# Validity of Using Detailed, Specific Prompts in ChatGPT for Allergen Avoidance Recommendation in Common Contact Allergen

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## Abstract

Allergic contact dermatitis (ACD) is a significant public dermatologic problem due to its prevalence and impact on patient well-being. Effective management is primarily focused on identifying the trigger allergens and avoiding them. Traditionally, the appropriate product for individuals who have ACD is provided by expert counseling. However, it encounters many challenges, such as time-consumption, complexity, and a large amount of information. To address this, artificial intelligence (AI), in particular ChatGPT, can serve as a supportive tool as it has proven effective in a variety of medical applications. Nonetheless, research on the application of ChatGPT in clinical practice has not yet reached a consensus. This research aims to evaluate the validity of employing detailed, specific prompts in ChatGPT to generate allergen avoidance product recommendations. The methodology involves selecting the top ten allergens prevalent in Thailand, designing specific and detailed prompts to task ChatGPT to recommend five appropriate products in the five most common sources of allergens, and having a dermatologist evaluate the validity of ChatGPT-generated responses based on four categories: "valid," "invalid," "unknown," and "unresponsive." The results show that the overall validity of the answers generated by ChatGPT is 82.0%, and it achieved a 92.26% accuracy rate in recommending products of choice in the cosmetic and personal care product categories. According to the study, ChatGPT provides a high validity rate in recommending appropriate products for allergen avoidance in common contact allergens. ChatGPT may be a beneficial supplementary tool for physicians in guiding patients with allergic contact dermatitis on allergen avoidance. This study has limitations in terms of generalizability as it focused on a specific set of common contact allergens and only a detailed question was tested. Further research is needed to assess the effectiveness of ChatGPT in a wider range of allergens and explore the distinction between using a variety of levels of specific questions in order to enhance its effectiveness in clinical practice.

*Keywords*: *Allergen Avoidance, Allergic Contact Dermatitis, ChatGPT*

## 1. Introduction

Allergic contact dermatitis (ACD) is a common inflammatory skin disorder that is a major public health concern due to its prevalence and impact on patient quality of life (Thyssen et al., 2007). This condition is a type IV delayed hypersensitivity reaction that only occurs in individuals who have already been sensitized to allergens. Its symptoms include redness, itching, papules, and, in some cases, blisters (Lachapelle, 2014). This condition can result from both occupational and non-occupational allergen exposure. It can be caused by a wide range of substances, including cosmetics, personal products, chemicals, plants, and metals. The primary focus of allergic contact dermatitis management is to prevent contact with the offending substances, otherwise the symptoms could get worse and become chronic, contributing to serious impairment if the triggering substances are not identified and eliminated (Tramontana et al., 2023).

One of the most important aspects of controlling allergic reactions is the recommendation of allergen-avoidance strategies. The conventional methods require consulting with medical experts who give personalized recommendations based on the patient's medical history, allergy testing results, and expert knowledge.(Mowad et al., 2016) Despite its importance, allergen avoidance counselling has many challenges,

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including the complexity of the allergen name, the time-consuming process, and the lack of sufficient resources for effective guidance. (Jamil, Erikssohn, & Lindberg, 2012; Safeer & Keenan, 2005)

However, as technologyprogresses, there is an increasing interest in employing artificial intelligence (AI) to expedite and enhance the processing of such recommendations. ChatGPT, an OpenAI language model, has proven its ability to create human-like text responses (Gabashvili, 2023). According to Plebani (2023), ChatGPT employs algorithms to interpret natural language and produce predetermined or instantly generated responses. This technology offers an extensive array of applications with seemingly unlimited potential. Recent studies demonstrate that ChatGPT has the potential to be used in clinical decision support to generate appropriate differential diagnoses, provide cancer screening insights, provide trustworthy information about medical questions, and improve medical documentation accuracy.(Liu, Wang, & Liu, 2023) Additionally, despite the fact that ChatGPT had not been specially trained with data related to medicine, several studies show ChatGPT performed outstandingly in various fields of medical specialty examinations, including the Dermatology Board Certification Examination, neurology board exam, and the United States Medical Licensure Examination (USMLE) (Chen et al., 2023; Joly-Chevrier, Nguyen, Lesko-Krleza, & Lefrançois, 2023; Kung et al., 2023). Moreover, further studies have illustrated that the use of specific question formats has resulted in improved accuracy of ChatGPT (Ray, 2023), and using the new version provides better performance and accuracy than the old version in answering medical questions (Rosoł et al., 2023; Scheschenja et al., 2024).

However, there are plenty of limitations and concerns regarding ChatGPT's medical applicability Plus, the use of ChatGPT in clinical practice, such as in contact dermatitis clinics, remains unexplored-therefore, further study is necessary. This research aims to explore the validity of employing detailed, specific prompts in ChatGPT to generate allergen avoidance recommendations in common contact allergens for patients with contact dermatitis. The findings of this study may provide a basis for future developments in AI-driven healthcare solutions as well as enhancements to the efficiency and accessibility of contact dermatitis treatment strategies.

## 2. Objectives

To evaluate the validity of the answers provided by using a detailed, specific prompt into ChatGPT (GPT-4) to recommend the appropriate products regarding allergen avoidance practice in common contact allergens.

## 3. Method

### 3.1 Instruction design

This study included the top ten allergens that are most prevalent in Thailand, based on a study from Boonchai, Iamtharachai, & Sunthonpalin (2008). We selected the five most common allergen sources from each allergen group.

The author designed the instruction with the most specific, detailed information to ensure clarity and comprehension for the ChatGPT. The goal of the instruction is to task ChatGPT to recommend five products of choice for patients who are allergic to those specific allergens. The prompt used in this study is as follows:

"You are a dermatologist, who works in the contact dermatitis clinic. There are many patients who test the patch test with you to investigate their contact dermatitis. After the patch test was done, you are the doctor who has to advise about the allergen's information and recommend a specific brand or product that is safe for your patients and does not contain the material that they are allergic to.

Please recommend five specific (_Type of product_) that can be used by patients who are allergic to (__Name of allergen__)"

### 3.2 Generating answers in ChatGPT

The author used GPT-4 (ChatGPT Plus) platform to generate the answers in September 2023. In order to prevent preexisting context bias, the questions were manually entered into ChatGPT by choosing the "new chat" option when initiating each question. Fifty questions in total that represented 10 allergen categories and 5 common sources of each allergen, were entered into ChatGPT.

Once ChatGPT provides answers based on a specific item's model or brand, those responses will be collected and further evaluated for validity by a dermatologist. Answers that only mention the sort of product without mentioning the brand or that provide only tips on avoiding an allergy will be classified as "unresponsive."

### 3.3 Assessment of the validity of answers

A dermatologist manually evaluated the validity of the responses obtained from ChatGPT. Five tags were used to categorize the answers' validity: "valid," "invalid," "unknown," and "unresponsive." Products that were shown to be free from the specific allergen were marked as "valid," while those that were shown to contain the allergen were marked as "invalid." Products with components that could not be determined from the data source were marked as "unknown," and answers that did not correctly provide the product's model or brand, as mentioned above, were marked as "unresponsive."

The following data sources were used in this study to define products' ingredients: 1) products' websites; 2) safety data sheet (SDS); and 3) online websites, for example, https://www.ewg.org, https://www.whatsinproducts.com, https://www.accessdata.fda.gov. https://dailymed.nlm.nih.gov, https://incidecoder.comandhttps://www.skinsafeproducts.com

### 3.4 Data collection and analysis

A Microsoft Excel spreadsheet (Microsoft Corporation) was used to gather and analyze all of the answers. The percentage of each result categorization to the total number of product recommendations was calculated to evaluate the accuracy of ChatGPT-generated answers.

## 4. Results and Discussion
### 4.1 Result

After evaluating the data, it was discovered that the overall validity of the answers generated by ChatGPT is 82.0% (205 out of 250 answers). This indicates that ChatGPT is highly accurate in providing appropriate products for allergen avoidance. In addition, there were 8.0% (20 out of 250 answers) of unresponsive responses, indicating that ChatGPT was unable to suggest a particular product model or brand of product of choice; instead, it suggested checking ingredient labels, contacting manufacturers, or utilizing hypoallergenic or organic products. There were 6.80% (17 out of 250 answers) of responses that were unable to explore the ingredient list (unknown response) and 3.20% (8 out of 250 answers) of invalid responses.

Table 1 demonstrates how ChatGPT's validity varies depending on each specific allergen. ChatGPT produces outstanding outcomes in fragrance mix and colophony; it reveals 100% valid responses. With regard to potassium dichromate, cobalt chloride, neomycin, paraben mix, Balsam of Peru, and Budesonide, ChatGPT exhibits results that are within the acceptable range of 80–92%. For Phenylenediamine (PPD) and nickel sulfate, ChatGPT exhibits quite low accuracy and high unknown responses.

**Table 1** Result of ChatGPT-generated answer in recommending allergen avoidance products in the top ten most common allergens.

| Name of allergen | Valid | Invalid | Unknown | Unresponsive |
|---|---|---|---|---|
| Potassium dichromate | 23 (92%) | 0 | 2 (8%) | 0 |
| Nickel sulfate | 11 (44%) | 0 | 9 (36%) | 5 (20%) |
| Fragrance mix | 25 (100%) | 0 | 0 | 0 |
| Cobalt chloride | 20 (80%) | 0 | 0 | 5 (20%) |
| Neomycin sulfate | 23 (92%) | 2 (8%) | 0 | 0 |
| Parabens mix | 20 (80%) | 0 | 0 | 5 (20%) |
| Balsam of Peru | 22 (88%) | 3 (12%) | 0 | 0 |
| 4-Phenylenediamine base | 16 (64%) | 3 (12%) | 6 (24%) | 0 |
| Colophony | 25 (100%) | 0 | 0 | 0 |
| Budesonide | 20 (80%) | 0 | 0 | 5(20%) |
| summary | 205 (82%) | 8 (3.2%) | 17 (6.8%) | 20 (8%) |

When the performance of ChatGPT in recommending products was evaluated in each category, the accuracy rates varied across different product categories. Considerable accuracy rates were observed, especially in the categories of cosmetics, personal care products, and cleaning products. According to the results, ChatGPT achieved a 92.26% accuracy rate in recommending products of choice in the cosmetic and personal care product categories. Additionally, ChatGPT provided recommendations with a high accuracy of 90.0% in the cleaning product category. The model also performed well in the categories of drugs and paint and varnish, with validity rates of 86.0% and 60.0%, respectively. Unfortunately, the model's validity was very poor for jewelry and leather products, with 6.67% and 0%, respectively, see Table 2

**Table 2** Results of product recommendations from ChatGPT classified by product category.

| | Cosmetic & personal care product (n=155) | Cleaning product (n=10) | Paint and varnish (n=15) | Leather product (n=5) | Pharmaceutical (n=50) | Jewelry (n=15) |
|---|---|---|---|---|---|---|
| Valid | 143 (92.26%) | 9 (90.0%) | 9 (60.0%) | 0 | 43 (86.0%) | 1 (6.67%) |
| Invalid | 6 (3.87%) | 0 | 0 | 0 | 2 (4.0%) | 0 |
| Unknown | 1 (0.65%) | 1 (10.0%) | 1 (6.67%) | 5 (100%) | 0 | 9 (60.0%) |
| Unresponsive | 5(3.23%) | 0 | 5 (3.33%) | 0 | 5 (10.0%) | 5 (33.33%) |

### 4.2 Discussion

With the rapid development of AI technology, chatbot applications such as ChatGPT are expanding rapidly. Special attention has been focused on ChatGPT research and development by scientific and academic organizations, particularly in the field of medicine.(Dave, Athaluri, & Sigh, 2023; Ray, 2023; Reddy, 2023; Souza et al., 2023) A study from Hassani and Silva (2023) presents that ChatGPT has the capability to transform data science by increasing accessibility, efficiency, and effectiveness through its impact on data analysis and predictive modelling. It also has the potential to save time and resources involved with data science work. In this study, we focus on the contact dermatitis model since it is a data-intensive case study. Patient education following patch testing serves as a cornerstone of contact dermatitis management, but it can be challenging for doctors due to the time required, the complexity of allergen chemical labels, and the difficult and enormous amount of data for patients to understand.

This study was a preliminary pivotal study to evaluate the validity of using detailed, specific prompts in ChatGPT for allergen avoidance recommendations in common contact allergens. Our findings indicate that ChatGPT (GPT-4) achieved a satisfactory level of validity for allergen avoidance product recommendations

for allergic contact dermatitis patients. ChatGPT's product recommendations have an overall validity of 82.0%. Our findings correspond to those of prior studies (Elias, Burshtein, & Sharon, 2024; Ferreira et al., 2023; Kung et al., 2023; Rames et al., 2024; Sarraju et al., 2023), which have noted ChatGPT's intriguing potential for answering medical questions and performing examinations.

The accuracy rates showed variation among the various product categories. Particularly in the categories of cosmetics, personal care items, and cleaners such as fragrance mix, colophony, and potassium dichromate, impressive accuracy rates were noted. The findings show that ChatGPT was 92.26% valid in recommending products in the categories of cosmetics and personal care products and 90% valid in cleaning products. However, the model shows a poor level of validity when it relates to jewelry and leather. In the leather and jewelry groups, the percentage of unknown responses was as high as 100% and 60%, respectively. This might be due to the limited material information in the database for these types of products, as sometimes details of ingredients are companies' secrets. This makes it difficult to assess the accuracy of ChatGPT's answers. If companies of the products improve the online database with more specific information, the recommendation accuracy can be improved.

In addition, our investigation reveals that 3.2% of the product options that are recommended still contain the specific allergen, even when we use the prompt for providing products that refrain from allergens. The allergens causing invalid responses are Neomycin Sulphate, Balsam of Peru, and 4-phenylenediamine base. These allergies are frequently present in medications and cosmetics. As a result, those who are allergic to certain allergens should use ChatGPT with caution and guidance from their physicians. A possible explanation for the incorrect response is that the ChatGPT model was trained using a wide range of texts from the internet that were accessible until September 2021, and it does not have online real-time data updating capability.(Zhou et al., 2024) These issues could be resolved in the future by ChatGPT's latest trained data updated version or by the introduction of extended learning machines (LMs) that can do real-time searching to incorporate the most recent data in their answers.

Also, some studies cautioned about fluctuations in response accuracy in offering false information. ChatGPT is capable of fabricating and hallucinating information and references explicitly as if they were true, and it may also offer an explanation that is unrelated to the correctness of the responses it produces. (Gravel, D'Amours-Gravel, & Osmanlliu, 2023; Thirunavukarasu et al., 2023)

The study additionally reveals that 8% of the recommendations made by ChatGPT did not include a specific model or brand. Nickel Sulphate, Cobalt Chloride, parabens mix, and Budesonide are the allergens that ChatGPT was unable to provide specific product recommendations. The research by Beaulieu-Jones (2023), Ferreira (2023), and Haze et al., (2023) revealed that ChatGPT generated different, varying levels of precision and completeness in answers to identical questions. The number of questions input previously, and the complexity of the instruction designs may also be factors that affect the accuracy of ChatGPT's response. This suggests that further research is needed to explore ChatGPT's limitations and consistency in providing recommendations.

Additionally, our study indicates that incorporating ChatGPT's recommendations into clinical practice may prove advantageous, particularly with regard to patient education. The results we obtain correspond with previous studies (Campbell et al., 2024; Hernandez et al., 2023; Koh et al., 2023), which found that while this model seems to be a useful tool for patients to get information, it is unable to replace the position of a healthcare professional in providing individualised medical counselling and treatment. When used wisely, a combination of both can aid in the transition to a new age of patient-centred healthcare.

There are many limitations in our research. Initially, the limited sample size might potentially restrict the applicability of our results. It is necessary to do further studies that consider various allergy groups and product types with a larger sample size. Secondly, the accuracy of the outcome could be impacted by a more unambiguous and detailed prompt. Therefore, to completely understand the influence of question simplicity on study outcomes, future research will need to examine the use of various levels of complexity and detailed questions. Thirdly, further research should be conducted to investigate the possible limitations of ChatGPT, as our study did not assess the consistency and reproducibility of utilizing ChatGPT for allergy avoidance

product recommendations. Lastly, our study focuses only on the ChatGPT AI chatbot. As time has passed, many other AI chatbots are available in the market for comparison. So, further study is needed to explore the capabilities of different AI chatbots beyond ChatGPT. It would be beneficial to compare the results with those of other AI chatbots like Alisa, Claude, Gemini, or Copilot.

## 5. Conclusion

The conclusion of this study indicates that ChatGPT has a high validity rate for providing appropriate products for allergen avoidance in common contact allergens. ChatGPT may be a beneficial supplementary tool for physicians in guiding patients with allergic contact dermatitis on allergen avoidance. This AI technology could potentially improve patient outcomes by supporting medical professionals in providing more personalized and accurate advice for allergen avoidance. However, this study has limitations in terms of generalizability as it focused on a specific set of common contact allergens, and only a detailed prompt was tested. Further research is needed to assess the effectiveness of ChatGPT in a wider range of allergens and explore the distinction between using a variety of levels of specific questions in order to enhance its effectiveness in clinical practice.

## 6. Acknowledgements

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