability to supersede technology and speak directly to a member of their surgical team for time sensitive or urgent issues. Accordingly, AI technology is best conceptualized as an assistant to the surgical team, rather than as a replacement (Fig. 1).

There are important limitations to this initial pilot study. It was not feasible to predict or analyze every potential patient question during the perioperative period for a reduction mammoplasty. Similar analysis should be performed on a more extensive listing of potential patient questions that may arise during the perioperative period. Although this particular AI software generally provided sound medical advice in these scenarios, it may not be the case with other clinical questions for reduction mammoplasty, for medical advice regarding other operations, or with other available AI software. ChatGPT's algorithms have been refined over the past 5 years, integrating text-based information from across the internet into its working knowledge. ChatGPT utilizes iterative prediction in order respond to prompts provided by the user. Over time, human feedback has been integrated to hone the AI-generated responses. A limitation of AI algorithms is that they are informed by free, publicly available datasets on the internet. This excludes resources that require payment for access such as many medical journals.<sup>8</sup> Thus, publicly available AI programs are inherently limited by the data available to them. The questions included in this study may not represent the most frequent clinical questions during the perioperative period for all patients undergoing breast reductions, though these are frequently asked questions amongst our patient cohort. Of the analyzed concerns, many of these points are discussed in the preoperative consultations or included within educational



materials provided to the patient before surgery. Although this may be the case, we find that many patients still seek counsel from the surgical team regarding these concerns and appreciate hearing from either a nurse or advanced practice provider for reassurance. AI, as discussed in this study, may be able to aid in this capacity. Yun and colleagues describe that current evaluation tools may be insufficient for completely assessing the rigor and quality of AI generated responses.<sup>38</sup> Developing novel assessment tools of AI-generated outputs may be required to better determine accuracy and accessibility. Furthermore, AI is not a stagnant tool, but can evolve and adjust its processing based on new inputs of information. Literature has demonstrated a continual evolution of publicly available AI software over multiple iterations.<sup>39</sup> In the present analysis, no assessment was conducted regarding a learning curve or validity and replicability of the responses over time.<sup>15</sup> Given the findings of this study, our aim is to develop a safe methodology for studying the use of publicly available AI software to assist with answering patient questions during the perioperative period for reduction mammoplasty. Long-term goals include the development of a plastic surgery-specific AI tool that could serve as a longitudinal digital companion to patients throughout the perioperative period.

## CONCLUSIONS

Currently available AI tools, in their evolving form, can provide recommendations for common perioperative questions and concerns for reduction mammoplasty. Although the reading level of these outputs are higher than ideal, this represents an initial step toward the development of a plastic surgery-specific AI application that can function as the first resource for patients undergoing surgery. With further calibration, AI interfaces may serve as a tool for fielding patient queries in the future; however, patients must always retain the ability to bypass technology and be able to contact their surgeon.

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## DISCLOSURE

*The authors have no financial interest to declare in relation to the content of this article.*

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