

## PERSPECTIVE

# Relief in Sight? Chatbots, In-baskets, and the Overwhelmed Primary Care Clinician

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## ABSTRACT

The recent emergence of publically facing artificial intelligence (AI) chatbots has generated vigorous discussion in the lay public around the possibilities, liabilities, and uncertainties of the integration of such technology into everyday life. As primary care clinicians continue to struggle against ever-increasing loads of asynchronous, electronic work, the potential for AI to improve the quality and efficiency of this work looms large. In this essay, we discuss the basic premise of open-access AI chatbots such as CHATGPT, review prior applications of AI in healthcare, and preview some possible AI chatbot–assisted in-basket assistance including scenarios of communicating test results with patients, providing patient education, and clinical decision support in history taking, review of prior diagnostic test characteristics, and common management scenarios. We discuss important concerns related to the future adoption of this technology including the transparency of the training data used in developing these models, the level of oversight and trustworthiness of the information generated, and possible impacts on equity, bias, and patient privacy. A stepwise and balanced approach to simultaneously understand the capabilities and address the concerns associated with these tools will be needed before these tools can improve patient care.

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In modern healthcare, particularly in primary care, clinicians face increasing volumes of asynchronous, electronic, non-visit care (NVC).<sup>1</sup> This administrative burden, including time spent documenting in the electronic health record (EHR), is a known contributor to clinician burnout<sup>2,3,4</sup> and waste in the healthcare system.<sup>5,6</sup> Electronic NVC, including triaging patient concerns, communicating test results, completing prior authorizations, patient forms, and other documentation requests, and responding to patient inquiries for education and clarification, is cognitively demanding, and time-consuming.<sup>7,8</sup> And, despite—and perhaps because

of—the promises and advancements in health information technology,<sup>9</sup> the administrative burden stemming from mundane EHR tasks has grown over time.

Artificial intelligence (AI) has many potential applications in healthcare delivery<sup>10</sup> and in particular to primary care.<sup>9</sup> Most common use cases have focused on risk prediction, diagnostics, and identifying gaps in population health management.<sup>9</sup> Less often and without convincing benefit of improved patient outcomes in primary care, AI has been leveraged to provide medical advice and triage,<sup>10</sup> analyze remote patient monitoring data, provide digital health coaching, and assist with EHR chart review and documentation. However, desperately busy clinicians are eagerly, yet cautiously, awaiting the specific application of AI to the daunting clinical work of the contemporary EHR in-basket.

In November 2022, ChatGPT, the AI-enabled chatbot created by the OpenAI research laboratory (2023, San Francisco, CA), became available to the public free of charge and with great fanfare and debate in the popular press. ChatGPT is a variant of the Generative Pre-training Transformer (GPT) language model that was designed for conversational language translation, question answering, and language generation.<sup>10</sup> According to ChatGPT (query: “describe ChatGPT for a scientific audience” query, January 2023), “it is trained on a large dataset of human conversations in order to learn the structure and dynamics of natural language conversations, and can be used to generate human-like responses to input text...ChatGPT has been shown to perform well on various tasks related to conversational language generation, including dialogue generation, question answering, and language translation. It has also been used to build chatbots and other conversational systems that can interact with users in a natural and engaging way.”

ChatGPT and other AI-enabled chatbots have many potential applications in healthcare. According to ChatGPT itself (query: “write a scientific essay of 700 words on the potential uses, pros, and cons of ChatGPT in primary care in-basket management”), “ChatGPT has the potential to be a useful tool for providing information, answering questions, and triaging patients” (see [Appendix](#) for the full text of the response). It provides two specific use cases, similar to other AI-enabled chatbots used in healthcare applications<sup>9</sup>: (1) as a virtual assistant for providing general health information and answering common questions; and (2) as a triage tool, helping to prioritize and route patients to the appropriate

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level of care. It notes the advantages of using a chatbot, specifically its round-the-clock availability and ability to handle large volumes of inquiries. Importantly, the AI algorithm acknowledges that the chatbot may not accurately diagnose or treat patients, information shared may not be accurate or up to date, and the advice provided is not a substitute for the judgement of a trained medical professional.

We propose that ChatGPT—and similar AI-enabled chatbots available to the busy clinician at the point of care—can also help in more immediate and actionable, even if less exciting, ways by tackling the in-basket. Specifically, these tools can be used by clinicians and other team members to support a wide range of clinical and non-clinical communications that dominate the in-basket and thereby improve efficiency, reduce cognitive load, and relieve administrative burden. For example, these tools can be used to quickly generate text to notify a patient of both normal and abnormal test results (Table 1). Apart from distinguishing normal and abnormal, AI-enabled chatbots can provide information and education on self-management of chronic disease or explain abnormal, but innocuous laboratory abnormalities. A query such as “compose result letter, elevated cholesterol, need to work on diet” will inform the patient of their abnormal results and subsequently provide them with specific dietary guidance on managing hyperlipidemia. Not only would using the AI-enabled chatbot to communicate results save time—as the chatbot “thinks” and rapidly produces written output that is grammatically sound and correctly spelled—it can decrease the cognitive energy of summarizing and translating those results into a patient-centered electronic communication. While the application of these tools to the outbox (what the clinician writes to the patient) appears promising, one can imagine the possibility of the AI-enabled chatbot directly proposing responses to in-basket (what the patient writes to the clinician) queries, helping to triage messages by priority, improve the comprehensiveness of the patient response, and decrease the clinician’s cognitive load.

The AI-enabled chatbot-generated response may also provide higher quality patient communication and can even be used to generate communications in different languages, a gap in most current EHR systems that may deepen health-care disparities among patients with limited English proficiency. Similarly, these tools might be used to efficiently generate common letters such as work excuses, summaries of patient health events or conditions, prior authorization requests, responses to patient concerns, and appeals of insurance denial for a requested medication or service (Table 1). A recent study by Ayers et al.<sup>11</sup> bolsters the argument that AI-enabled chatbot-generated communication is at least comparable in quality to clinician-generated communication.

Open AI chatbots that can provide real-time and actionable clinical knowledge and patient-centered information remain under development, but clearly hold great potential. When faced with a diagnostic or therapeutic dilemma,

clinicians may seek peer guidance or search for information across multiple search engines and reference tools. Yet not all clinicians have expert colleagues within immediate reach, and the process of searching for clinical information, particularly in the face of diagnostic uncertainty, can be frustrating, time-consuming, and fruitless. AI-enabled chatbots offer a potentially new and better tool for the primary care clinician seeking quick and reliable decision support. For example, Table 1 presents sample queries related to the clinical features of statin myalgias (matching the patient’s electronically communicated description to classic symptoms), considering the sensitivity and specificity of previously completed physical exam maneuvers (when re-evaluating a prior diagnosis of radiculopathy), and reviewing patient-specific considerations prior to prescribing HIV pre-exposure prophylaxis. In the current state, result notification messages, responses to questions related to previously evaluated symptoms, or responses to questions related to the management of known conditions would appear to most readily benefit most from chatbot assistance, with perhaps even a majority of these messages able to be improved with the assistance of an AI-enabled chatbot.

Before clinicians join the ranks of others toying with AI-enabled chatbots in their professional pursuits, and more importantly, before chatbots assume a prominent role in in-basket management, several practical, ethical, and legal considerations must be addressed. These include assuring the trustworthiness of the source data used in information generation; the need for oversight of the accuracy and relevance of chatbot outputs; the development of processes that would assure equity and safety of the care provided; and the need to safeguard patient privacy. Each of these concerns has additional downstream implications for liability, scope of practice, and medical device and algorithm regulation.

The underlying source data for Open AI models are undisclosed to the end user, so it is unclear the degree to which training data included comprehensive, accurate, and reliable health information with sufficient granularity to inform clinicians’ decision-making. As such, all output must be carefully considered and reviewed by the clinician. Focused attention must be paid to the clinical accuracy of the content (for example, in Table 1, describing creatinine 1.5 as “normal” while at the same time representing “stage 3a chronic kidney disease”; or telling a patient with type 1 diabetes to have a “small snack or drink” to bring down their blood sugar to a safe level or to not use their insulin pump when fasting for a test). Information provided may also be irrelevant to the specific patient being addressed, as the AI-enabled chatbot uses publicly sourced data and is agnostic to any individual patient health information that may be available in the EHR (for example, in Table 1, when asked to tell a patient that their electrolytes were normal, ChatGPT assumed we were referring to sodium, potassium, and calcium; this may not be the case).

**Table 1 AI Chatbot–Generated in-basket Responses, February 2023**

Input	Output
patient letter with advice on diet and exercise for diabetes	<p>Dear [patient],</p> <p>I hope this letter finds you well. As you know, diabetes is a chronic condition that requires careful management to prevent complications such as heart disease, kidney disease, blindness, and amputations. One of the most important ways to manage your diabetes is through a healthy diet and regular physical activity</p> <p>Here are some specific recommendations for diet and exercise to help you manage your diabetes:</p> <p>Diet:</p> <ul style="list-style-type: none"> <li>• Choose foods that are high in fiber, such as whole grains, fruits, vegetables, and legumes. These foods can help improve blood sugar control and may also lower your risk of heart disease</li> <li>• Limit your intake of added sugars, such as those found in sweetened beverages, desserts, and processed snacks. These types of foods can cause blood sugar spikes and contribute to weight gain</li> <li>• Include protein-rich foods, such as lean meats, poultry, fish, beans, and tofu, in your meals and snacks. Protein can help regulate blood sugar and keep you feeling full and satisfied</li> <li>• Avoid or limit foods that are high in saturated and trans fats, such as fried foods, fast food, and processed snacks. These types of fats can increase your risk of heart disease</li> </ul> <p>Exercise:</p> <ul style="list-style-type: none"> <li>• Aim for at least 150 min of moderate-intensity exercise, or 75 min of vigorous-intensity exercise, per week. This can include activities like brisk walking, jogging, cycling, swimming, or dancing</li> <li>• If you're new to exercise or have any physical limitations, start slowly and gradually increase your intensity and duration over time</li> <li>• Make sure to check your blood sugar before and after exercising, and carry a quick source of sugar (such as glucose tablets or hard candy) in case your blood sugar drops too low</li> <li>• If you're unsure about what types of exercise are appropriate for you, talk to your healthcare provider or a certified diabetes educator</li> </ul> <p>I hope these recommendations are helpful as you work to manage your diabetes. If you have any questions or concerns, please don't hesitate to reach out to me or your healthcare team</p>
letter to patient informing them of new diagnosis of type 2 diabetes, with recommendations on lifestyle therapy and starting metformin (titrate from 500 mg daily to 1000 mg BID, increasing by 500 mg per day every 2 weeks)	<p>Sincerely, [Your Name]</p> <p>Dear [Patient],</p> <p>I am writing to inform you of your recent laboratory results and the diagnosis of Type 2 Diabetes. Your blood glucose levels were found to be elevated, indicating that your body is not effectively utilizing insulin. This is a common condition that can be managed with lifestyle changes and medication</p> <p>I recommend that you begin lifestyle therapy to help manage your diabetes. This includes maintaining a healthy diet with a focus on whole grains, fruits, vegetables, and lean protein, as well as regular exercise. Losing weight, if you are overweight, and avoiding smoking and excessive alcohol consumption can also help to improve your condition</p> <p>In addition to lifestyle changes, I will also be prescribing metformin for you. Metformin is a medication that helps to lower blood glucose levels by decreasing the amount of glucose produced by the liver and increasing the sensitivity of cells to insulin. I will be starting you on a low dose of 500 mg daily, and increasing the dose by 500 mg every 2 weeks until we reach the target dose of 1000 mg twice daily</p> <p>It is important to follow your recommended treatment plan and to schedule regular follow-up appointments with me to monitor your progress. I will also be providing you with information on how to monitor your blood sugar levels at home</p> <p>Please let me know if you have any questions or concerns. I am available to discuss any questions or concerns you may have</p> <p>Sincerely, [Your Name]</p>

Table 1 (continued)

Input	Output
patient letter informing them of normal CBC, elevated creatinine with new stage 3 CKD, and normal electrolytes. generate this letter in both English and Spanish	<p>Dear [Patient],</p> <p>I am writing to inform you that the results of your recent laboratory tests showed a normal complete blood count (CBC), but an elevated creatinine level. Based on these results, it has been determined that you have stage 3 chronic kidney disease (CKD)</p> <p>It is important to note that your electrolyte levels, including potassium, sodium, and calcium, were all within normal ranges. However, it is important to monitor and manage your kidney disease to prevent it from progressing</p> <p>You may benefit from seeing a nephrologist, a doctor who specializes in treating kidney disease. They can work with you to develop a treatment plan and recommend lifestyle changes to help manage your condition.</p> <p>It is also important to follow your healthcare provider's instructions and take any prescribed medications as directed</p> <p>If you have any questions or concerns about your diagnosis or treatment, please do not hesitate to contact me</p> <p>Sincerely, [Your Name]</p> <p>Estimado [Paciente],</p> <p>Le escribo para informarle que los resultados de sus pruebas de laboratorio recientes mostraron un recuento completo de glóbulos rojos (CBC) normal, pero un nivel elevado de creatinina. Según estos resultados, se ha determinado que usted tiene enfermedad renal crónica (CKD) de grado 3</p> <p>Es importante tener en cuenta que sus niveles de electrolitos, incluyendo potasio, sodio y calcio, estaban todos dentro de los límites normales.</p> <p>Sin embargo, es importante controlar y tratar su enfermedad renal para evitar que progrese</p> <p>Es posible que se beneficie de ver a un nefrólogo, un médico especializado en el tratamiento de la enfermedad renal. Ellos pueden trabajar con usted para desarrollar un plan de tratamiento y recomendar cambios en el estilo de vida para controlar su condición. También es importante seguir las instrucciones de su proveedor de atención médica y tomar cualquier medicamento recetado según lo indicado</p> <p>Si tiene alguna pregunta o inquietud sobre su diagnóstico o tratamiento, no dude en comunicarse conmigo</p>
patient letter with normal CBC, creatinine 1.5 with stage 3a ckd, normal electrolytes	<p>Atentamente, [Su Nombre]</p> <p>Dear Patient,</p> <p>I am writing to inform you that the results of your recent CBC (complete blood count) and creatinine levels are normal. However, your creatinine level is slightly elevated, indicating that you may have stage 3a chronic kidney disease (CKD)</p> <p>It is important to monitor and manage your CKD to prevent further damage to your kidneys. This may involve making lifestyle changes such as eating a healthy diet, exercising regularly, and taking any prescribed medications as directed. It is also important to have regular check-ups with your healthcare provider to monitor your kidney function and address any potential issues</p> <p>Your electrolytes (such as sodium, potassium, and calcium) are within normal ranges at this time. It is important to maintain normal electrolyte levels to ensure proper body function</p> <p>If you have any questions or concerns about your CKD or the management of your condition, please do not hesitate to contact your healthcare provider</p> <p>Sincerely, [Your Name]</p>
instructions to patient with type 1 diabetes on holding mealtime insulin when fasting for a test and monitoring blood sugar closely	<p>Dear Patient,</p> <p>I am writing to provide you with instructions for managing your type 1 diabetes while fasting for a test. It is important to follow these instructions carefully to ensure your safety and the accuracy of the test results</p> <p>When fasting for a test, you will need to hold your mealtime insulin. This means that you should not take any insulin injections or use an insulin pump during the fasting period</p> <p>It is important to monitor your blood sugar levels closely during this time to ensure they do not become too high or too low. You should check your blood sugar levels every 2–4 h using a blood glucose meter. If your blood sugar level becomes too high (above 180 mg/dL), you may need to have a small snack or drink to bring it down to a safe level. If your blood sugar level becomes too low (below 70 mg/dL), you should have a small snack or drink to bring it back up to a safe level</p> <p>If you have any questions or concerns about managing your diabetes while fasting for a test, please do not hesitate to contact your healthcare provider</p> <p>Sincerely, [Your Name]</p>

Table 1 (continued)

Input	Output
prior authorization for mounjaro for type 2 diabetes; patient has obesity, cvd, ckd; tried victoza and farxiga	<p>Dear Insurance Provider,</p> <p>I am writing to request prior authorization for the prescription of Mounjaro for my patient with type 2 diabetes, obesity, and comorbidities including cardiovascular disease (CVD) and chronic kidney disease (CKD)</p> <p>Mounjaro is a prescription weight loss medication that has been shown to be effective in improving blood sugar control and promoting weight loss in individuals with obesity and type 2 diabetes. It works by inhibiting the reuptake of serotonin, which can help reduce appetite and improve satiety</p> <p>My patient has tried other medications, including Victoza and Farxiga, but has not achieved adequate blood sugar control and weight loss. Mounjaro has the potential to significantly improve my patient's blood sugar control and overall health outcomes, particularly in light of their comorbidities</p> <p>I respectfully request that you consider approving this medication for my patient. Please find attached the necessary medical documentation to support this request</p> <p>Thank you for your time and consideration</p> <p>Sincerely, [Your Name]</p>
Describe the clinical features of statin induced myalgias	<p>The clinical hallmarks of statin myalgias are:</p> <ol style="list-style-type: none"> <li>1. Muscle pain or weakness: Statin myalgias can cause a wide range of symptoms, from mild muscle aches to severe muscle weakness. The muscle pain or weakness can affect any muscle in the body, but it is often most severe in the legs, hips, and shoulders</li> <li>2. Myositis: Inflammation of muscle which can occur in the context of statin use, it can be usually accompanied by muscle enzymes elevation like CK or aldolase</li> <li>3. Fatigue: Myalgias can cause a feeling of general muscle weakness or fatigue, making it difficult to perform daily activities</li> <li>4. Elevation of creatinine kinase: Statins can cause increase in creatinine kinase which is a muscle enzyme, it is however not specific and it can be elevated in many other conditions as well</li> <li>5. Rhabdomyolysis: Rarely but statins can cause a serious condition called rhabdomyolysis, which is characterized by the breakdown of muscle tissue and the release of muscle proteins into the bloodstream. It can cause muscle pain, weakness, and dark-colored urine</li> </ol> <p>It is important to note that these symptoms usually occur within the first few weeks of starting statin therapy and can improve or resolve with discontinuation of the medication. However, if the symptoms persist or worsen, it is important to contact a healthcare professional. Not all patients taking statins will experience myalgias and it's important to weigh the benefits and risks of the therapy with your doctor, as well as monitoring for any other side effects</p>
What is the sensitivity and specificity of the straight leg raise for diagnosing lumbar radiculopathy?	<p>The sensitivity and specificity of the straight leg raise (SLR) test for diagnosing lumbar radiculopathy can vary depending on the study, population, and the criteria used to diagnose lumbar radiculopathy</p> <p>A systematic review published in the journal Spine in 2011 reported that the sensitivity of the SLR test for lumbar radiculopathy ranges from 78–88%, while the specificity ranges from 37–96%. It means that a positive SLR test results in 78–88% chance of having lumbar radiculopathy but it can also have false positive results 37–96% of the time</p> <p>It's important to note that the accuracy of the SLR test can also be influenced by the experience of the clinician performing the test and the patient's ability to follow the instructions properly. Other examination techniques, such as a thorough history and physical examination, as well as nerve conduction studies or imaging studies, like MRI, should also be used to confirm the diagnosis of lumbar radiculopathy</p>



Table 1 (continued)

Input	Output
<p>what tests do i need to order before prescribing HIV PreP?</p>	<p>When prescribing pre-exposure prophylaxis (PrEP) for HIV prevention, it is important to ensure that the patient is not currently infected with HIV and does not have any contraindications to the medication</p> <p>The following tests are typically recommended before prescribing PrEP:</p> <ul style="list-style-type: none"> <li>• HIV test: To confirm that the patient is HIV-negative. This is typically done with a rapid antibody test, which can provide results within minutes, or a nucleic acid test (NAT), which can detect the virus within a few days of infection</li> <li>• Hepatitis B screening: This is to make sure the patient is not infected with hepatitis B, as some of the medications used in PrEP can interact with certain anti-hepatitis B drugs</li> <li>• Renal function test: To make sure that the patient’s kidneys are functioning normally, as some of the medications used in PrEP can be associated with changes in kidney function. A creatinine clearance test is done for this</li> <li>• Pregnancy test: If the patient is female, a pregnancy test is done to make sure that the patient is not pregnant</li> </ul> <p>It’s important to note that these tests will be carried out at the initial screening and after that patient will need to be monitored for any potential side effects, adherence to medication, repeat lab work and be tested for HIV every three months</p> <p>It’s important to discuss the patient’s sexual and drug use history, including any symptoms of HIV infection, as well as any other medical conditions they have, with the patient before prescribing PrEP. A patient should also be counseled on the risks and benefits of taking PrEP and the importance of consistent and correct use of the medication, as well as on other preventive measures such as condom use and regular HIV testing</p>
<p>respond to my patient at high risk for fracture, who I recommended take Alendronate, who is worried about atypical femur fractures and osteonecrosis of the jaw and is afraid to start the drug. encourage her to start the drug. provide statistics on risk (query updated, May 31, 2023)</p>	<p>Dear [Patient’s Name],</p> <p>I understand your concerns about starting Alendronate and the potential risks associated with it. However, I want to assure you that the benefits of this medication for someone at high risk for fractures outweigh the potential risks in most cases. Let me provide you with some statistics to help you make an informed decision</p> <p>Atypical femur fractures are a known but rare side effect of long-term use of bisphosphonates like Alendronate. The incidence of atypical femur fractures is estimated to be around 1.78 cases per 100,000 person-years of exposure to bisphosphonates. In other words, the risk of experiencing this type of fracture is relatively low</p> <p>On the other hand, the risk of developing a typical osteoporotic fracture, such as a hip or spine fracture, is significantly higher for individuals with osteoporosis. By taking Alendronate, you can reduce the risk of these typical fractures by approximately 50%. It is important to note that typical fractures are far more common than atypical fractures</p> <p>Regarding osteonecrosis of the jaw, this is an extremely rare side effect associated with bisphosphonate use, including Alendronate. The reported incidence of osteonecrosis of the jaw is approximately 1 in 10,000 to 1 in 100,000 patients who take oral bisphosphonates. While the risk exists, it is minimal compared to the benefits of preventing fractures in high-risk individuals</p> <p>It’s essential to remember that every medication has potential side effects, but the decision to prescribe Alendronate is based on the assessment of your individual fracture risk and the potential benefits of the treatment. If you are at high risk for fractures, Alendronate can significantly reduce that risk and improve your quality of life</p> <p>To minimize the potential risks associated with Alendronate, it’s important to follow the prescribed dosage and take the medication as instructed. Regular check-ups and monitoring by your healthcare provider will help ensure that any side effects are detected early, allowing for prompt intervention if necessary</p> <p>I encourage you to have an open and honest discussion with your healthcare provider about your concerns. They will be able to provide you with personalized advice based on your specific medical history and circumstances. Remember, the ultimate goal is to prevent fractures and maintain your bone health</p> <p>Take care, and feel free to reach out if you have any further questions or concerns. Your health and well-being are our top priorities</p> <p>Best regards, [Your Name] [Your Title/Position]</p>

It is important to ensure that the language and content of information generated by any AI algorithm are as free of bias and judgement as possible. Episodes of AI-generated information containing bias or stereotypes are well documented<sup>12</sup> and much work is needed before we can be assured that the clinical application of AI does not worsen or exacerbate existing healthcare disparities. Reassuringly, ChatGPT has been programmed with some recognition of its own limitations, for example, returning an error prompt when asked to “notify patient they are HIV positive and counsel on safe sex.” In the current state, clinicians and other healthcare providers must ensure that all communicated information is both accurate and appropriate to a patient’s plan of care to safeguard against safety concerns. The potential for an AI-enabled chatbot to propagate medical misinformation, an increasingly pervasive problem in the public domain, should also be a significant concern to clinicians, healthcare organizations, and regulatory bodies.

It is important to assure that patient confidentiality is maintained and no protected health information or patient identifying information is entered into the chatbot. But this also means that the model cannot learn from patient-specific data, which limits its scope of application and ability to learn from patient contexts and experiences. If the chatbot lives outside of the EHR, an informative clinical context that is specific to the patient and the situation is not available to the chatbot when generating its response. Included information remains limited to what is provided by the user and available in the public domain and should remain so until clear protocols are in place to safeguard the confidentiality of any patient data which is used.

AI has a wide range of applications in healthcare and can facilitate, support, and improve EHR-based tasks.<sup>13</sup> Most previously described AI applications are not actionable by individual clinicians; instead, they rely on informaticists, data scientists, and programmers to enhance currently available EHR capabilities. The responsibility of assuring safeguards are applied to this technology must not fall to individual clinicians. Healthcare organizations, medical specialty societies, and medical boards will need to quickly develop protocols and best practices for employing these tools in ways that address concerns related to trustworthiness, patient privacy, and equity. While there is likely a future where AI-enabled algorithms augment, enhance, and complement clinician activities, that future is not yet in sight. Yet, there are also small, but meaningful, ways that clinicians can make their lives easier now with the targeted application of AI technology. AI-enabled chatbots—when used carefully—provide an example of how open-sourced AI resources might someday support clinicians drowning in a sea of documentation requirements, patient messages, and other EHR tasks.

## APPENDIX

*User:* write a scientific essay of 700 words on the potential uses, pros, and cons of ChatGPT in primary care.

*ChatGPT:* ChatGPT is a variant of the popular language generation model GPT-3 (Generative Pre-trained Transformer 3) that has been specifically designed for use in chatbot applications. In primary care, ChatGPT has the potential to be a useful tool for providing information, answering questions, and triaging patients.

One potential use of ChatGPT in primary care is as a virtual assistant for providing general health information and answering common questions. For example, a patient could ask ChatGPT about the symptoms of a particular illness, and the chatbot would be able to provide a list of common symptoms and possibly even recommend self-care measures or suggest seeking medical attention if necessary. This could be especially useful for patients who may not have easy access to a primary care physician or who may be hesitant to visit a clinic for fear of COVID-19 exposure.

Another potential use of ChatGPT in primary care is as a triage tool, helping to prioritize and route patients to the appropriate level of care. For example, ChatGPT could ask patients a series of questions about their symptoms and use their responses to determine whether they should be seen by a primary care physician, a specialist, or whether their condition can be managed through self-care or telemedicine. This could help to reduce wait times and ensure that patients receive the most appropriate care for their needs.

There are several potential benefits to using ChatGPT in primary care. One of the most significant is the ability to provide 24/7 access to health information and support. Patients can ask ChatGPT questions at any time of day, and the chatbot can provide prompt and accurate answers, reducing the need for patients to wait until regular office hours to seek medical advice.

Another benefit of ChatGPT is its ability to handle large volumes of inquiries. With a chatbot, patients can ask as many questions as they want without having to worry about taking up too much of a healthcare provider’s time. This can be especially useful in situations where patients may have a lot of questions or concerns about their health, or when they are seeking information about a rare or complex condition.

However, there are also some potential drawbacks to using ChatGPT in primary care. One concern is that the chatbot may not be able to accurately diagnose or treat patients. While ChatGPT can provide useful information and recommendations, it is not a substitute for a trained medical professional. Patients who rely on ChatGPT for medical advice may not receive the same level of care as they would from a human healthcare provider.

Another potential drawback is the risk of patients becoming overly reliant on ChatGPT for medical advice. If patients rely too heavily on the chatbot, they may be less likely to seek medical attention when it is necessary, which could lead to delays in treatment and potentially serious consequences.

Overall, ChatGPT has the potential to be a useful tool in primary care, particularly for providing information and triaging patients. However, it is important to recognize its limitations and ensure that patients continue to receive the appropriate level of care from trained medical professionals.

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#### Declarations:

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**Conflicts of Interest** None.

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