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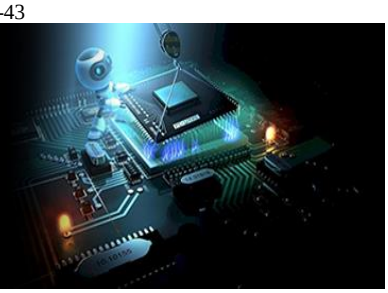

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# Contributions to AI research online diabetes diet consultation using an integrative cloud system

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**Abstract**
Prior to the COVID-19 epidemic, India was home to some of the world's most malnourished populations. Despite having 120 million metric tonnes of grain on hand as of July 1, 2021, our country is shamefully responsible for housing one-fourth of the world's food-insecure people Families who rely on the informal sector for revenue do not have the security to purchase enough healthy food since their earnings are low and unpredictable. The nutritional state of the nation has been further deteriorated as a result of the epidemic, and the impoverished and hungry people of India are bearing the brunt of this long-standing issue.

**Keywords:** Artificial Intelligence, cloud, based, diet and diabetes

## Introduction
The way systems are used to enhance current systems is changing due to new technology in this digital era. It is already well acknowledged that AI significantly enhances patient healthcare by using their electronic health records (EHR). It is necessary to define AI before examining its function and effects on EHR. Generally speaking, "artificial intelligence" (AI) is "the study and creation of computational models and systems with the ability to mimic human intellect in areas such as reasoning and problem solving. Industry is feeling the effects of AI's meteoric rise in popularity, with increased productivity in fields as diverse as manufacturing, healthcare, and web-based technologies (think Google and Amazon).

People are increasingly hoping that AI will one day be able to outperform humans in terms of strength and capabilities. As a result, advancements in artificial intelligence have been shown to have a notable influence on the healthcare industry, particularly in regards to the precision of areas like robotic medical equipment and the prediction of diagnoses. Furthermore, the government of the United Kingdom has positioned artificial intelligence as a "frontrunner" in digital innovation, allocating more than £210 million to a variety of AI-related healthcare breakthroughs, including those that aim to diagnose and prevent new illnesses. Potentially helpful for the NHS would be early illness prevention. Technology like speech recognition also allows physicians to record consultations instead of taking notes.

Begin the essay by highlighting the importance of electronic health records (EHR) in contemporary healthcare and the increasing use of artificial intelligence (AI) to enhance the capabilities of EHR. Outline the major turning points in the development of EHRs, including the shift from paper to digital records and other important developments. Justify HER's broad acceptance by outlining the obstacles and possibilities that prompted its implementation. Find out what machine learning algorithms, NLP, and predictive analytics are, and how they fit into the bigger picture of AI integration with EHR. Examine the interdependencies between these parts and how they help EHR systems with data interpretation, decision support, and analysis. Learn more about the role that AI plays in EHR intelligent data processing. The capacity of machine learning algorithms to sift through mountains of data in search of useful patterns that can guide medical decisions is something to talk about.

## Literature review
N'gbesso, Yolande. (2020). People are increasingly hoping that AI will one day be able

to outperform humans in terms of strength and capabilities. The main objective of this research is to examine the effects and difficulties of combining AI with HER. Requests for software firms to access patients' electronic health records may encounter some resistance. Maybe it's because getting patient records is such a painstaking process. For the advancement of AI integration to EHR, it would have been preferable to embrace a more flexible way to exchanging EHR data. Consequently, a plan for future research will centre on creating and launching a data sharing system that follows industry standards for protocol and data sharing.

Saxena, Pushkarprabhat *et al.* (2023). Data management and analysis, academic research, patient care, and healthcare system improvement are all greatly aided by healthcare informatics, a discipline that combines healthcare with information technology and computer science. Diagnostics, treatment planning, and administrative procedures have all been utterly transformed by the use of AI into healthcare informatics. Potential benefits of artificial intelligence (AI) in healthcare informatics, including enhanced diagnoses, more tailored treatment plans, and more efficient administrative procedures, are the subject of this study. Concerns about algorithmic bias, standardised procedures, data protection, and ethics are among the obstacles. In illuminating the complexities and critical success elements for AI's smooth incorporation into healthcare systems, the research emphasises the revolutionary effects of AI. It makes a big splash in the ever-changing field of healthcare informatics.

Nashwan, Abdulqadir *et al*. (2023). Among the many industries that see AI as a game-changer, healthcare is one of them. Integrating AI into EHRs has the potential to greatly enhance patient care, medical research, and the enrollment process for clinical trials. In this brief message, we discuss how artificial intelligence (AI) has the potential to enhance the efficiency, precision, and speed of cancer clinical trial recruiting. By using machine learning (ML) techniques, AI can automate this process, accurately and swiftly identifying prospective trial participants. Thanks to state-of-the-art encryption methods and differential privacy algorithms, which guarantee data anonymization, this integration has the potential to address several issues, including data privacy and security. A standardized hierarchical layout may also help with the second major hurdle, which is the absence of interoperability and consistent electronic health record formats. Research might be accelerated, clinical trials could be more successful, and more personalized cancer therapies could be possible with the use of AI-automated and -improved recruiting methods.

Lin, Anthony *et al*. (2021). Artificial intelligence (AI) has emerged as a result of persistent progress in data aggregation and computer science, and it has revolutionised the way several modern-day business's function. Automakers have made tremendous AI advancements, ushering in a new era of autonomous automobiles; online retailers utilise AI to analyses customer interest; and pilots use AI to guide aircraft. The healthcare industry has been sluggish to embrace AI, in contrast to other sectors where it has been widely used to boost performance and efficiency. However, artificial intelligence (AI) presents a golden opportunity for healthcare to enhance some aspects of care delivery because to the vast amounts of data generated in electronic health records (EHRs). Here we'll go over some of the present AI in EHRs, some of the limits of AI in EHRs that you should be aware of, and how to go ahead with the integration of AI in healthcare.

Mohammed, Amira *et al*. (2021). The use of electronic health records (EHR) has had a substantial impact on Qatar, but few research have examined how this impact has affected healthcare providers there. The purpose of this study is to evaluate, synthesise, and analyse the impact of electronic health record systems in Qatari healthcare facilities. Healthcare providers in Qatar may feel the effects of potential benefits and drawbacks from evaluating the EHR system's installation. The primary goal is to assess the impact of EHR on healthcare workers. From three private hospitals in Qatar, 210 volunteers were chosen at random. A verified survey was sent out to the doctors, chemists, nurses and nutritionists who work in various Qatari healthcare facilities. The goal is to find out whether the results of switching from paper records and files to an electronic health record system enhanced the efficiency and quality of healthcare workers' job. According to the findings of an online study, the majority of healthcare professionals see the EHR system as a beneficial tool.

## Research methodology

### Artificial Intelligence integrated cloud-based diet consultation for diabetes risk score screening and hepatic steatosis

A diabetes risk screening calculator based on the Indian Diabetes Risk Score (IDRS) was included to the "My Dietitian" app by Mohan *et al*. (2007). With the following link, you can access the Google Play Store and download the application:

### Diabetes risk score screening through the android mobile application

Global Status Report on Non-communicable illnesses 2010 (2011) found that non-communicable illnesses, such as diabetes and cardiovascular disease, accounted for almost two-thirds of all fatalities worldwide. Most of the advice given for dealing with these epidemics focused on changing people's way of life, encouraging them to eat better, be more active, and cut down on things like drinking, cigarette chewing, and drug use. Included in the efficacy analysis of the developed android-based diet consultation mobile app integrated with Artificial Intelligence (AI) to offer personalized consultation to those opting for the same was the Indian Diabetes Risk Score (IDRS) for screening the diabetes risk. Through the URL participants (N=100) were told about the screening and given an online permission form and questionnaire to assess the diet consultation tool. Everyone who took part in the research was a voluntary volunteer over the age of 16. Individuals between the ages of 70 and 88 needed the help of family members in order to use the app. People were measured for anthropometric characteristics, such as waist circumference, in the comfort of their own homes, either alone or with the help of friends and family. In order to separate the participants of the study, the researchers used a convenience sampling approach. Out of all the participants, 100 were selected for the study, and those with a history of diabetes mellitus were removed. Respondents aimed to reach maximum samples within the allotted time since they wanted to engage online due to the COVID-19 epidemic. The user interface of the app, an online questionnaire, tele-briefing, and Quick Messenger Services (QMS) were used to collect data for the thorough dietary consultation. Information on the subject's age,

gender, stature, weight, waist-hip ratio, and past behaviours (such as alcohol use, smoking, and exercise routine) was meticulously documented. The medically undiagnosed diabetic population in India can be better identified and the prevalent risk factors for diabetes can be better categorised according to the severity of the disease with the help of a Diabetes Risk Score that takes into account age, central obesity, family history of diabetes, and physical activity levels during leisure time.

**Impact of cloud based android mobile application on hepatic steatosis**

A group of nine people at intermediate risk for diabetes who were planning to donate their livers participated in an online awareness session that followed the survey. The goal of the session was to decrease hepatic steatosis by active weight control. Their recommendations for a "very low carbohydrate diet" (VLCD, n=4) or a "low carbohydrate diet" (n=5) were based on the desired degree of hepatic steatosis reduction and their level of adherence preferences. The length of time that each individual plan received online assistance ranged from two weeks to a month. The medical recommendation was to assess the liver fat fraction using Magnetic Resonance Imaging (MRI) after the rigorous food programme was completed. Power Bi enabled percentage analysis, standard deviation, paired samples test (t-value), and degree of significance (p-value) were performed using retrospective data acquired from the participants.

**Data analysis**

**Diabetes risk score screening through the android mobile application**

It was thought that the Indian Diabetes Risk Score (IDRS) was a strong predictor of diabetes cases in India. Using four parameters - respondent age, waist circumference measurements, family history of diabetes, and levels of physical activity - this risk score indicated undiagnosed diabetes in the community and was far easier to understand and implement. The lowest possible score was set at 0, while the maximum score was set at 100. A score of 60 or above indicates a potential risk of diabetes, according to Stanley *et al*. (2012). Research conducted by Nagarathna *et al*. (2020) found that IDRS might be used as a clue to identify diabetes individuals at high risk. Major public health problems were exacerbated by the under diagnosis of Type 2 diabetes and pre-diabetes.

**Percentage of diabetes risk based on family history (n=100)**

Results from an analysis of family history data using the IDRS score showed that the proportion of those with at least one parent with diabetes was 54%, far higher than the percentages for those without a family history of diabetes (19%) or for those whose parents had the disease (27%).

**Classification of diabetes risk based on gender (n=100)**

Of the 54% of men who took part, 36.9% were at very high risk of getting diabetes. In contrast, 36.9% of the women who took part in the study were at high risk for the same. There was a 17.1% disparity in men and a 9.1% disparity in females when comparing the total number of individuals to those at high risk. The proposal has been made.

Among those who had their diabetes risk evaluated, 74% had a significantly greater likelihood of developing the disease. Only 7% were deemed to be in the low-risk group, while 19% were deemed to be at moderate risk. The proposal has been made.

The average plasma glucose level was higher for the high-risk group (38% vs. 33% and 29%, respectively) compared to the moderate and low risk groups. When doing the risk-based follow-up tele-consultation, the data was collected. A lot of information has been given.

**Diabetes risk score analysis based on age- high risk category among each age group**

Those between the ages of 51 and 60 had the highest chance of getting Type 2 diabetes, according to an age-based study of diabetes risk scores. A rise in risk score was attributed to a decline in physical activity and a rise in house confinement due to social alienation and the COVID-19 epidemic. According to Visser *et al*. (2020), people's nutritional status was severely affected by the pandemic's social isolation, which was followed by the lockdown or quarantine requirements. Bertrand *et al*. (2021) and Pfeifer *et al*. (2021) both highlighted that people's exercise routines were reported to decrease during the pandemic.

**Diabetes risk score and physical activity**

Participants' levels of physical activity corroborated the association between inactivity and an increased risk of diabetes. This was in line with the findings of the study by Smahel *et al*. (2018), which found that among young people, obesity and other metabolic disorders are caused by a lack of physical workouts, reduced amounts of physical movement as a result of the displacement of dynamic lifestyles and behaviour, and repeated nibbling.

It was discovered that the high-risk participants had an average larger waist circumference for both men and women.

**Impact of cloud based mobile application on weight loss and hepatic steatosis**

The tables below describe the outcomes of the online dietary intervention approaches.

**Profiles of proposed donors opted for online dietary intervention for reduction in body weight and hepatic steatosis through VLCD (Very Low Carbohydrate) diet**

**Table 1:** Profiles of proposed donors opted for online dietary intervention for reduction in body weight and hepatic steatosis through VLCD (Very Low Carbohydrate) diet

| Sl. No. | Gender/ Age (years) | Weight (kg) for 2 weeks 1st 2nd | | 1st review | | | 2nd review | | | | Degree of Hepatic steatosis 1st 2nd | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Energy (kcal) | Protein (g) | Carbohydrate (g) | Fat (g) | Energy (kcal) | Protein (g) | Carbohydrate (g) | Fat (g) | |
| 1. | F/36 | 61 | 58.5 | 1000 | 50 | 170 | 38 | 775 | 31 | 34 | 28 | 14% 8% |
| 2. | F/41 | 68 | 65 | 1000 | 50 | 192 | 44 | 510 | 43 | 44 | 26 | 10% 7.8% |
| 3. | F/40 | 73.6 | 69 | 1399 | 40 | 247 | 58 | 1000 | 41 | 74 | 28 | 8.5% 5.5% |
| 4. | M/38 | 76.3 | 69 | 1599 | 50 | 145 | 45 | 800 | 40 | 34 | 16 | 10% 7.8% |

**Profiles of proposed donors opted for online dietary intervention for reduction in body weight and hepatic steatosis through a low carbohydrate diet**

In order to test the effects of a drastically reduced carbohydrate diet, four people were considered as potential liver donors: three women and one man. Based on the data provided, it was obvious that the participants' hepatic steatosis had been significantly decreased thanks to the frequent follow-up and online instruction.

**Table 2:** Profiles of proposed donors opted for online dietary intervention for reduction in body weight and hepatic steatosis through a low carbohydrate diet

| Sl. No. | Gender/Age (years) | Weight(kg) for 2 weeks 1st 2nd | | 1st review | | | | 2nd review | | | | Degree of Hepatic steatosis 1st 2nd | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Energy (kcal) | Protein (g) | Carbohydrate (g) | Fat (g) | Energy kcal) | Protein (g) | Carbohydrate (g) | Fat (g) | | |
| 1. | F/36 | 73 | 69 | 1400 | 55 | 178 | 52 | 926 | 25 | 62 | 25 | 10% | 7.7% |
| 2. | F/31 | 78 | 69 | 1000 | 55 | 175 | 39 | 840 | 30 | 48 | 22 | 9.4% | 4.5% |
| 3. | F/28 | 70 | 66.5 | 800 | 22 | 74 | 24 | 700 | 25 | 54 | 22 | 10% | 7% |
| 4. | F/39 | 64 | 62 | 1400 | 40 | 288 | 42 | 1000 | 60 | 92 | 26 | 12% | 9% |
| 5. | M/46 | 67 | 69 | 1121 | 50 | 172 | 36 | 800 | 35 | 84 | 24 | 4.2% | 2.6% |

Five people who were about to donate their livers chose to follow a low-carbohydrate diet. Of them, four were determined to be female and one to be male. According to the statistics provided, there has been a notable decrease in both body weight and hepatic steatosis.

Effect of pre and post VLCD (Very Low Carbohydrate Diet) on weight loss and nutrient consumption

In Table 3, we can see the results of the Very Low Carbohydrate Diet (VLCD) in terms of weight reduction and altered dietary habits. A p-value of 0.05 was considered statistically significant. An obvious reduction in body weight (*$p$< 0.05), nutrient intake (energy, protein, carbs, fat), and hepatic steatosis (*$p$< 0.05) after the VLCD diet was shown in the current evaluation.

**Table 3:** Effect of pre and post VLCD (Very Low Carbohydrate Diet) on weight loss and nutrient consumption

| Constructs | | Mean | Std. Dev | Analysis | |
|---|---|---|---|---|---|
| | | | | t | *P* |
| Pre-weight - Post weight | | 4.3500 | 2.1610 | 4.026 | 0.028* |
| Pre-energy - Post Energy | | 478.250 | 240.440 | 3.978 | 0.028* |
| Pre-protein - Post protein | | 13.750 | 6.185 | 4.446 | 0.021* |
| Pre-Carbohydrate Carbohydrate | Post | 142.000 | 25.781 | 11.016 | 0.002* |
| Pre-Fat - Post fat | | 21.750 | 9.535 | 4.562 | 0.020* |
| Degree of hepatic steatosis | | 3.3500% | 1.80647 | 3.709 | 0.034* |
| Pre–to degree of hepatic | | | % | | |
| Steatosis - post | | | | | |

Effect of pre and post Low Carbohydrate Diet on weight loss and nutrient consumption

Table 4 shows the reported importance of weight reduction and altered nutrient intake pattern with reduced carbohydrate diet. A p-value of 0.05 was considered statistically significant. It was clearly shown that after a low-calorie diet, there was a substantial reduction in body weight (*p < 0.05), nutrient intake (energy, carbs, fat), and hepatic steatosis (*p < 0.05). Following a low-carbohydrate diet, there was no discernible difference in protein intake (*p > 0.05).

**Table 4:** Effect of pre and post low carbohydrate diet on weight loss and nutrient consumption

| Constructs | Mean | Analysis | | |
|---|---|---|---|---|
| | | SD | t | *P* |
| Pre-weight - Post weight | 4.1000 | 2.8810 | 3.182 | 0.033* |
| Pre-energy - Post Energy | 291.000 | 158.044 | 4.117 | 0.015* |
| Pre-protein - Post protein | 9.400 | 20.720 | 1.014 | 0.368 |
| Pre CHO - Post CHO | 109.400 | 63.842 | 3.832 | 0.019* |
| Pre-Fat - Post fat | 14.800 | 9.039 | 3.661 | 0.022* |
| Degree of hepatic steatosis - pre - to degree of hepatic steatosis – post | 2.96000% | 1.23004% | 5.381 | 0.006* |

Feedback from users on the app development (N=541, n=131)

An analysis of the survey replies has been conducted in order to determine the total percentage for scoring the responses. Of the 541 individuals who filled out the survey, 32 gave "good" or "very good" input, while 45 gave "no comments" or "nil" feedback. You can see all of the recommendations and contributions from 131 respondents (n%=24.2%) in Table the remaining respondents (n=410, n%=75.8%) chose not to provide any input at all. As an interesting aside, out of 541 respondents, 31 registered dietitians (n%=5.7%) agreed that the app would be useful for their practice, and they provided suggestions and feedback to improve the app's therapeutic features even further.

**Table 5:** Feedback from users on the app development

| Survey item | Frequency | Cumulative percent (%) |
|---|---|---|
| After calculating BMI. If app can priorities the diet plans or suggest diet plan to follow instead of listing all dirt plan, it will be good. Please include the benefit of each diet plan along with the details of each suggested plan. (e.g. if we follow standard diet plan for a week, it will reduce the excess fat or will reduce our weight by 2 kg | 2 | 76.2 |
| Appreciably well done in developing the app and questionnaire | 2 | 76.5 |
| Excellent app. It'll help to avoid the misconceptions about dirt and Nutrition up to an extend | 3 | 7783 |
| Excellent work | 3 | 78.4 |
| From my opinion I will feel like the app would provide the needs of people and will help them into getting depth<br>Knowledge. | 2 | 78.7 |
| From user interface perspective the text was going outside the screen. Diet plans are available over the internet.. A more personalized plan after taking more individual specifics would be more interesting. Even if it's a paid service. A reference section explaining what's protein, calories are required etc. would help. Unless it's more contextualized, I don't find this useful | 2 | 79.1 |
| Great initiative. A little more customization will help rather than standard diet plans. | 4 | 83.9 Continued… |
| I am very glad to be a part of this interaction. Thanks for providing the opportunity to record feedbacks | 4 | 84.7 |
| In find calorie, auto drop down will be more useful | 3 | 85.2 |
| In my opinion it is a great start. I would recommend to continue working on it to include more meals including<br>Meals outside India. Thank you for the app | 3 | 85.8 |
| Innovative | 3 | 86.3 |
| It should be little more user friendly | 2 | 86.7 |
| Some modifications and additions to be made to available diet plans. The format is not appealing | 2 | 95.7 |
| The list of food, snacking option is limited. Maybe provide info on more items people eats based on locality | 2 | 96.1 |
| This app is very useful | 3 | 96.7 |
| Very good work. Need of an hour | 2 | 97 |
| Very useful app needs to get popularized | 4 | 97.8 |
| Will provide feedback after usage of few weeks | 3 | 99.1 |
| Women friendly App to address issues at all ages adolescent pregnant pre- and post-menopausal stages etc. | 2 | 99.4 |
| You should work on diet plan which is specific to each disease, as there are people who would search for diet plans by feeding the name of a particular disease instead of any kind of diet plan names. If you switch to that, people from non- diet field can easily recognize as which all kind of diet that they're in need to follow | 3 | 100 |

## Conclusion

Intriguing aspects of digital nutrition consulting possibilities were investigated in this research. There were benefits to using a mobile app for self-monitoring rather to the more traditional online or paper-based approaches. Technologies that use artificial intelligence (AI) showed promise for bringing about these improvements, particularly those that required integration with third-party software and hardware services. A better grasp of the several avenues open to nutrition education and associated follow-up consultations was offered by this research. With the use of AI, chatbot features might be added to mobile apps; these bots could help with personalized nutrition follow-up and alert users when their risk of diabetes is going up.

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