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# Study on IoT based automated paralysis patient healthcare system

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## Abstract

Internet of Things (IoT) and Artificial Intelligence (AI) integration has transformed healthcare using improved patient monitoring, assistive technology, and voice pathology. This study discusses IoT real-time health monitoring, gesture-based automated reminders, and assistive gesture-based devices for providing a healthy life for the handicapped. Machine learning algorithms such as SVM, CNN, and BiLSTM exhibit excellent accuracy in diagnosis of voice pathology, while homecare robotic systems (HRS) provide rehabilitation and daily care support. Though there has been an improvement, data security, cost-effectiveness, and real-time processing problems still persist, and hence it is important to integrate blockchain-based security and cost-effective approaches. Future research needs to ensure scalability, security, and real-time AI automation in order to make wider availability and improved healthcare outcomes possible.

**Keywords:** Wearable Sensors; Gesture-Controlled Assistive Devices; Machine Learning (SVM; CNN; Bilstm) Remote Health Monitoring; Homecare Robotic Systems (HRS)

## 1. Introduction

Better access to medicine and diagnosis account for increased global life expectancy, yet healthcare costs can be reduced with automation. Real-time tracking and seamless transfer of medical information enable the Artificial Intelligence of Things (AIoT), the amalgamation of AI, IoT, and Edge Computing, to revolutionize healthcare. Accessibility is promoted by wearable monitoring devices for patients' conditions beyond hospitals. IoT is very important to healthcare as it allows connected devices to gather and share information. Devices for paralyzed patients based on the Internet of Things use sensors and microcontrollers to measure vital signs like body temperature and pulse and send them to physicians remotely.

Patient freedom is also enhanced with gesture-controlled assistive devices, where one can communicate using minimal gestures. AI, Big Data, and Cyber-Physical Systems combined with Homecare Robotic Systems (HRS) are revolutionizing home healthcare, especially for elderly citizens. The system is an innovative Arduino Uno-based health monitoring system, sensors, LCD display, and GSM module that provides real-time health data. With health and wellness becoming increasingly prominent, the system enables the user to determine key parameters in advance. Arduino Uno microcontroller is the controlling board with the help of sensors such as DHT11 to measure temperature and humidity, pulse sensor for measuring heart rate, and alcohol sensor to measure alcohol.

Real-time data on-site is provided by LCD display, while remote access is facilitated by the GSM module via provision of health data to the Blynk mobile app. Blynk is a simple-to-use IoT platform that simplifies monitoring and accessibility of health parameters. Hardware and software integration is an easy and accessible option for people with health concerns. Objective of this project meeting the changing demands of health-aware users with a comprehensive monitoring system. By incorporating local and remote health monitoring capabilities, the system provides an effective

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and convenient way of personal health management. The subsequent sections will describe the system components, features, and implementation.

## 2. Literature review

Survey on Computer Vision for Medical Diagnosis from Face provides an overview of how computer vision methods are used for face analysis to diagnose medical conditions. The paper highlights that facial features, facial expressions, and thermal patterns aid in the detection of majority diseases. Computer imaging, thermal imaging, stereo photogrammetry, and video surveillance methods have been employed in the detection of more than 30 medical ailments. Clinical application is restrained due to issues of privacy, validity, and reliability. The review presents a secure edge computing framework founded on Software-Defined Networks (SDN) in an Internet of Things (IoT)-powered healthcare ecosystem. It introduces a light- weighted authentication protocol under SDN-based edge computing to address the issue of IoT devices' resource limitations and security attacks. The proposed framework supports efficient load balancing through smart job migration, maximizes network performance through edge collaboration under SDN management, and provides secure verification of IoT devices. Literature review also explores voice pathology detection in smart healthcare with a focus on conventional evaluation techniques and AI-driven multimodal techniques. It explains the necessity of an integrated Internet of Things-based support system that promotes autonomy, mobility, and communication and solves the existing technological challenges.

The review brings into perspective the variability and advancement of IoT-based health solutions designed for monitoring in paralysis. It takes into account the integration of relatively affordable, portable devices and simplicity of interfaces for the collection of correct and credible information and streamlines communication with careers. The focal point in terms of areas are the technologies of healthcare 4.0 and cyber-physical systems (CPS) with reference to homecare robots. Areas for concern include difficulties with AI model bias, protecting data, and implementing superior materials in increasing the interactivity of human with the robot. Review also considers independent health monitoring of voice disorders, the significance of ongoing health monitoring using IoT-enabled devices and clever sensors, and the inclusion of biosensors, accelerometers, and wireless networking to facilitate improvement in patient care. Review further highlights the requirement for an elevated system with integrating wearable technologies, real-time information transmission, and IoT connectivity in order to strengthen patient care and independence.

## 3. Features of proposed model

Proposed architecture for an IoT-based automated paralysis patient care system combines wearable sensors, artificial intelligence (AI), and cloud computing to improve real-time health tracking and assistive communication. The system employs an Arduino UNO microcontroller as the central processing unit, supported by MPU6050 accelerometer sensors to track hand movements. Such gestures enable patients to convey important needs through a gesture-controlled assistive interface on an LCD display. Also, body temperature and pulse sensors monitor continuously critical health parameters and send real-time feedback to a cloud platform like ThingSpeak through an ESP8266 Wi-Fi module to be accessed remotely by doctors and caregivers. For greater patient autonomy, the model also incorporates a system of automated alerts that alert caregivers during emergencies like sudden falls or irregular vitals via cloud-based and mobile application notifications.

The use of AI-powered machine learning algorithms (e.g., SVM, CNN, and BiLSTM) assists in identifying voice pathologies, which facilitates better management of speech disorders. Additionally, the model uses blockchain-based security protocols to prevent access to sensitive healthcare information. Through the integration of IoT, AI, and real-time automation, the system reduces the reliance on human carers, enhances the availability of healthcare, and increases the quality of life for paralysis patients with the system making medical monitoring more efficient and cost-effective.

Suggested IoT-based paralysis patient auto-heathcare system provides real-time health monitoring with round-the-clock observation of life parameters. Sensors are used to monitor body temperature, heart rate, and muscle movement, and information is provided to the caregivers in the form of a mobile application. An emergency warning system involving a GSM module provides timely assistance in life-critical complications. Voice and gesture-based interaction assistants ensure more interactive patient participation. The Blynk IoT platform provides remote access to health data, allowing for improved patient monitoring. The system also includes automated reminders for medication, which avoid delays in treatment. This end- to-end solution enhances the quality of life for paralysis patients through real-time monitoring and management.

The suggested system combines various sensors to deliver a full range of health measures, such as temperature, humidity, pulse rate, and alcohol concentrations, providing users with a deeper insight into their health. By the addition of an LCD display, the system delivers instant on-site feedback, allowing users to observe their health measures on-site in real-time and make accurate decisions about their health. Adding a GSM module in the system facilitates remote communication, thus enabling the users to upload their health information to the Thingspeak for simple remote monitoring, improving convenience and accessibility. The Thingspeak is an easy-to-use interface, presenting health information in a clear and understandable form, whereby the users can merely monitor and understand their vital figures. The system as proposed meets the needs of users in both local and remote settings, offering an integrated solution to health monitoring that allows people to control their health proactively regardless of where they are..

## 4. Features of existing model

Present paradigm of IoT-enabled automated paralysis patient care systems predominantly applies wearable sensors, microcontrollers, and cloud platforms for remote care and assistance. These systems embrace IoT-supportive devices such as accelerometers, temperature sensors, and pulse detectors to track the vital signs and movement patterns of a patient. The information is wirelessly sent via Wi-Fi modules (e.g., ESP8266) to cloud storage systems such as Thingspeak, allowing doctors and caregivers to track patient health in real time. Moreover, gesture-controlled assistive devices based on flex sensors and MPU6050 accelerometers assist paralyzed patients in expressing their needs by making small hand movements.

Messages are displayed on LCD displays, and warning systems like buzzers notify caregivers in case of emergencies, for example, falls. Homecare Robotic Systems (HRS) using AI and IoT enhance patient care through automation of daily living and rehabilitation. Existing models, however, are marred by challenges such as data security threats, astronomical costs, and real-time processing limitations. Most systems lack blockchain-based security, leaving patient data vulnerable. Moreover, cost is a barrier to access, restraining the use of advanced assistive technologies

Although current models significantly improve patient autonomy and the efficacy of health care, efforts must be redoubled to advance data protection, reduce costs, and integrate AI-driven automation into more scalable and reliable solutions. Current health monitoring systems tend to target individual parameters, without considering the incorporation of a complete range of vital metrics, restricting the extent of health information. Most current solutions do not incorporate real-time feedback loops, preventing users from gaining immediate insights into their health condition while monitoring on-site.Lack of smooth communication between on-site equipment and remote platforms prevents users from remotely monitoring their health parameters, restricting the versatility of the system. Some health monitoring devices have complicated user interfaces, making accessibility difficult and lowering usability, especially for a larger population.

Current health monitoring systems tend to concentrate on single parameters, missing the incorporation of a full suite of vital measurements, which prevents the depth of health information. Most current systems do not support real-time feedback loops, which prevent users from gaining immediate insight into their current health status while being monitored in the field.The lack of smooth communication between field devices and remote servers hinders users from remotely monitoring their health parameters, which prevents the system from being versatile. Some health monitors have sophisticated user interfaces, providing accessibility barriers and diminishing usability among a wider community. Existing systems tend to display disjointed information about health, which makes users struggle to access an overall snapshot of their condition and may also overlook important markers of health.

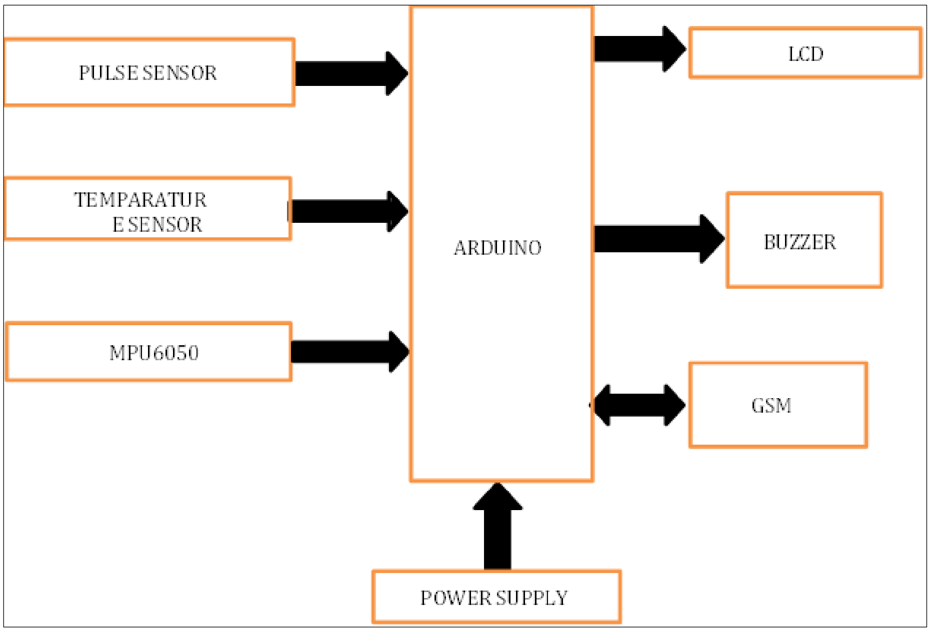


**Figure 1** Diagram for existing system

Above figure shows an Internet of Things (IoT)-based automatic healthcare system for paralytic patients that continuously monitors vital health parameters. The main ingredient is an Arduino microcontroller board that takes input from an MPU6050 sensor to detect a fall, a temperature sensor to measure body temperature, and a pulse sensor to measure heart rate. Power supply supplies power to the system, which indicates real-time fluctuation with an LCD display. A buzzer alerts caretakers in case of any abnormal conditions, and a GSM module alerts emergency services. By ensuring timely medical response and reducing dependence on round-the-clock human monitoring, this smart healthcare system enhances patient safety.

## 5. Methodology

Methodologies of different research studies on IoT and AI-based healthcare systems are discussed in this review. For medical diagnosis from faces, computer vision methods like stereo-photogrammetry, thermal imaging, and deep learning models (SVM, CNN) are applied for feature extraction and disease classification. Healthcare systems based on IoT utilize edge computing and Software-Defined Networking (SDN) for fast and secure processing of medical data. Voice pathology detection utilizes spectrogram analysis, BiLSTM networks, and cloud computing to classify diseases accurately.

The system utilizes sensors such as ultrasonic, infrared, and accelerometers to detect impending danger, monitor vehicle speed, and monitor driving behavior. The system provides critical information to drivers and traffic centers through IoT connectivity, enabling proactive avoidance of accidents. In addition, technologies such as GPS, GSM, and cloud computing ensure seamless data transfer and remote access for emergency personnel. Artificial intelligence integration also facilitates decision-making through the anticipation of hazardous conditions. This study examines the effectiveness of IoT- based solutions in preventing road accidents, improving vehicle safety, and offering a safer and more efficient transportation environment.

IoT-based assistive systems for disabled people use wearable sensors, microcontrollers, GSM modules, and mobile apps for real-time health monitoring and home automation.Real-time monitoring of paralysis patients uses Arduino-based systems with accelerometers, temperature sensors, and Wi-Fi modules for vital sign monitoring and caregiver alerting. Homecare robotic systems (HRS) utilize AI, IoT, and motion capture for autonomous patient care assistance.

Speech pathology detection methods apply MFCC feature extraction, machine learning classifiers (SVM, KNN, CNN-LSTM), and IoT-based monitoring for instantaneous voice disorder detection. These approaches as a whole emphasize the emerging importance of AI and IoT in amplifying accessibility, communication, and remote healthcare services. Suggested IoT-facilitated automated paralysis patient healthcare system leverages machine learning algorithms like Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and Convolutional Neural Network-Long Short-Term Memory (CNN- LSTM) for precise monitoring and prediction of health. The sensor data in the form of heart rate, temperature, and muscle activity are gathered and wirelessly transmitted using IoT to a cloud-based network. SVM classifies abnormal health conditions, KNN analyzes patient health trends, and CNN-LSTM enhances real-time prediction by learning spatial and temporal characteristics. The system alerts caregivers via a mobile application in the event of an emergency. This intelligent approach offers continuous monitoring, early anomaly detection, and improved healthcare management for paralysis patients.

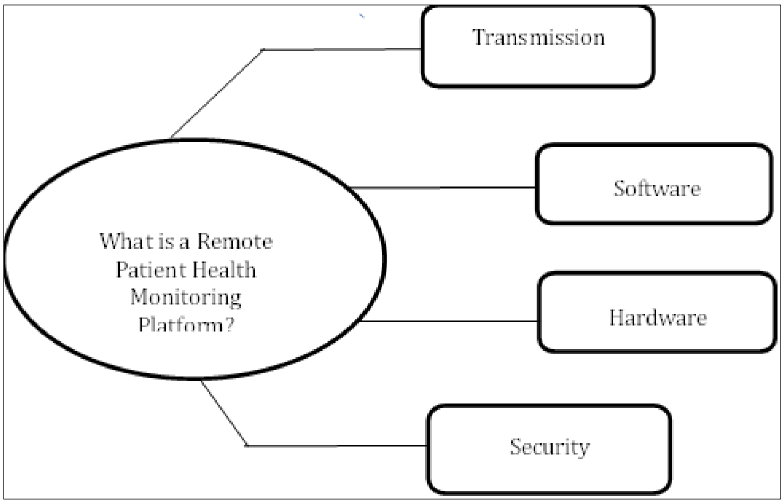


**Figure 2** Diagram for Remote Patient Health Monitoring System

Internet of Things (IoT)-centric paralyzed patient healthcare automated system needs a Remote Patient Health Monitoring Platform, represented in the figure above. This platform comprises transmission (wireless transfer of data from sensors to doctors and nurses), software (programs like applications which are used for the processing of health data and alarms), hardware (sensors like motion, temperature, and pulse detectors interfaced with microcontrollers), and security (maintaining privacy and data protection).

Through integrating these elements, paralysis patients can be remotely tracked, with updates on their real-time health status, emergency notification, and instant response from their caregivers. This enhances patient safety and reduces the necessity for around-the-clock monitoring. The health monitoring system development is in a systematic process, combining all the components to function efficiently. The process starts with the determination of the main health parameters such as temperature, humidity, pulse rate, and alcohol content. Appropriate sensors like DHT11 (temperature & humidity sensor), pulse sensor, and alcohol sensor are chosen and connected with the Arduino.

Thereafter, an LCD screen is utilized to deliver instantaneous feedback to ensure users are able to keep an eye on their health data in real time. Concurrently, a GSM module is included to enable remote connectivity, and a feature that sends health data to the Blynk smartphone app. The Thingspeak platform is a user-friendly interface where one can monitor his or her health data remotely.

Each health parameter is assigned a virtual pin, and data is transferred from the Arduino Uno to Thingspeak without any hitches. Testing and calibration are performed in a cyclical process to ensure system reliability by enhancing hardware connections and programming logic. The last step involves user testing for assessing the system's usability and effectiveness. This IoT-based health monitoring system improves accessibility and timely health monitoring, representing an all-around, remote, and effective solution to patient care and emergency response.

Workflow diagram illustrates the IoT-based automated paralysis patient healthcare system, detailing step-by-step methodology for effective patient monitoring and assistance. It starts with patient data collection using several sensors, data transmission, and processing through an Arduino-based setup. health monitoring and assistive system provides real-time monitoring of vital parameters. A gesture-controlled communication module helps patients communicate even with mobility issues. Automated notifications and alerts notify caregivers and physicians of life-threatening conditions, enabling remote access for prompt medical attention. Finally, the system improves patient independence and quality of life, providing a responsive and reliable healthcare solution.

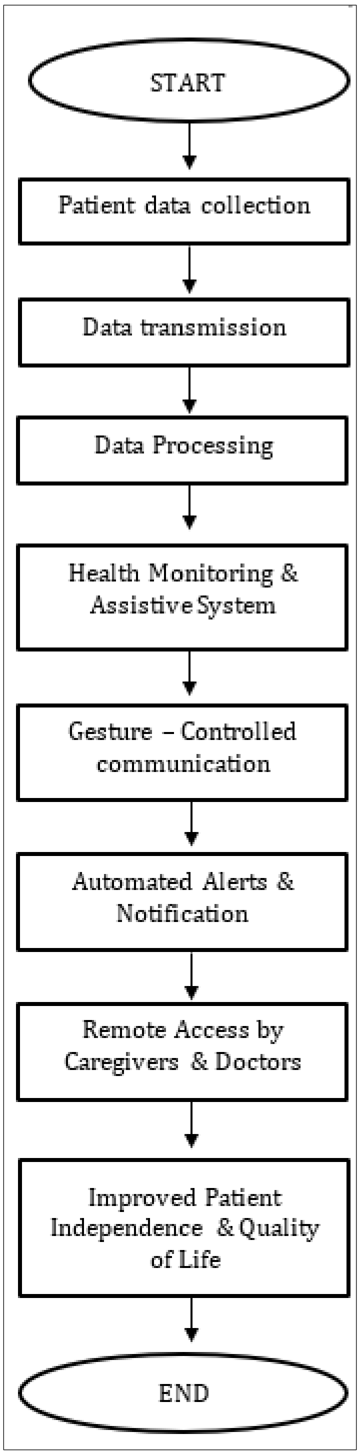


**Figure 3** Data Flow Diagram

## 6. Result and discussion

Findings from this research emphasize the substantial contribution of IoT and AI-enabled healthcare technologies towards enhanced patient monitoring, tools for assisting disabled patients, and speech pathology testing. Wearable sensors, cloud technology, and AI-driven diagnosis models have enabled enhanced real-time health monitoring, distant monitoring of patients, and automated alerts for emergency care. The research shows that IoT-based paralysis patient care systems are efficient in reducing the workload of caregivers by monitoring patient health automatically and sending real-time information through cloud platforms like ThingSpeak and Google Firebase. gesture-controlled assistive devices with accelerometers, flex sensors, and AI-based automation allow paralyzed patients to communicate and manage their environment, increasing their level of independence and life quality.

For machine learning-based diagnosis of speech pathology, SVM, CNN, and BiLSTM networks have been found to exhibit very good diagnostic performance in the identification of voice disorders. The use of spectrogram analysis coupled with EGG signals results in better diagnostic accuracy for the purpose of early diagnosis and treatment of speech pathologies. Moreover, homecare robotic systems (HRS) powered by AI and IoT provide autonomous patient care, where enhanced rehabilitation and everyday care are made possible with motion capture and real-time tracking.Despite this, challenges continue in terms of data security, expense, and lags in real-time processing in IoT-based healthcare systems. The research emphasizes the requirement for more advanced security frameworks, e.g., blockchain-based data security, to alleviate privacy issues with remote patient monitoring.

Additionally, cost and accessibility constraints in AI-based exoskeletons and assistive devices must be overcome to facilitate broader adoption, especially in low-resource environments.In summary, the results indicate that IoT and AI technologies have a revolutionary impact on healthcare by enhancing patient accessibility, automating health monitoring, and facilitating smart assistive solutions. Future studies must aim at improving real-time processing, maintaining data security, and making assistive technologies more affordable and scalable to reach a larger population.

## 7. Future enhancement

Future upgrades to the IoT-based automated paralysis patient healthcare system would include real-time processing improvement, security, cost-effectiveness, and scalability. 5G and Edge Computing integration would be one such significant upgrade to improve data transmission speed and efficiency and lower latency in remote patient monitoring. AI-based real- time decision-making can further enhance the precision of health monitoring to allow early diagnosis of diseases like abnormal heart rhythm, temperature variations, or unexplained immobility. Blockchain technology can be utilized to securely store and tamper-proof the information of patients in order to meet the requirements of data security. This will keep sensitive medical data secure and protect it while being transparent for healthcare providers. AI-based predictive analytics can also assist caregivers and physicians in predicting potential health complications, providing proactive measures to avoid emergencies.

For ease of access, affordable wearable technology with power-efficient sensors can be designed to decrease the economic burden on patients. Gesture-controlled assistive technology can be made more efficient through the use of deep learning algorithms to enhance communication systems, making them easier for patients with extreme disabilities. Additionally, brain-computer interface (BCI) technology can be utilized to facilitate direct communication for patients who have lost all motor skills.A third significant improvement would be the adoption of smart home automation with IoT-based patient care. This can enable people living with paralysis to automate their living environment, i.e., regulate lights, temperature, and panic alarms, using easy gestures or voice commands. Also, therapy aided by robots coupled with AI and IoT has the potential to enhance rehabilitation outcome through the development of customized therapy protocols based on real-time clinical data.Through the use of these developments, the paralysis healthcare system based on IoT can be more efficient, secure, and easy to use, thereby improving the patients' quality of life and decreasing the load on caregivers and medical professionals.

The future growth of the IoT-based automated paralysis patient care system will focus on accuracy, scalability, and automation. Anomaly detection and forecasting can be enhanced using deep learning models such as Transformer-based networks. Virtual assistants and AI-based wearable devices can be employed to promote patient engagement.Cloud-based analytics and blockchain for secure management of health data will ensure reliability

## 8. Conclusion

Convergence of AI and IoT-based healthcare systems has contributed enormously to the monitoring of patients, assistive technologies, and speech pathology diagnosis, especially among patients with paralysis. The paper identifies how cloud computing, wearable sensors, and machine learning models have made real-time monitoring of health more advanced, with provision for automatic alarms, remote monitoring of patients, and individualized rehabilitation care. Gesture-controlled assistive devices such as flex sensors and accelerometers allow paralyzed patients to communicate and learn to control their surroundings by themselves. In addition, AI speech pathology detection algorithms such as SVM, CNN, and BiLSTM provide high precisionin detectingvoicedisorders, enabling early detection and appropriate treatment. Even with all these developments, cost, privacy protection, and latency in real-time processing remain issues, which require more robust security mechanisms like blockchain technology. Exorbitant cost and limited availability of

AI-based exoskeletons and IoT-driven assistive technologies also limit mass adoption, especially in resource-constrained environments.Future research will have to focus on cost-effective solutions, scalable AI automation, and improved connectivity through 5G and edge computing to render healthcare services more efficient and inclusive. In conclusion, IoT and AI technology have a revolutionary impact on patient independence enhancement, automating healthcare, and enhancing assistive solutions. Overcoming the current limitations through enhanced security, affordability, and real-time AI-based monitoring will enable the greater accessibility and efficacy of healthcare systems for paralyzed individuals, providing them with a superior quality of life and long-term medical care.

## Compliance with ethical standards

*Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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