

The Relationship of Artificial Intelligence Technology and Employee Employment, Performance and Career Development: An Interview Based Research in Clinical Programming Area

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ABSTRACT

In 1956, the concept of “artificial intelligence” (AI) was first proposed. The public release of ChatGPT by OpenAI on Nov 30, 2022 marked a significant step forward in language model technology. Several previous studies have revealed either positive or negative relationship between AI technology and employees' employment, performance and career development. These researches also explained how the impact might be effective and provided suggestions to both employees and employers. However, none of the research results have been evaluated in the clinical new drug development scientific programming area, which generally includes both statistical programming and data programming. Their informative guidance could be ineffective without further research specifically conducted in this area. Through interviews, we plan to study the impact of AI technology on employees' employment, performance, and career development in the field of clinical new drug development and scientific programming. To erase the selection bias of our results which might be subjective to the population of interviewees, we plan to focus on interviewers in clinical programming area with intensive enough working experience to lead the interview. The interviewee will be an artificial intelligence system, with the results being interpreted by human beings. Besides the impacts brought by AI technology, our results also explore some possible suggestions for both scientific programmers and AI developers in the future.

INTRODUCTION

Artificial Intelligence (AI), which has been developed since 1956, is now applied across various industries, including healthcare, finance, education, and more. In the field of clinical new drug development, there has been much discussion about a potential surge in the adoption of AI technologies by scientific programmers, although this has not yet occurred. After reviewing some existing research on the impacts of AI technology on human beings, we believe there might be significant shifts in employment patterns, performance measures, and career development paths once AI technologies are integrated into programmers' work. This is based on the assumption that the acceptance of these changes should be consistent among practitioners from all industries. We also assume that the implementation of AI in the scientific programming field should not differ significantly from other industries – for example, repetitive work with a clear process might be among the first tasks to be reshaped or replaced by AI. If AI technology will eventually come in, we hope everyone to be well prepared and quickly adapted to the changes. Moreover, it's better to be also clear which working area or position might be impacted at first. To achieve both of these objectives – to experience the impacts in advance and in a near real environment - we plan to launch research with insights from both scientific human-being programmers and AI in clinical new drug development scientific programming area. Moreover, we will also ask AI to provide its ideas to support scientific programmers with these changes because supporting human beings will also be the role and responsibility of AI in the future. The interview results and interpretations will be included. Some short-term suggestions and areas for long-term discussion will also be attached at the end of this paper.

BEFORE RESEARCH START

RESEARCH DESIGN

Here is a list of preplanned steps for this research. We will go through them one by one in this paper. Step 1 will be mentioned very shortly in introduction section. Step 2-3 will be listed in before research start section. Step 4-7 will be listed in method selection section. Step 8 will be listed in results and interpretation section, Step 9 will be listed in results and interpretation section.

1. Understand the history of artificial intelligence.
2. Read existing researches on AI impacts to employment, performance and career development.
3. Select major influence factors for further use.
4. Identify both top hot areas and jobs with AI embedded successfully and their main characteristics boosting a successful AI implementation.
5. Analyze the similarity of the way of work between a scientific programmer (SP) or data scientist (DS) and a practitioner in these areas.
6. Find out the most similar piece of work to proceed an interview with AI.
7. Interview with senior programmers to transfer major influence factors into questions of interviewers' interests.
8. Interview with AI in a selected working area of SP or DS with questions from human being and answers from AI.
9. Outline a fiction of AI first step deeply into SP job.

RESEARCH REQUIREMENT

Senior scientific programmers are responsible for Step 4-6 and act as interviewee in Step 7. The major responsibility of senior scientific programmers is to use human intelligence to analyze the similarity of work and then use human reasoning to identify one working area that might be the first steps for AI to come in. The second responsibility is to transfer influence factors including employment, psychology, technique, development etc. which are terms from human resource management area into a list of questions from scientific programmers for AI to answer.

An interviewers who should be adept in talking with AI will use the question list from senior programmers to perform the interview with AI. The process will involve back and forth trainings to AI in several rounds' talks. AI interviewers will also connect to senior programmers to find the most appropriate way to ask questions and collaborate with senior programmers to get reasonable answers. AI interviewers will also read AI answers and make a summary of interpretation.

AI models, specifically the GPT-3 model developed by OpenAI, will be used for the AI interview.

HUMAN RESOURCE MANAGEMENT MODULES OF INTEREST

Talent development is one of the most important reasons for this research. Employee employment, performance and career development are three areas in which most of talents may pay attention, which in human resources management modules refer to candidate selection, performance management, occupation competence and talent development. For every step in the whole research, we will put our consideration firstly on these modules and secondly transfer them to talents related questions. How to be the best of all candidates and get the Job? How to be the top at your position and prepare for the next? How to bring in your career motivation?

EXISTING RESEARCHES ON AI IMPACTS ON EMPLOYEE

Based on the results from previous research by Guanglu Xu et al. ^[1], a list of both negative and positive impacts to employment, psychology and behaviors are attached in table 1 with major influence factors to be used to conduct the interview.

Impacts of AI on Employee	Major Influence factor Description
Negative impacts on employment	Replacement by AI Reduced demand for low skilled employees Increased Income gaps between high skilled and low skilled

Positive impacts on employment	Increased demand for high skilled labor Correlated with employee income growth New products and services with new occupation emerging
Negative impacts on psychology and behavior	Disappointed due to unemployment caused by AI Negative emotion triggered by AI Harm employee's healthy Increased Job insecurity, turn over intention, cynicism, depression, job burnout Negatively related to job satisfaction, organizational commitment
Positive impacts on psychology and behavior	Increased skill requirements for creativity and human-machine collaboration Increased job performance by increasing growth-need strength

Table 1 AI Impacts - Major Influence Factors

METHOD SELECTION

LOOK INTO AREA IN OTHER INDUSTRY WITH AI BEING EMBEDDED

After reviewing AI development history, we summarize a list of hot areas for AI in table 2 as the selected areas for further analysis.

Industry	AREA
Manufacturing	Predictive equipment maintenance, intelligent product detection, etc.
Logistics	Intelligent handling, etc.
Customer Service	Precision marketing, intelligent after-sales service, etc.
Healthcare	NLP (natural language processing) in medical coding, etc.
Image generator	A follower of the genre, not a pioneer

Table 2 Industries and Areas Where AI has been Coming

ANALYZE THE SIMILARITY

We analyze all areas in table 2 and then summarize a list of similarities of all in table 3 for further research use.

Category	Similarity
AI can impact or replace	1. Repetitive low-level tasks – AI can generate derivative designs through AIGC; 2. Accurate/clear demand – AI can schedule planning, produce process optimization; 3. Large amount of data - AI can find insights faster and more accurately.
AI unlikely to replace	1. High-level tasks – where need pioneer, expertise, etc.; 2. Complex demands – where need strong interpersonal communication skills and emotional resonance; 3. Boss – people have to assume legal responsibility.

Table 3 Similarities in all Areas with AI in

PICK UP ONE SIMILAR AREA FROM PROGRAMMING WORKING SCOPE

DM Programming Medical Monitoring Listing (MML) is selected due to the following findings.

1. Well organized with standard EDC/CDASH data structure – easy to be identified
2. For medical monitoring purpose only – clear demands
3. A repetitive work – regularly run through clinical trial
4. No statistical analysis needs involved
5. No further SDTM and ADaM related consideration

TRANSFER INFLUENCE FACTORS TO QUESTIONS OF INTEREST

After interview with senior programmers, we generated a list of 8 questions to ask AI in table 4. Most of them area related to impacts of AI or from influence factors listed in table 1. One question is about similarity to help analogize between industries. One question about technique for talent in technique areas to review.

Influence Area	Questions	No.
Similarity	The Impact of DM Programming Free MML on DM Programmer Work might be Same Analogize to the Impact of Checkout-free Shopping on Cashier	1
Employment	Can AI be developed to automate the work of a DMP, specifically tasks related to MML? If so, what potential impact could this have on the employment of DMPs?	2
Employment	What new roles or career opportunities might emerge for DMPs as AI technology continues to evolve?	3
Employment	Could the integration of AI into the DMP's workflow enable them to focus on higher skilled tasks, potentially leading to a higher salary or faster promotions?	4
Phycology and Attitude	How might DMPs feel about the prospect of AI taking over the programming aspects of their work? What could be the reasons for their sentiments?	5
Phycology and Attitude	What are DMPs' perspectives on incorporating AI into their MML tasks?	6
Technique	What are the key technological challenges in implementing AI for DM programming in the context of MML?	7
Development	What resources or learning pathways would you suggest for DMPs who are interested in gaining skills in AI technology?	8

RESULTS AND INTEPRETATION

SIMILARITY QUESTIONS AND ANSWERS

Figure 1 is the answer of AI to question 1 “The Impact of DM Programming Free MML on DM Programmer Work might be Same Analogize to the Impact of Checkout-free Shopping on Cashier”.

As an AI, based on the information I have, I can analyze the differences between the job responsibilities of a Clinical Trial DM (Data Management) Programmer and a cashier in their daily tasks. The roles of a DM Programmer primarily involve clinical trial data management, programming, and analysis, while cashiers are responsible for tasks related to item scanning, sales, and payment processing. However, there are some similarities between the two positions:

1. **Attention to Detail and Accuracy:** Both DM Programmers and cashiers require a high sense of responsibility and accuracy in their work. DM Programmers need to ensure data accuracy, while cashiers need to handle money and transaction information precisely.
2. **Data Handling:** Both positions involve handling data to some extent. DM Programmers deal with complex clinical trial data, while cashiers handle sales and monetary data.
3. **Basic Computer Skills:** Both roles may require basic computer skills. DM Programmers use specific programming languages and tools, while cashiers use cash registers and relevant software.
4. **Interpersonal and Communication Skills:** Both DM Programmers and cashiers need good interpersonal and communication skills. DM Programmers need to communicate with other researchers and scientists, while cashiers interact with customers.

It is important to note that while there are some similarities, the professional requirements and skills for these two positions are significantly different.

Figure 1 Answer of Question 1

EMPLOYMENT QUESTION AND ANSWERS

Figure 2 is the answer of AI to question 2 “Can AI be developed to automate the work of a DMP, specifically tasks related to MML? If so, what potential impact could this have on the employment of DMPs?”.

Yes, AI can be developed to automate certain tasks related to MML (Medical Monitor Listing) performed by DMPs (DM Programmers) in clinical trials. AI technologies, such as machine learning and natural language processing, can process and analyze clinical trial data, generate reports, and create MMLs more efficiently and accurately than manual methods.

The potential impact on DMP employment could be twofold:

1. **Job Redefinition:** AI automation can free DMPs from repetitive tasks, enabling them to focus on higher-skilled data analysis and interpretation.
2. **Workforce Reduction:** As AI enhances efficiency, the demand for DMP positions might decrease, leading to potential workforce adjustments.

While AI can augment DMP roles and improve overall productivity, it may also bring about changes in job responsibilities and workforce dynamics, prompting the need for DMPs to upskill and adapt to AI-driven workflows.

Figure 2 Answer of Question 2

Figure 3 is the answer of AI to question 3 “What new roles or career opportunities might emerge for DMPs as AI technology continues to evolve?”.

As AI technology continues to evolve, several new roles and career opportunities may emerge for DMPs (DM Programmers) in the clinical data management field. These opportunities will likely be driven by the increasing adoption of AI and the need for human expertise to complement AI capabilities. Here are some potential new roles for DMPs:

1. **AI Data Analyst:** DMPs with expertise in clinical trial data and AI technologies can become AI data analysts. They will use AI tools to extract insights from large datasets, identify patterns, and support data-driven decisions.
2. **AI Validation Specialist:** DMPs can take on roles as AI validation specialists, ensuring the accuracy and reliability of AI algorithms and models used in data analysis.
3. **Data Strategy Consultant:** DMPs can become data strategy consultants, assisting organizations in devising data management strategies that integrate AI solutions.
4. **Clinical Data Scientist:** DMPs who acquire skills in data science and AI can work as clinical data scientists, applying their expertise in data analysis and visualization to support clinical trial design and execution.
5. **AI Implementation Specialist:** DMPs with knowledge of AI technologies can work as AI implementation specialists, facilitating the successful integration of AI systems into data management workflows.
6. **AI Ethical and Regulatory Compliance Officer:** With AI's increased use, there may be a demand for DMPs to address ethical and regulatory considerations related to AI in clinical research.
7. **Clinical Trial Innovation Manager:** DMPs can explore roles as clinical trial innovation managers, leading efforts to incorporate cutting-edge AI solutions to optimize trial processes.

Figure 3 Answer of Question 3

Figure 4 is the answer of AI to question 4 “Could the integration of AI into the DMP's workflow enable them to focus on higher skilled tasks, potentially leading to a higher salary or faster promotions?”.

Yes, the integration of AI into the DMP's workflow can enable them to focus on higher-skilled tasks, potentially leading to several career benefits:

1. **Higher Value Contributions:** AI can handle repetitive tasks, allowing DMPs to focus on complex data analysis, interpretation, and strategic decision-making, which can be highly valued by employers.
2. **Enhanced Efficiency:** By utilizing AI, DMPs can achieve higher productivity and meet project goals faster, enhancing their overall performance.
3. **Recognition and Promotion:** Their contributions to higher-skilled tasks might lead to recognition, promotions, and career advancement within the organization.
4. **Competitive Edge:** DMPs who excel at integrating AI into their workflows can position themselves as valuable assets, potentially leading to higher demand and bargaining power.
5. **Skill Development:** Working alongside AI systems enables DMPs to gain expertise in AI technologies, making them attractive candidates for specialized roles.

While AI automation might change the nature of some tasks, the strategic application of AI can elevate DMPs' contributions, leading to increased salary prospects and career growth opportunities.

Figure 4 Answer of Question 4

PHYCOLOGY AND ATTITUDE QUESTION AND ANSWERS

Figure 5 is the answer of AI to question 5 "How might DMPs feel about the prospect of AI taking over the programming aspects of their work? What could be the reasons for their sentiments?".

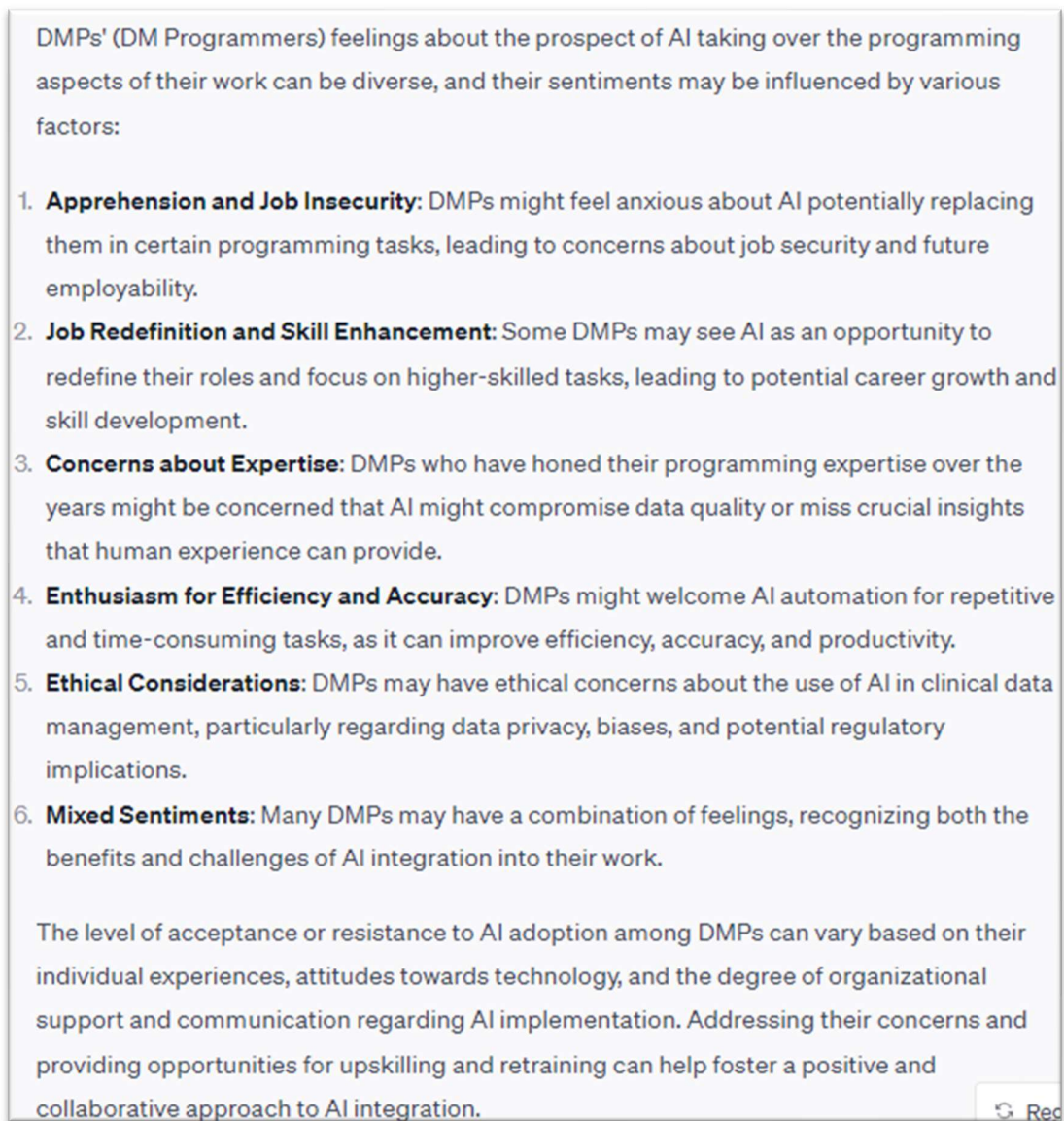


Figure 5 Answer of Question 5

Figure 6 is the answer of AI to question 6 "What are DMPs' perspectives on incorporating AI into their MML tasks?".

DMPs' (DM Programmers) perspectives on incorporating AI into their MML (Medical Monitor Listing) tasks can vary based on individual experiences and attitudes towards AI technology:

1. **Efficiency and Productivity:** Some DMPs may view AI as a tool to enhance efficiency and productivity in MML tasks, allowing them to process and analyze data more quickly and accurately.
2. **Opportunities for Skill Development:** DMPs with a positive outlook might see AI as an opportunity to upskill and gain expertise in AI technologies, making them more valuable in the industry.
3. **Concerns about Job Redefinition:** DMPs may have concerns about how AI integration might redefine their roles. They might want reassurance that AI won't fully replace their critical decision-making and domain expertise.
4. **Accuracy and Quality:** DMPs may appreciate AI's ability to analyze vast datasets and generate reports with higher accuracy, leading to improved data quality in MML tasks.
5. **Ethical Considerations:** Some DMPs might be cautious about potential ethical considerations related to AI use in clinical data management, particularly concerning patient data privacy and regulatory compliance.
6. **Mixed Sentiments:** Many DMPs may have mixed feelings, recognizing both the benefits and challenges of incorporating AI into MML tasks.

To successfully integrate AI into MML tasks, it's essential for organizations to communicate the benefits of AI adoption, address DMPs' concerns, and provide training opportunities to facilitate a smooth transition. Engaging DMPs in the process and incorporating their input can foster a more positive and collaborative approach to AI implementation.

Figure 6 Answer of Question 6

TECHNIQUE QUESTION AND ANSWERS

Figure 7 is the answer of AI to question 7 "What are the key technological challenges in implementing AI for DM programming in the context of MML?".

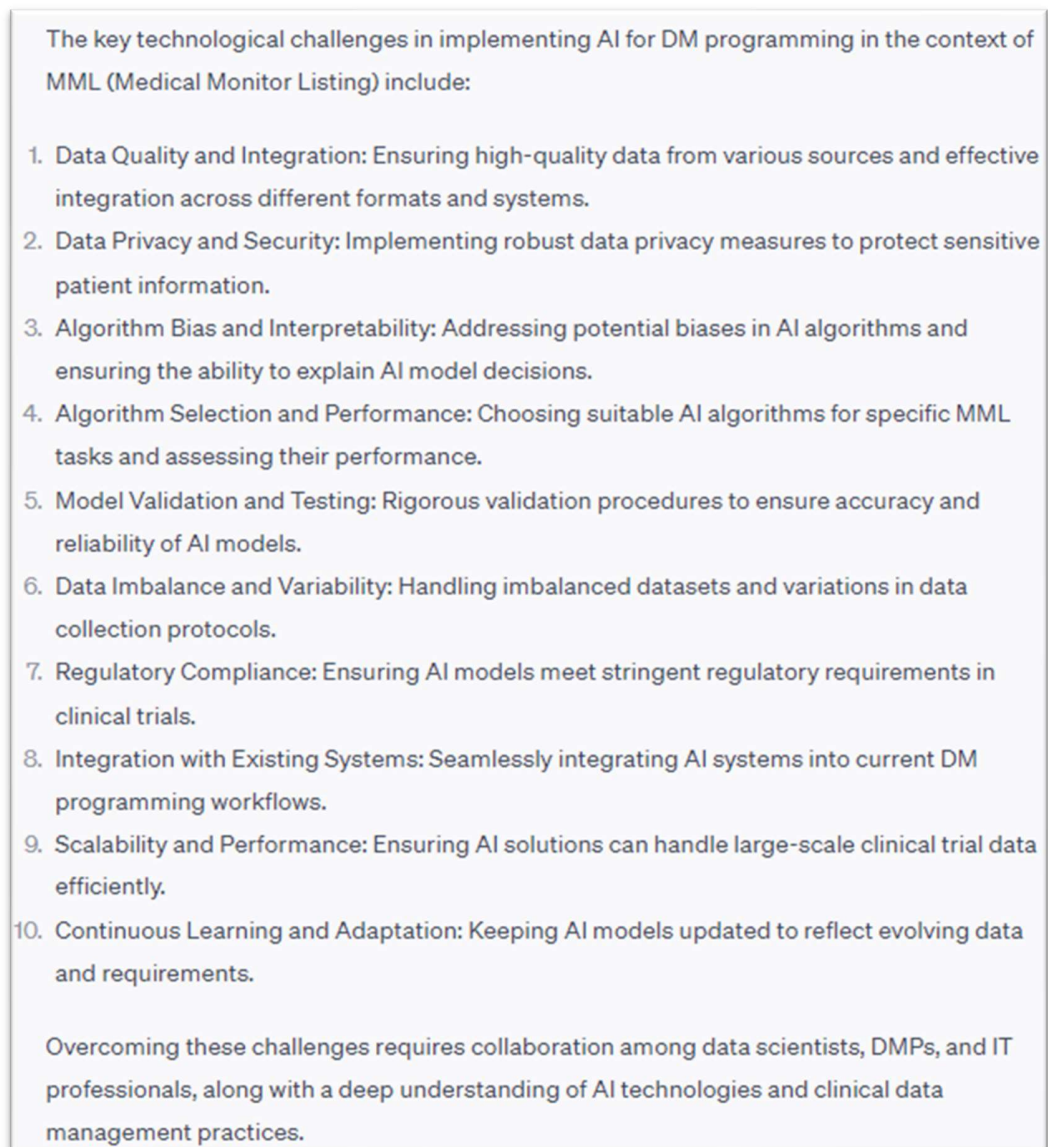


Figure 7 Answer of Question 7

DEVELOPMENT QUESTION AND ANSWERS

Figure 8 is the answer of AI to question 8 “What resources or learning pathways would you suggest for DMPs who are interested in gaining skills in AI technology?”.

For DMPs (DM Programmers) interested in gaining skills in AI technology, the following resources and learning pathways can be helpful:

1. **Online Courses:** Enroll in online platforms like Coursera, Udacity, and edX, which offer AI and machine learning courses taught by experts from top universities and industry professionals.
2. **AI Specializations:** Focus on AI specializations within data science courses, covering topics such as machine learning, deep learning, and natural language processing.
3. **Data Science Bootcamps:** Consider attending data science bootcamps that provide immersive, hands-on training in AI and data science skills.
4. **AI Certification Programs:** Pursue AI certification programs offered by recognized organizations like Google, Microsoft, and IBM to gain credibility and expertise in AI.
5. **AI Libraries and Frameworks:** Learn popular AI libraries and frameworks like TensorFlow, Keras, and PyTorch, which are widely used in AI development.
6. **Online Tutorials and Blogs:** Follow online tutorials and blogs by AI experts to learn about the latest developments and best practices in AI.
7. **AI Community Participation:** Engage with AI communities on platforms like GitHub and Kaggle to collaborate with peers and contribute to AI projects.
8. **AI Hackathons and Competitions:** Participate in AI hackathons and competitions to apply AI concepts in real-world scenarios and gain practical experience.
9. **Books and Research Papers:** Read books and research papers on AI and machine learning to deepen your understanding of the field.
10. **Practice Projects:** Work on personal AI projects or contribute to open-source AI projects to build a strong portfolio and demonstrate your skills to potential employers.

By combining self-paced learning with hands-on practice, DMPs can gradually develop their AI expertise and position themselves for new career opportunities in the evolving landscape of clinical data management.

Figure 8 Answer of Question 8

RESULTS INTEPRETATION

AI outline its Impact on DMPs:

1. AI can automate MML tasks, leading to job redefinition and potential workforce reduction.
2. AI evolution could generate new roles for DMPs (e.g., AI Data Analyst, AI Validation Specialist).
3. AI could allow DMPs to focus on higher-skilled tasks leading to career advancement and skill development.

AI also paraphrase DMPs' perspectives:

1. DMPs may have mixed feelings towards AI either positive or negative depending on his or her own experience (job insecurity increased, expertise to be useless, enthusiasm for efficiency and accuracy etc.).
2. Views on AI in MML tasks may vary (concerns about job redefinition, data privacy, algorithm bias).

AI also point out its challenges and provide learning resources:

1. Challenges: Data quality, algorithm selection, regulatory compliance, scalability.
2. Resources: Online courses, AI certification programs, AI communities, and practical AI projects.

CONCLUSION AND FURTHER DISCUSSION

AI technology will ultimately come to scientific programmers' work. Based on the research results, AI might have huge impacts to employment, bring in psychology pressures and create new career occupation and motivations. We would like to provide four suggestions to scientific programmers: 1. working smarter, not Harder with AI - let AI helps you with your work; 2. Fostering harmony at work with AI as AI has less emotional problems which can help you when you feel upset; 3. Zoom in AI Camera on main hurdles to solve the core issues with AI technology; 4. Develop career embracing AI skills from AI user to AI developer. For potential AI developer in clinical new drug development area, it's better to have further discussions on 1. the purpose of apps whether for a commercial product or a non-profit app by considering both of AI technology high speed self-development nature and business needs; 2. How to develop AI apps in highly regulated industry - refer to GPTzero ^[2] in other industries.

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2. <https://gptzero.me>

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