Pros and cons of using artificial intelligence Chatbots for musculoskeletal rehabilitation management

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ABSTRACT

Artificial intelligence (AI), specifically Large Language Models (LLMs), which focus on the interaction between computers and human language, can influence musculoskeletal rehabilitation management. AI chatbots (e.g., ChatGPT, Microsoft Bing, Google Bard) are a form of LLMs designed to understand, interpret, and generate text similar to what is produced by humans. Since their release, chatbots have triggered controversy in the international scientific community, including when they have passed university exams, generated credible scientific abstracts, and shown potential for replacing humans in scientific roles. The controversies extend to the field of musculoskeletal rehabilitation. In this Viewpoint, we describe the potential applications and limitations, and recommended actions for education, clinical practice and research when using AI chatbots for musculoskeletal rehabilitation management, aspects that may have similar implications for the broader health care community. *J Orthop Sports Phys Ther 2023;x(x):xxx-xxx.*

Key words: artificial intelligence, ChatGPT, clinical reasoning, Microsoft Bing, Google Bard, musculoskeletal pain.

Artificial intelligence (AI) is a field of study that combines computer science and robust datasets to enable and/or improve problem-solving. Large Language Models (LLMs) focus on how computers and human language interact. Recent progress has seen algorithms capable of understanding *and* generating advanced and meaningful language.[6] Several AI companies have released AI chatbots, including ChatGPT, Microsoft Bing, Google Bard, with a user-friendly interface available for free. AI chatbots are designed to understand, interpret, and generate text similar to that produced by humans.[5] Modern LLMs predict the possibility of a specific word or phrase in relation to the context of the words around it, and can automatically and instantaneously generate human-like responses to the user's prompt—a notable improvement over previous iterations.[5,6]

Simple AI tools are already used for analysing data, classifying, and predicting in musculoskeletal rehabilitation. Adding sophisticated AI chatbots may foster new health care solutions and further inform decision-making.[10] However, the "game-changing" abilities of AI chatbots may also result in unplanned challenges to musculoskeletal rehabilitation that deserve further discussion, especially with respect to education, clinical practice, and research. In this Viewpoint, we describe the potential applications and limitations, as well as recommended actions for education, clinical practice and research when using AI chatbots for musculoskeletal rehabilitation.

AI CHATBOTS: POTENTIAL APPLICATIONS AND LIMITATIONS

We present the strengths, weaknesses, opportunities, and threats of AI chatbots in FIGURE 1. AI chatbots provide both pros and cons when addressing health care education, practice, and research scenarios in musculoskeletal rehabilitation (TABLE 1).

In education,[2,8] AI chatbots can assist in writing essays and dissertations, and in preparing research papers. AI chatbots can provide personalized learning experiences by offering tutorials for complex concepts (e.g., pain neurophysiology) and virtual teaching assistance during musculoskeletal rehabilitation clinical training. AI chatbots can help students manage their time with reminders and scheduling for assignments.

In clinical practice,[2,8] AI chatbots can assist providers' clinical reasoning, suggesting, for example, which symptoms to investigate (e.g., pain, disability), which tests to perform (e.g., provocation, mobility) and influencing treatment decisions. Chatbots can accelerate administrative and clinical workflow activities such as scheduling musculoskeletal rehabilitation appointments, contacting insurance companies, and coordinating patient records such as daily notes and discharge summaries. They can support tailoring of patient care, facilitate communication (e.g., simplifying healthcare messages into patient's language), and improve adherence to home programs (e.g., through reminders for home exercises).

In research,[2,8] AI chatbots can improve scientific writing efficiency by drafting, correcting grammar, formatting, and proofreading articles, enhancing language and readability. Chatbots can efficiently generate a literature review by summarizing research papers, assisting data collection and analysis, generating research questions, computer codes, and statistical analyses. AI chatbots can also improve researcher productivity by overcoming language barriers for non-native English-speaking authors.

Nonetheless, AI chatbots have several limitations[2,8] that can also influence musculoskeletal rehabilitation. Chatbots increase the risk of plagiarism and copyright disputes over the material copied from other documents. They may provide inaccurate sources/references and may produce credible – albeit - incorrect answers. Chatbots can

also 'hallucinate'—inventing terms when information is limited—generating superficial and misleading answers, mainly when simple prompts are posed in contrast to detailed ones or when the previous versions of Generative Pre-trained Transformer (GPT) model (e.g., GPT-3.5) are adopted compared the new ones (e.g., GPT-4). Chatbots can generate repetitive and redundant text, lacking in creativity, originality, and analysis when deliberating complex health care concepts. While some AI chatbots are constantly updated, others (e.g., ChatGPT), having been trained by scraping data up to 2021, have restricted knowledge, potentially limiting content generation at risk for dated recommendations. Lastly, AI chatbots are free for now, but there is a possibility that some versions (e.g., Professional and Premium editions) will likely convert to pay-as-you-go in the future, introducing inequalities between low and high-income countries.

AI CHATBOTS: RECOMMENDED ACTIONS

Since their release, AI chatbots have generated controversy in the international scientific community, stimulating debate on their use among scientists and researchers.[7] The concerns reflect AI chatbots' abilities to: 1) achieve passing or near passing scores of the United States Medical Licensing Examination, which is a set of three standardized tests of expert-level knowledge required for medical licensure in the United States;[4] and 2) generate scientific abstracts capable of fooling human reviewers that were unable to differentiate between AI-generated and original abstracts.[3] Because AI chatbots can influence education, clinical practice and research, we recommend taking immediate actions to mitigate potential negative outcomes (**TABLE 2**).

Education-based Actions: We support the development and implementation of academic principles and guidelines for use of AI chatbots (and other platforms).

Promoting a culture of ethics and integrity; developing of real-time, ongoing, critical thinking skills; promoting practical-based assessments; and training will help students. For faculty, we advocate for continuous digital literacy training to promote the appropriate adoption of LLMs and AI chatbots. While generating content for their teaching sessions or quizzes for examining the knowledge of students, faculty must have the skills to analyse opportunities and limits of using chatbots. These actions may reduce areas that may become overly dependent on technology such as essay writing, journaling self-reflection, and developing formative knowledge. Guidelines may also prevent cheating on unsupervised examinations, projects and papers. Partially limiting the use of AI chatbots in learning activities could foster novel collaborations between students, educators, and peers, promoting interpersonal skills that are fundamental for future practice.

Clinical Practice-Based Actions: We promote the development and implementation of clinical guidelines addressing the use of AI chatbots involving security and privacy controls and creating policies on professional responsibilities for use of LLMs. The first step is to ensure that the transparent use of AI chatbots will not perpetuate or exacerbate existing biases, inequalities or injustices in health care, thus respecting the autonomy, dignity and rights of patients and healthcare professionals. We advocate for a culture that sees AI chatbots as a support tool, accessed with proper training, support and resources, but not at the expense of the therapeutic alliance, respect, and compassion. These guidelines may reduce legal and health-related risks, critical issues regarding privacy violations, data security, that can also protect from cyber-attacks. It is presently unknown how AI chatbots manage, transmit and store sensitive patient information used during conversations.

Research-Based Action: We recommend the development and promotion of international guidelines and standards to define accepted uses of AI chatbots, and ongoing study of the true value that chatbots bring to a research setting. LLMs have the capacity to generate research quickly. We encourage the a culture of quality over quantity, in which AI chatbots are used as supportive tools, and where researchers are trained in how to use chatbots well. Our recommendations reflect those of several publishing groups who have declared concerns about how AI chatbots may undermine international authorship criteria defined by the International Committee of Medical Journal Editors and the Committee on Publication Ethics guidelines.[1,9] We seek to deter data fabrication, ghostwriting, and the production of unreliable, non-original, low-quality papers or grants, which threaten the credibility of the musculoskeletal rehabilitation academic community.

SUMMARY

Technology will continue to evolve. Responsible members of the musculoskeletal rehabilitation community, each in our specific fields (education, clinical practice and research), must work together towards a common goal: creating and developing guidelines on the ethical use of AI chatbots. Adopting guidelines will help (a) balance the positive and negative aspects of each AI tool, by integrating its use for specific purposes (TABLE 3) and (b) ensure people remain at the centre of musculoskeletal health care. As much as AI chatbots can be trained to acquire specific skills in educational, clinical, and research fields, they cannot replace humans' hard competencies (e.g., use of therapeutic touch) and people skills (e.g., verbal and non-verbal communication).

KEY POINTS

Findings:

- AI chatbots are an artificial intelligence model designed to understand, interpret and generate text that is similar to natural human language.
- AI chatbots can influence educational, clinical and research fields in musculoskeletal rehabilitation.

Implications:

- There is a need for internationally-agreed principles, guidelines and rules to guide the ethical implementation of AI chatbots in the musculoskeletal rehabilitation field.

Cautions:

- AI chatbots (and other artificial intelligence platforms), as acknowledged to date, have potential benefits and limitations that demand conscientious use.

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TABLE 1. Example of artificial intelligence chatbots pros and cons when addressing healthcare education, practice, and research scenarios in musculoskeletal rehabilitation.

Scenario	Examples AI Chatbots Pros	Examples of AI Chatbots Cons
Education A university student has to prepare an essay on the rehabilitation of a patient with an anterior cruciate ligament injury and asks AI chatbots for help.	Provide a vast amount of information on the topic of the essay (e.g., explanations, advice, guidance). Support the organization of the essay (e.g., tips on structure, identifying key topics to be covered, establishing a logical flow). Help the expansion and development of ideas (e.g., broadens the point of view, finds new perspectives, generates additional and innovative ideas). Enable grammatical review and correction (e.g., suggests writing style and sentence structure, identifies common errors and suggests fluent and accurate alternatives).	Difficulty attributing intellectual property to students' writing and evaluating the expected learning outcomes. Prevent the development of critical thinking skills, self-reflection, knowledge, and expertise. Risk of becoming overly dependent on technology with long-term negative consequences, threatening independent/critical thinking. Limit students' interactions with educators and peers, influencing the development of interpersonal skills fundamental for their future practice.
Clinical Practice Clinician manages a patient with non-specific neck pain during a direct access and asks AI chatbots for help.	Provide useful background information to gain a general understanding of the clinical condition (e.g., risk factors, red flags, prognostic factors) Suggest which elements to investigate during history taking (e.g., pain intensity) and physical examination (e.g., mobility and strength test) useful to formulate the diagnosis. Advice on treatment strategies (e.g., manual therapy, therapeutic exercise and education) and outcome measures (e.g. self-administered questionnaires).	Possible inaccuracies and obsolescence in guiding clinicians with incorrect and not-updated information, thus deviating the practice from the best available evidence. Lack of direct clinical experience, lack of in-depth understanding of clinical nuances, complexity and individual patient issues. Limited understanding of the patient's context, providing general answers that do not consider the individual characteristics, preferences, and previous experience of the patient. Progressive impoverishment of meta competence, clinical reasoning, problem-solving and decision-making skills needed for interpreting the complexity of patients with MSK pain; the

	Support the treatment process planning (e.g., identify intervention priorities, set realistic goals, suggest treatment frequency).	long-term consequences on the rehabilitative profession still need to be understood.
<u>Research</u> A researcher has to produce a grant proposal for research on shoulder tendinopathies and asks AI chatbots for help.	Provides a broad overview of the topic (e.g., helps to understand the most relevant and original aspects of the grant) Stimulates creativity by offering suggestions on possible innovative methodological approaches to be used (e.g., study designs) to address the challenges of the grant Supports the structuring of the proposal and its development (e.g., suggests the arrangement of sections and clear, concise and coherent writing of the arguments presented). Performs linguistic review (e.g., provides word or sentence alternatives, corrects punctuation and improves sentence structure and clarity).	Progressive underdevelopment of the researchers' skills, originality, creativity and writing ability, critical analysis and creative thinking. Need to adapt the information provided that may not fully fit the specific requirements of the grant proposal and the particular needs of the funder or the research organization. Possible inaccuracy and/or lack of evidence and data to support arguments presented, contributing to the production of unreliable, non-original, low-quality grant proposal Lack of review and support from colleagues, mentors or professionals in the field, thus preventing more in-depth feedback, specific advice and critical evaluation of the grant proposal.

Legend: AI, Artificial Intelligence; MSK, Musculoskeletal

TABLE 2. Recommended actions when adopting artificial intelligence chatbots in musculoskeletal rehabilitation.

Field	Actions	Approach
Education	Defining and developing academic principles and guidelines in curricula.	Addressing AI chatbots allowed and not-allowed use (e.g., in which circumstances), indicating the rules when declaring its transparent use and implementing a surveillance system detecting failures towards established guidelines.
	Promoting a culture of ethics and integrity among students.	Raising students' awareness of the risks of using AI chatbots, which can be trained on poor-quality data sets and generate biased or misleading learning.
	Coaching students with challenging tasks.	Continuously valuing, promoting and assessing students' critical appraisal skills, soft competencies, independent thought and self-directed learning abilities.
	Avoiding only writing assignments and diversifying the evaluation models rendering them multi-dimensional.	Including the use of oral presentations, multiple-choice exams, open-ended questions, practical assessments, simulated scenarios, collaborative group projects and supervised patient treatments in combination with scientific writing.
	Continuously training the digital literacy of the faculty members on AI chatbots-related issues.	Promoting awareness of the academic community capable of detecting further potentialities and pitfalls early.
	Training students in all programs regarding the potentialities and risks of AI chatbots.	Promoting their full awareness, updating their knowledge and digital literacy according to the progressive advancements in the field.
Clinical Practice	Implementing and testing AI chatbots for clinical practice.	Guaranteeing adequate security and privacy, accuracy and reliability of its data to avoid misuse in clinical settings.
	Stimulating professional and scientific societies to regulate AI chatbots.	Identifying policies and guidelines on the use of AI chatbots, the limits of application by defining the deontological boundaries and the professional responsibilities in case of litigation.
	Fostering a culture among clinicians on AI chatbots.	Identifying AI chatbots as a support (e.g., workload lowering) rather than a replacement for them, keeping their expertise and clinical judgement central.
	Training clinicians on AI chatbots.	Providing support and resources, involving policymakers and promoting the patients' education on the benefits and risks

		of adopting AI chatbots in MSK rehabilitation, increasing their awareness of this artificial intelligence tool.
	Continuing to promote the importance of clinician's soft skills.	Emphasizing the quantity and quality of human interactions that cannot be guaranteed in the clinical setting using AI chatbots.
	Outlining the clinician's core competencies.	Highlighting skills and tasks and those that can be delegated to AI chatbots while embracing technological advancements.
Research	Developing and promoting internationally shared guidelines and standards on AI chatbots.	Defining whether to add AI chatbots as an author, its use during the drafting and the threshold of acceptable text AI chatbots generated in manuscripts; stimulating cooperation with other institutions (e.g., journal editors and publishers) to implement artificial intelligence plagiarism-checker tools.
	Researching the stakeholders' perspective on AI chatbots.	Investigating frequency (e.g., with quantitative surveys) and experience (e.g., by qualitative interviews and focus groups) of AI chatbots use among stakeholders (e.g., students, faculty members, clinicians and researchers) in MSK rehabilitation.
	Studying performance, accuracy and reliability of AI chatbots.	Investigating the comparative effectiveness of AI chatbots vs humans in performing educational (e.g., correcting tasks), clinical (e.g., interpreting patient findings) and research (e.g., performing a peer-review) tasks in MSK rehabilitation.
	Analyzing the educational, clinical and research impact of AI chatbots in MSK rehabilitation.	Investigating longitudinally (e.g., with prospective observational studies) the maintenance or degradation of core competencies after using AI chatbots among stakeholders (e.g., students, faculty members, clinicians and researchers).
	Training researchers on the benefits and risks of adopting AI chatbots in research.	Stimulating reflection on their responsibilities as authors and awareness on its ethical use; encourage them to disclose its adoption (e.g., in acknowledgements or methods section) reporting details (e.g., name of the tool, version, extension) in their research outputs (e.g., grant proposal, scientific articles).

Promoting a culture of research quality (e.g., high standards) rather than quantity (e.g., "publish or perish")'.	Continuing to stimulate the development of curiosity, heuristic, creativity and imagination among researchers despite AI chatbots.

Legend: AI, Artificial Intelligence; MSK, Musculoskeletal.

TABLE 3. Examples of artificial intelligence tools with possible applications in musculoskeletal rehabilitation.

Aim	Name	Source*
AI Writing assistance	DeepL Write	https://www.deepl.com/write
	Istatex	https://instatext.io
	Grammarly	https://app.grammarly.com/
	QuillBot	https://quillbot.com/
	Trinka	https://www.trinka.ai/
	Grammar Check	https://www.grammarcheck.ai
	ProWritingAid	https://prowritingaid.com
	Sentence Checkup	https://sentencecheckup.com
	Slick Write	https://www.slickwrite.com/#!home
AI Translation	DeepL Translator	https://www.deepl.com/translator
	Google Translate	https://translate.google.com/
	Bing Translator	https://www.bing.com/translator
	Reverso Translation	https://www.reverso.net/text-translation
	Taia	https://taia.io
	Systran Translate	https://na-translate.systran.net
	Smartling	https://www.smartling.com
	SmartCat	https://www.smartcat.com/machine-translation/
	TextUnited	https://www.textunited.com
	Language I/O	https://languageio.com
AI Writing generator	ChatGPT	https://chat.openai.com/
	Copy.ai	https://www.copy.ai/
	Texta	https://www.texta.ai/
	ChatSonic	https://writesonic.com/chat
	Writier	https://writier.io/
	Writerly	https://writerly.ai/
	Google Bard	https://bard.google.com/?hl=en
	Perplexity	https://www.perplexity.ai
	Jasper.ai	https://www.jasper.ai
	Jenni	https://jenni.ai
AI Research assistant	Elicit	https://elicit.org
	Research rabbit	https://www.researchrabbit.ai
	Inciteful	https://inciteful.xyz
	R Discovery	https://discovery.researcher.life
	Scholarcy	https://www.scholarcy.com
	Scite	https://scite.ai/home
	Notion	https://www.notion.so
	Wizdom	https://www.wizdom.ai
	SciSpace	https://typeset.io
	Consensus	https://consensus.app
AI Detector	DetectGPT	https://detectgpt.com
	GPTZero	https://gptzero.me

	Orginality.ai	https://originality.ai
	Plagibot	https://plagibot.com
	Writer	https://writer.com/ai-content-detector/
	Copyleaks	https://copyleaks.com/ai-content-detector
	Content at Scale	https://contentatscale.ai/ai-content-detector/
	Sapling	https://sapling.ai/ai-content-detector
	Turnitin	https://www.turnitin.com/products/features/ai-writing-detection
	Compilatio	https://www.compilatio.net/en
AI Image creator	Canva	https://www.canva.com/ai-image-generator/
	Nightcafe	https://creator.nightcafe.studio/text-to-image-art
	Starry AI	https://starryai.com/app/my-creations
	Craiyon	https://www.craiyon.com
	DALL·E 2	https://openai.com/dall-e-2
	Fotor	https://www.fotor.com/features/ai-image-generator/
	Pixray	https://replicate.com/pixray/text2image
	Bing Image Creator	https://www.bing.com/create
	Midjourney	https://docs.midjourney.com
	Jasper Art	https://www.jasper.ai/art

Legend: AI, Artificial Intelligence.

* Web links accessed on 5th September 2023

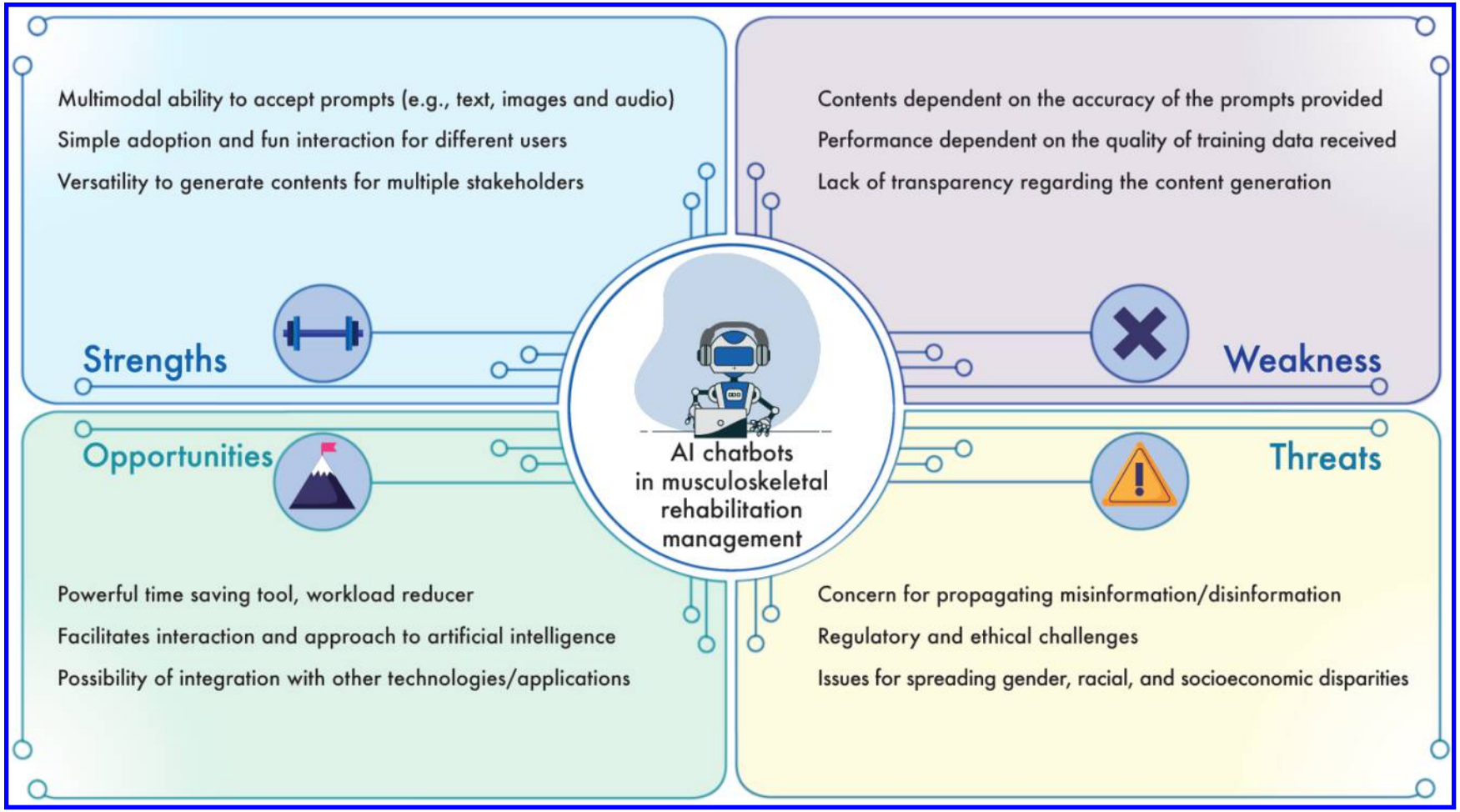

FIGURE 1. SWOT (strengths, weaknesses, opportunities, and threats) analysis of artificial intelligence chatbots for musculoskeletal rehabilitation.