

POTENTIAL OF LARGE LANGUAGE MODEL CHAT GENERATIVE PRE-TRAINED TRANSFORMER IN CONSTRUCTING MULTIPLE CHOICE QUESTIONS ON PHARMACOLOGY OF DIABETES

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ABSTRACT

Objective: Creating high-quality multiple-choice questions (MCQs) is often a time-consuming and demanding process. This text aims to explore whether Chat generative pre-trained transformer (ChatGPT) can generate satisfactory MCQs on the topic of "pharmacology of diabetes."

Methods: The ChatGPT, a large language model based on GPT technology, has been utilized as an artificial intelligence tool to create various types of MCQs. The answers generated by ChatGPT have been recorded for further analysis.

Results: ChatGPT generates pharmacology MCQs covering cognitive and affective domains with correct answers. It creates MCQs of varying difficulty, corrects mistakes, and can frame negative type and case-based MCQs. It generates three or four options unless specified otherwise.

Conclusion: ChatGPT can quickly generate high-quality MCQs but has limitations, including a lack of medical expertise, context comprehension, answer verification, and visual aid production. Teachers should validate ChatGPT-generated MCQs for accuracy and reliability, ensuring they align with the curriculum and include necessary context and visual aids for better comprehension.

Keywords: Chat generative pre-trained transformer, Multiple-choice question, Pharmacology, Diabetes, Medical education.

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INTRODUCTION

Diabetes is a medical condition characterized by elevated blood glucose levels due to inadequate insulin production or ineffective insulin use. This can result in serious complications, such as heart disease, kidney damage, and vision loss. Effective diabetes management requires lifestyle adjustments and regular monitoring of blood glucose with health-care support.

Chat generative pre-trained transformer (ChatGPT), an AI language model introduced in November 2022, has gained widespread popularity and is being explored for its applications in medical education, writing, and research. One unexplored area is its potential to generate high-quality multiple-choice questions (MCQs) for medical subjects [1-3].

In this article, we aim to investigate whether ChatGPT is capable of producing high-quality MCQs or not, considering that the process of creating such questions demands significant time and effort.

METHODS

As an artificial intelligence tool, the large language model (LLM) ChatGPT was utilized. We tasked it with formulating various types of MCQs. The answers provided by ChatGPT were cross-verified using the standard textbook of Pharmacology, Goodman, and Gilman's: The Pharmacological Basis of Therapeutics [4].

Constructing high-quality MCQs requires time and effort. In this write-up, we seek to explore whether ChatGPT can construct MCQs that are of good quality or not. To this end, an account was created at <https://chat.openai.com/auth/login>, and ChatGPT was asked to create MCQs on the pharmacology of diabetes that varied in difficulty levels and addressed different learning domains. The result was generated.

RESULTS

The examples of the MCQs created by ChatGPT are shown below:

Example 1

Write an MCQ on the pharmacology of diabetes that addresses the recall domain of learning. MCQ should have three options.

ChatGPT's response

- [1] Which of the following medications works by stimulating insulin secretion from the pancreatic beta cells?
- A. Metformin
 - B. Glipizide
 - C. Pioglitazone

Answer: B (Glipizide)

Explanation: Glipizide is a sulfonylurea medication that works by stimulating insulin secretion from the pancreatic beta cells. Metformin works by reducing glucose production in the liver and improving insulin sensitivity. Pioglitazone works by increasing insulin sensitivity in peripheral tissues.

Example 2

Write an MCQ on the pharmacology of diabetes based on comprehension of knowledge. MCQ should have four options.

ChatGPT's response

- [1] Which of the following medications is a DPP-4 inhibitor used for the management of Type 2 diabetes?
- A. Metformin
 - B. Insulin glargine
 - C. Sitagliptin
 - D. Exenatide

Answer: C (Sitagliptin)

Explanation: Sitagliptin is a DPP-4 inhibitor that works by increasing insulin secretion and decreasing glucagon secretion, which results in lower blood glucose levels. Metformin is a biguanide medication that works by reducing glucose production in the liver and improving insulin sensitivity. Insulin glargine is a long-acting insulin used to control blood glucose levels. Exenatide is a GLP-1 receptor agonist that works by increasing insulin secretion, decreasing glucagon secretion, and slowing gastric emptying.

Example 3

Write an MCQ on the pharmacology of diabetes based on the affective domain. MCQ should have 4 options.

ChatGPT's response

- [1] Which of the following factors is most important when choosing a medication for the management of diabetes?
- Cost of the medication
 - Side effects of the medication
 - Mechanism of action of the medication
 - Availability of the medication

Answer: B (Side effects of the medication)

Explanation: The affective domain of learning deals with attitudes, values, and emotions. When choosing a medication for the management of diabetes, the most important factor to consider is the potential side effects of the medication. This is because side effects can significantly impact a patient's quality of life and adherence to treatment. While cost, mechanism of action, and availability are also important considerations, they are secondary to the potential side effects of the medication.

Example 4

Write six MCQs on the pharmacology of diabetes with varying difficulty levels. MCQ should have four options.

ChatGPT's response

- [1] Which of the following medications is a GLP-1 receptor agonist used for the management of Type 2 diabetes?
- Metformin
 - Insulin lispro
 - Dulaglutide
 - Pioglitazone

Answer: C (Dulaglutide)

Explanation: Dulaglutide is a GLP-1 receptor agonist that works by increasing insulin secretion, decreasing glucagon secretion, and slowing gastric emptying. Metformin, insulin lispro, and pioglitazone have different mechanisms of action.

- [2] Which of the following medications works by inhibiting the breakdown of GLP-1, resulting in increased insulin secretion and decreased glucagon secretion?
- Canagliflozin
 - Sitagliptin
 - Exenatide
 - Rosiglitazone

Answer: B (Sitagliptin)

Explanation: Sitagliptin is a DPP-4 inhibitor that works by inhibiting the breakdown of GLP-1, resulting in increased insulin secretion and decreased glucagon secretion. Canagliflozin, exenatide, and rosiglitazone have different mechanisms of action.

- [3] Which of the following medications is a SGLT2 inhibitor that works by inhibiting glucose reabsorption in the kidneys?
- Metformin
 - Insulin glargine
 - Canagliflozin
 - Pramlintide

Answer: C (Canagliflozin)

Explanation: Canagliflozin is a SGLT2 inhibitor that works by inhibiting glucose reabsorption in the kidneys, leading to increased urinary glucose excretion and decreased blood glucose levels. Metformin, insulin glargine, and pramlintide have different mechanisms of action.

- [4] Which of the following medications is a meglitinide used for the management of Type 2 diabetes?
- Acarbose
 - Repaglinide
 - Liraglutide
 - Nateglinide

Answer: B (Repaglinide)

Explanation: Repaglinide is a meglitinide medication that works by stimulating insulin secretion from the pancreatic beta cells. Acarbose works by inhibiting carbohydrate absorption in the gut. Liraglutide is a GLP-1 receptor agonist. Nateglinide is another meglitinide medication.

- [5] Which of the following medications is a TZD used for the management of Type 2 diabetes?
- Metformin
 - Acarbose
 - Rosiglitazone
 - Exenatide

Answer: C (Rosiglitazone)

Explanation: Rosiglitazone is a TZD medication that works by increasing insulin sensitivity in peripheral tissues. Metformin, acarbose, and exenatide have different mechanisms of action.

- [6] Which of the following medications is a combination of a DPP-4 inhibitor and a biguanide used for the management of Type 2 diabetes?
- Canagliflozin/Metformin
 - Linagliptin/Metformin
 - Exenatide/Liraglutide
 - Glimepiride/Pioglitazone

Answer: B (Linagliptin/Metformin)

Explanation: Linagliptin/Metformin is a combination medication that contains a DPP-4 inhibitor and a biguanide. Canagliflozin/Metformin is a combination of a SGLT2 inhibitor and a biguanide. Exenatide/Liraglutide is a combination of two GLP-1

Example 5

Write a negative type of MCQ on the pharmacology of diabetes.

ChatGPT's response

- [1] Which of the following medications is NOT indicated in patients with Type 1 diabetes?
- Metformin
 - Glipizide
 - Sitagliptin
 - Canagliflozin

Correct Answer: B) Glipizide

Explanation: Glipizide is a sulfonylurea medication that stimulates insulin secretion from the pancreas and is only indicated for use in patients with Type 2 diabetes. It is contraindicated in patients with Type 1 diabetes, as their pancreas cannot produce insulin. The other options listed are all medications commonly used to treat Type 2 diabetes.

Example 6

Write a case-based MCQ

ChatGPT's response

Case: John is a 62-year-old male who presents to his primary care physician with complaints of increased thirst, frequent urination, and blurred vision. His fasting blood glucose is measured at 160 mg/dL and HbA1c is 8.5%. He has a history of hypertension and hyperlipidemia, and currently takes lisinopril and atorvastatin.

[1] Which of the following medication classes would be most appropriate to add to John's treatment regimen to help manage his diabetes?

- A) Alpha-glucosidase inhibitors
- B) GLP-1 receptor agonists
- C) DPP-4 inhibitors
- D) SGLT-2 inhibitors

Correct Answer: B) GLP-1 receptor agonists

Explanation: In this case, John has newly diagnosed Type 2 diabetes with an HbA1c of 8.5%. Given his cardiovascular risk factors, a GLP-1 receptor agonist would be a good choice as it can help lower blood glucose while also providing cardiovascular benefits. Alpha-glucosidase inhibitors may be considered, but are typically reserved for use in patients with milder hyperglycemia. DPP-4 inhibitors and SGLT-2 inhibitors could also be considered, but GLP-1 receptor agonists have been shown to have greater cardiovascular benefits.

DISCUSSION

From the examples, the following points are worth noting regarding ChatGPT's MCQ framing ability: ChatGPT can generate MCQs on the pharmacology of diabetes, including explanations for each option, covering different levels of the cognitive and affective domains. The suggested answers for all MCQs were correct, as seen in Examples 1, 2, and 3. This AI can create MCQs of varying difficulty levels, as shown in Example 4. In one case, there were two correct answers (options B and D), but ChatGPT initially identified only one (option B). After being informed of the mistake, ChatGPT apologized and corrected it by acknowledging both correct answers. When asked the same question again, it provided the correct answer. ChatGPT can effectively frame negative-type MCQs by highlighting negative words in capital letters, such as NOT and EXCEPT, demonstrating good MCQ framing capacity (Example 5). It can generate case-based MCQs effectively (Example 6). ChatGPT can create MCQs with varying numbers of options (3 or 4) when specified. If not specified, the MCQs typically have four options.

Furthermore, when ChatGPT was asked about its potential to frame MCQs for pharmacology as a medical subject, it gave below mentioned answer:

"As an AI language model, I have the ability to generate MCQs on various topics, including pharmacology – a medical subject." However, it is important to note that the quality and accuracy of the MCQs generated by ChatGPT may vary and should not be solely relied upon for medical assessment or education purposes.

The MCQs generated by ChatGPT are based on the vast amount of data; it has been trained on, including medical literature and resources, but they should always be reviewed and validated by a qualified medical professional before being used for educational or assessment purposes. In addition, it is crucial to ensure that any MCQs are in line with the curriculum or guidelines of the specific educational institution or organization.

Overall, while ChatGPT has the potential to generate MCQs for pharmacology and other medical subjects, it is important to exercise

caution and consult with qualified medical professionals for accurate and reliable medical education and assessment materials."

In general, LLMs garnered massive interest with ChatGPT's launch in late 2022, drawing over 1 billion users in 90 days. With the introduction of GPT-4 in March 2023, capable of handling multimodal inputs, such as text, images, and speech, these models could revolutionize medicine, though the irreplaceable human touch in healthcare must be preserved [5].

CONCLUSION

Although ChatGPT can quickly generate a large number of high-quality MCQs, it should not be relied on without caution. Its limitations include a lack of medical expertise, difficulty in comprehending context, inability to verify answers, and inability to produce visual aids. Therefore, teachers must ensure that ChatGPT-generated MCQs are valid and reliable. While ChatGPT can be a useful tool for generating MCQs, it should not replace the expertise of qualified medical professionals. Teachers should review and validate the MCQs to ensure they align with the curriculum and meet necessary standards. In addition, providing context and visual aids is important for enhancing comprehension and accuracy.

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AUTHORS' CONTRIBUTIONS

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CONFLICTS OF INTEREST

None.

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