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Original Article

Challenges of Implementation a Smart Hospital in Taft City in 2025; A Qualitative Study

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Abstract

Introduction: The design of a smart hospital, despite its numerous advantages, faces challenges that require the integration of many organizations to overcome. Although advancements have been made in establishing smart hospitals in Iran, the seamless integration of physical hospital devices and information systems has not yet been fully realized. This integration faces challenges, and identifying these challenges can be effective in accelerating the launch of smart hospitals. This study aimed to identifying the challenges of establishing a smart hospital in Taft City in 2025.

Methods: The present qualitative study was conducted in 2025 in Taft City, Yazd Province, through semi-structured interviews with a purposive sample (10 individuals), including the hospital CEO and manager, quality improvement officer, quality improvement expert, health economics expert, financial manager, human resources manager, health information technology expert, medical equipment expert, nursing manager, and technical manager. Data collection involved semi-structured interviews, field note-taking, and recording of memos based on the principle of data saturation. Data analysis was performed through qualitative content analysis.

Results: This study interviewed 10 participants (5 females and 5 males) aged 30-58. The mean age of the participants was 41.7 years and the mean work experience of them was 16.4 years. During the data analysis process, 3 main themes (Policy-Making Challenges, technological and infrastructural challenges, financial and economic challenges), 6 categories (Leadership and Management Challenges, Legal Challenges, Technological Challenges, Infrastructural Challenges, Initial Costs, Maintenance and Upgrade Costs) and 24 subcategories were identified.

Conclusion: The results of the present study indicated that the most important challenges included Policy-Making Challenges, Technological and Infrastructural Challenges, financial and economic challenges. By resolving these obstacles and empowerment technology, the success of the smart hospital launch project in Taft City, Yazd Province, can be facilitated.

Keywords: Smart hospital, Digital hospital, Digital health, Challenges

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Introduction

The exponential growth rate of the population, the lack of growth in the number of doctors in proportion to this population, and the occurrence of unforeseen epidemics (such as COVID-19 in recent years) have created many challenges for the healthcare sector in the modern world (1). On the other hand, in recent years, the speed of information production has been increasing due to the presence of electronic devices, internet infrastructures, and solutions based on them, such as the Internet of Things and big data. This has led to significant advances in industry, technology, and communication, impacting human life in the past decades (2). Hospitals, as the most important centers for providing health services, have also been affected by these revolutions, and significant advancements have taken place in hospital management and care (3). To provide effective healthcare services, reduce costs, and simultaneously improve health outcomes, hospitals have turned towards the introduction of smart hospitals (4). The concept of

a smart hospital is complex, and various definitions and terms may be used to describe it, including: smart hospital, electronic hospital, digital hospital, intelligent hospital, automated hospital, internet hospital, and integrated hospital (5). In general, the goal of smart hospitals is to enhance patient care, optimize operational efficiency, and ensure data security through the integration of advanced technologies (6). Additionally, the use of emerging technologies such as artificial intelligence, the Internet of Things, cloud computing, virtual reality, augmented reality, advanced security, and machine learning for monitoring patients' vital signs, diagnosis, treatment, and service delivery are among the other features of smart hospitals (7).

The digital hospital is a concept that emerged in the early 2000s in Korea, with the goal of fostering a complete transformation from analog hospital workflows where charts, films, slips, papers, and pens were mostly used for all aspects of recording patients' medical histories to a digital hospital workflow involving the "four 'lesses'" (filmless, chartless, slipless, paperless) method by establishing computerized physician order-entry, picture archiving and communication systems, Electronic Medical Record (EMR) systems, and hospital business systems.(8, 9)

Despite the increasing importance of hospital smartification, there is a lack of information and assessment tools due to its novelty, resulting in only a few studies conducted in this field. (10). The Imam Khomeini Hospital smartification has been initiated, with the objective of establishing an innovative architecture based on advanced technologies (11). The study by Azad et al. showed that, the protecting patient data privacy and maintaining legal compliance as a fundamental requirement (12).

Utilizing smart hospitals offers significant advantages such as increased patient satisfaction (13), improved efficiency of medical personnel (14), optimized resource allocation and reduced administrative burden (15), decreased healthcare costs (16), and Despite the considerable potential of smart hospitals, there are significant challenges and barriers to their implementation. The first challenge is the high initial investment; the upfront costs of implementing smart technologies can be substantial, although they often lead to long-term cost savings (17). Results from several studies, such as those by Kumar et al. (2025) (18), Gautam et al. (2023) (19), and Cheng et al. (2023), indicate that the establishment of smart hospitals requires considerable expenditure. The second challenge is data security and privacy (20); protecting patient health data against cybersecurity threats is a critical and ongoing concern, and implementing smart hospitals necessitates continuous vigilance and investment in robust security measures (21). The findings of Rafik et al. (2023) showed that data security is one of the barriers to establishing a smart hospital (22). The next challenge is the increased risk associated with reliance on technology, meaning that the greater the dependence on smart technology, the higher the risk to hospital operations in the event of a severe incident (23). The results of the study by Elendu et al. (2025) emphasized this issue and identified it as one of the barriers to establishing a smart hospital, stating that many hospitals have fallen victim to cyberattacks in recent years and that this sector faces ongoing threats (24). The fourth challenge is system integration (25); system integration means ensuring that various devices and systems can communicate seamlessly with each other and share data (26). The results of the study by Lamba et al. (2025) indicated that integrating various devices is one of the barriers to establishing a smart hospital (27). Considering that the challenges of establishing a smart hospital are specific to the infrastructure and culture of each region, and that each local area must conduct extensive research to achieve smart hospitals, identify barriers, and allocate funding to address these challenges. Currently, in the city of Taft, Yazd province, the plan to establish a smart hospital has been underway for several years, but it has faced challenges that need to be identified, prioritized, and addressed. Therefore, this study was designed and conducted to investigate the challenges of establishing a smart hospital in the Taft city in 2025. Due to the increase in bed occupancy and the lack of empty beds, the increase in the average length of stay, the increase in the elderly population, urban tourism attractions, and the possession of an international medical tourism certificate in the hospital, Taft Hospital has moved towards the digitalization of online visit services, online patient education, online medical consultation, Online evaluation and following and international medical cooperation. Therefore, it is necessary to identify the challenges of a smart hospital. Also, given that no study has been conducted in this regard

in the Taft city so far, this study aims to identify the challenges of a smart hospital in the Taft city 2025.

Methods

Study Design

The present qualitative study used a content analysis method with the proposed five-step method (Graneheim and Lundman, 2004) in Taft City Hospital, Yazd Province.

Population and Research Sample

The study population consisted of senior and middle managers of the Shahid Beheshti Hospital of Yazd University of Medical Sciences, and the research sample included administrative managers, hospital managers, nursing manager, financial managers, the hospital quality improvement and accreditation expert, the quality improvement officer, the health economics expert, , the human resources officer, the health information technology expert, the medical equipment expert, and the hospital's technical supervisor. The participants were selected by purposive sampling. In this method, the researcher used participants in the research who had rich experience with the Smart Hospital and were willing to participate in the research. The number of participants was determined based on data saturation so that after 10 semi-structured interviews, no new stratum was formed.

Participant Selection and Sampling Method

A purposive sampling strategy was employed to select ten experts and specialists for participation in semi-structured interviews or completion of a structured questionnaire. Purposive sampling was chosen due to its ability to intentionally recruit individuals with substantial expertise and relevant professional experience in the subject matter under investigation.

Inclusion criteria were as follows:

1. Possession of a relevant academic degree.
2. Educational background at the master's or doctoral level.
3. Documented experience in conducting research and publishing scholarly articles.
4. Demonstrated willingness to participate in the study.
5. Familiarity with the concept and processes of smart hospital implementation.
6. Prior involvement in electronic healthcare initiatives, such as administrative automation, electronic prescription systems, managerial dashboards, and related projects.

Exclusion criteria included:

1. Lack of knowledge regarding the research topic.
2. Unwillingness to participate in the study.

Following these criteria, ten professionals and decision-makers in the fields of healthcare and information technology, based in Taft city and Yazd province, were identified and recruited. These participants possessed valuable practical experience and informed perspectives on the challenges and opportunities associated with establishing a smart hospital in the region.

Data Collection

The collection tool in this study was a semi-structured interview guide sheet) supplementary file one) and taking notes in the field. The method of collecting information is to conduct semi-structured interviews. After introducing himself, the researcher obtained permission to the interview. If the participants were willing and satisfied, the time and place of the interviews were arranged according to the participants' preferences. the interview was conducted face to face. He or She was free to participate in the study. Before starting the interview, consent was obtained from the participant for audio recording. Then, the interviews started with simple and general topics and gradually moved on to specific questions based on the answers given. Some of the questions asked (introduce yourself, What do you know about smart hospitals? If you have some knowledge, please describe them. Do you think it's feasible to establish/implement a smart hospital?) further follow-up questions were asked along these lines (explain a little more; please give an example) The interview process continued until the last interview when data saturation was reached. Each interview lasted between 45 and 60 minutes. To increase the accuracy and precision of the data obtained, the interviews were implemented immediately after the completion of each interview. A code was assigned to each interview to maintain its confidentiality. It was also given at the time of recording the interviews; the details of the interviews include age, location of the interview, the interviewee's position in the organization, and the date and time of the interview were recorded.

Data Analysis Method

The data collection and analysis were carried out simultaneously, based on the method proposed by Graneheim& Ludman, whose steps include 1- conducting the interviews and reviewing them several times to find a correct understanding of all the cases conducted, 2- extracting semantic units and categorizing them under the title of compact units, 3- summarizing and categorizing compact units and choosing a suitable label for them, 4- arranging subcategories and 5- choosing a suitable title that can cover the categories obtained.

In this study, after conducting each interview immediately in the shortest possible time and listening twice, the recorded information was written word by word on paper, and then the information was typed. Simultaneously with the implementation of the first interview, the analysis process began.

During the analysis process, first, the transcripts were read line by line, and the important paragraphs were marked and identified; then, the units of analysis were determined, and in the present study, the entire text of each interview was considered as the unit of analysis. After that, the semantic unit was determined, and the expressions related to the challenges of Establishing a Smart Hospital in Taft City were considered. Then, coding was done using the MAXQDA software, version 2020 The analysis was carried out independently by two researchers, NM and LA, who are proficient in qualitative research analysis. After researchers independently coded the data. If the reliability between the codes was higher than 70%, it was accepted. Otherwise, it was referred to a third author for discussion and review, and consensus was reached among the members. Also, after coding all the data, a comparison was made between the codes based on the conceptual similarities and differences they had with each other, and the conceptually similar codes were grouped into classes with a more precise and abstract concept. Finally, by continuously comparing the classes Again, the hidden content in the data was identified under the title of the main theme (28).

Trustworthiness and Rigor

Lincoln and Goba's four criteria of reliability, validity, transferability, and verifiability were used to ensure the accuracy and scientific rigor of the material presented (29).

A specialized educational team (including an expert, a hospital manager, and a professor in the field of healthcare management) was used to review the findings. In addition to semi-structured interviews, note-taking during the interviews was also used to validate the data. The initial findings of this study, along with initial codes and categories, were presented to a sub-sample of participants to elicit their opinions and feedback (member survey). Some parts of the data were reviewed by colleagues not involved in this study. To determine the reliability of the findings, the opinions of an external observer were used; this observer was a researcher familiar with the challenges of managing qualitative research methods but was not a member of the research team. The transcripts of a number of interviews and extracted codes were provided to them, and the accuracy of the data coding process was checked. Determining the possibility of confirming the findings, all activities were recorded, and a report of the research process was prepared to determine transferability; the results were discussed with two faculty members whose positions and experiences were comparable to the participants, and the results were reconfirmed.

Ethical Considerations

Ethical approval for the present research was obtained from the Ethics Committee of Marvdasht Azad University (IR.IAU.M.REC.1403.424). When the participants were informed about the research objectives and asked to consent to the interviews, they were assured that the information collected would remain confidential. They were also informed that they could withdraw from the study anytime.

Results

Table 1 presents the participants' demographic information. This study interviewed 10 participants (5 females and 5 males) aged 30-58. The mean age of the participants was 41.7 years and the mean work experience of them was 16.4 years. In terms of education, 30% (3 people) held a doctorate degree, 10% (1 person) was a specialist in infectious diseases, and 60% (6 people) held a Master of Science degree (MSc).

After reviewing and analyzing the data, according to (Table 2), Three main themes (Policy-Making

Table1: Demographic information of research participants

Number	Gender	Position	Degree and Field of Study	Age (years)	Work Experience (years)
1	Male	Head / Faculty Member, University of Medical Sciences	PhD in Health Services Management	47	21
2	Male	Quality and Patient Safety Officer	PhD in Health Services Management	52	24
3	Female	Accreditation Officer	PhD in Health Services Management	38	15
4	Female	Health Economics Expert	MSc in Health Economics	30	5
5	Male	Head of IT Department	MSc in Information Technology	35	10
6	Female	Head of Medical Equipment Department	MSc in Biomedical Engineering	33	6
7	Male	Director of Nursing Services	MSc in Human Resources	47	23
8	Female	Human Resources Manager	MSc in Public Administration	39	14
9	Male	Financial Affairs Officer	MSc in Business Administration	38	19
10	Female	Hospital Medical Director	Specialist Physician (Infectious Diseases)	58	27

Mean work experience of participants: 16.4 years; Mean age of participants: 41.7 years

Table 2: The challenges of Establishing a Smart Hospital

Main Theme	Category		Subcategory
Policy-Making Challenges	Leadership and Management Challenges	Management-Related Challenges	Lack of stewardship and clarity in responsibilities
			Absence of intersectoral integration and coordination
			Weakness in managerial stability and specialized knowledge
			Lack of unified frameworks and standards
			Complexities related to multi-faceted collaborations
			Lack of understanding and support for the necessity of smart transformation
		Organizational Structure Challenges	Absence of managerial structures and specialized team-building
			Lack of organizational and intersectoral integration
			Inadequate infrastructure and insufficient needs assessment
			Shortage and underdevelopment of specialized human resources
	Legal Challenges	Security Dimension	Lack of comprehensive legal and regulatory frameworks
			Infrastructural vulnerabilities and data security threats
		Ethical Dimension	Privacy breaches and unauthorized access to information
			Vulnerability to cyberattacks and inadequate data protection
Technological and Infrastructural Challenges	Technological Challenges		Obsolescence and inefficiency of physical and hardware infrastructure
			Network limitations and connectivity issues
			Incompatibility and lack of system integration
	Infrastructural Challenges		Physical and technological infrastructure limitations
			Complexity of implementing and integrating smart technologies
			Challenges in integrating information and operational systems
Financial and Economic Challenges	Initial Costs		Barriers to initial investment
			Economic management and justification issues
	Maintenance and Upgrade Costs		Operational and infrastructure maintenance expenses
			Human resource–related costs

Challenges, technological and infrastructural challenges, financial and economic challenges), 6 categories (Leadership and Management Challenges, Legal Challenges, Technological Challenges, Infrastructural Challenges, Initial Costs, Maintenance and Upgrade Costs) and 24 subcategories were identified.

Policy Challenge

The implementation of a smart hospital faces numerous policy-related challenges. The primary policy issue for smart hospitals is to strike a balance between the potential benefits of advanced technologies and the need to ensure data security, protect patient privacy, and promote equitable access to healthcare services. Addressing these concerns requires robust data management frameworks, interoperability standards, and strategies to mitigate the digital divide. During the conducted interviews, this challenge was identified as one of the most significant, and it was categorized into two main areas.

One of the most significant challenges in establishing a smart hospital was the issue

of regulations and guidelines, which itself comprised two main Categories: the "guideline challenge" and the "regulation challenge." Each of these main Categories also included Subcategories such as the lack of guidelines, lack of infrastructure, and lack of management. In this regard, the first participant stated during their interview, ""*The establishment of a smart hospital necessitates a unified set of guidelines and integrated management that can coordinate different organizations. It was never clear who was responsible for Which entity holds the responsibility for overseeing, facilitating, and coordinating activities among the relevant organizations*" Another participant also expressed, "*Managers were replaced so frequently that no one had the chance to acquire the necessary expertise in this field. Whenever the plan was introduced to a new president or manager, their subsequent replacement would leave the initiatives on hold.*"

One off participant stated during its interview "Some managers still don't realize the importance of smart transformation and the optimal use of resources, even in the face of the shortages our societies are dealing with. They see it as a non-essential service, while in fact it is vital for building a competitive edge and attracting skilled physicians."

One of the participants stated: "We need to look at successful examples of smart hospital implementation and learn from those experiences. We should also assess what a smart hospital really needs, see how ready we are, and evaluate our staff's readiness so we can plan and manage the necessary training programs."

"A significant challenge concerning the establishment of a smart hospital is the regulatory challenge. You see, when a smart hospital is launched, all information is online, and perhaps some individuals might misuse this information, or some hackers could disseminate patient data. Therefore, the security of these systems must be ensured first, and then the launch can proceed."

Infrastructure and Technology Challenges

The infrastructure and technology in a smart hospital encompass the complete implementation of Electronic Health Records (EHR), the deployment of Clinical Decision Support Systems (CDSS), the utilization of the Internet of Things (IoT) and sensors, the creation of an appropriate network and hardware infrastructure, and the implementation of international standards. Having robust infrastructure and technology is crucial for a smart hospital.

In this study, this challenge was also identified as one of the most significant, comprising two primary categories: technological challenges and infrastructural challenges, further divided into six subcategories. Participant 2, during the interview process, stated: '*Initially, it must be assessed whether the city of Taft possesses the appropriate infrastructure to support high-speed internet connectivity and the adoption of innovative technologies within the hospital.* This assessment determines the feasibility of establishing a smart hospital.' Participant 3 commented: 'A smart hospital is a hospital that must be constructed in accordance with urban planning and building codes, adhering to safety and health standards. Its establishment fundamentally requires a suitable building and a strong internet connection. I doubt that such a hospital will be established soon.'

Participant 5 commented: "*Our country has been hit by cyberattacks several times, and a lot of patient information has been exposed. The current laws just don't work, the security infrastructure is weak, and there's no real protection for the privacy of data shared online.*"

Financial and Economic Challenges

Another challenge identified in this study was the financial and economic challenge. It is evident that establishing a hospital requiring modern and up-to-date equipment entails substantial financial and economic investment. This challenge comprises two primary categories: initial costs and Maintenance and Upgrade Costs, further subdivided into several subcategories, including the Barriers to initial investment, Economic management and justification issues, Operational and infrastructure maintenance expenses, Human resource–related costs. In this context, Participant 4& 9 stated during their interview: '"*Setting up smart hospitals takes a lot of investment and enough financial resources. To get these, we need to use different strategies—bringing in private investors, getting government or international help, trying new business models, and so on. We also have to check the project's economic viability and make sure senior managers understand the long-term return on investment.*" Participant 6 stated during their interview:

"Starting a smart hospital needs a lot of initial equipment, and it's expensive. The yearly maintenance and upgrade costs are high for the hospital. To take better care of the equipment, we need to plan and run training courses for all the people who use the medical devices."

Participant7&8stated during their interview:"*In our smart hospital, we need more skilled and experienced staff, especially in using modern technologies. To bring them in and keep them here, we have to offer certain advantages, like higher salaries. But this puts a lot of financial pressure on the organization. We need to look closely at the costs and our budget limits to figure out how to deal with this challenge."*

Discussion

The findings of this study indicated that the main challenges in the process of smart hospital development can be classified into three major categories: policy-related challenges, technological and infrastructural challenges, and financial and economic challenges.

In the present study, one of the identified challenges in smart hospital development pertains to policy-making. The findings highlight the absence of effective leadership and governance, lack of transparent stewardship, and insufficient intersectoral coordination as key barriers. Furthermore, the absence of a unified standard framework, instability in management, and limited specialized knowledge in the field of smart hospitals and their administration were identified as significant challenges. Consistent with the findings of this study, Golpira et al. also reported that the lack of strategic planning, managerial instability, and inconsistency in program implementation are major obstacles in the development of smart hospitals (30).

In the present study, another identified challenge relates to the organizational and structural dimensions of smart hospital development. The absence of an effective managerial framework and specialized team-building, deficiencies and weaknesses in developing skilled human resources, inadequate infrastructure, and a lack of accurate needs assessment were recognized as major obstacles in this area. These findings are consistent with those of Layeghi et al., who also emphasized that advanced medical equipment, trained human resources, and efficient management are fundamental challenges in achieving smart hospitals (31).

In this study, challenges related to legal frameworks and data security were also identified as significant barriers to the implementation of smart hospitals. The lack of comprehensive legal regulations and vulnerabilities to data security threats were highlighted as key issues in this area. These findings are consistent with the study by Kruse et al., who also identified concerns regarding privacy and cybersecurity as major reasons for resistance to adopting innovative technologies in hospitals (32).

Moreover, the findings of the present study revealed that the ethical and legal aspects of smart hospital development particularly issues related to privacy breaches, unauthorized access to information, and vulnerability to cyberattacks are among the most significant barriers to the adoption of smart technologies in healthcare systems. This aligns with studies analyzing data breaches and security incidents, which indicate that both external and internal intrusions and cyberattacks have resulted in extensive disclosure of health information, raising serious concerns regarding confidentiality and patient trust (33).

In the technological and infrastructural dimension, the study participants identified aging and inefficient physical and hardware infrastructure, internet network limitations and issues, and system incompatibility and lack of integration as some of the most critical challenges to implementing smart hospitals. These findings align with those of Kumar et al., who highlighted issues such as network reliability, adequate coverage, and capacity expansion as key factors in the development of smart hospitals (34).

Furthermore, this study identified physical and technological infrastructure constraints, the complexity of implementing and integrating smart technologies, and difficulties in aligning information and operational systems as additional major barriers. This is consistent with the findings of Kuan et al. (35), who emphasized system integration and the provision of stable and essential infrastructure as core features of smart hospitals. In addition, the findings of M. Byung et al. indicate that the implementation of smart hospitals requires robust infrastructure aligned with cybersecurity standards, privacy, and regulatory requirements, and that the absence of these components constitutes a significant obstacle to the widespread

adoption of these technologies (36).

The financial and economic dimension was also identified as a prominent challenge in the implementation of smart hospitals. The findings indicated that high initial investment costs and difficulties in justifying the economic feasibility of projects are among the major obstacles in this area. Limited financial resources and the absence of sustainable financing models often lead to delays or suspension of digital transformation projects. These findings align with studies conducted in the healthcare sector of Saudi Arabia, where high upfront costs and the lack of clear economic plans were cited as primary reasons for halting digital initiatives (37).

Moreover, evidence from research in South Korea suggests that in the absence of precise calculations of return on investment (ROI) and financial simulation models, securing support from investors and government authorities for smart hospital development becomes more challenging (38).

In addition to initial costs, ongoing maintenance and update expenses were highlighted as significant barriers. The present study revealed that these costs primarily consist of two components: (1) operational and infrastructure maintenance costs, including hardware repairs, network equipment upgrades, software license renewals, and cloud services; and (2) human resource-related costs, such as continuous staff training, hiring IT and cybersecurity specialists, and workforce retraining. These findings are consistent with studies conducted in Singapore, which demonstrated that even with high initial investments, ongoing costs to keep systems and infrastructure up-to-date account for a substantial portion of hospital budgets, and in the absence of sustainable financial models, service quality is severely impacted (39).

Conclusion

The findings of the present study indicated that the implementation of smart hospitals is a complex and multidimensional process, facing challenges across policy, technological and infrastructural, as well as financial and economic dimensions. These results suggest that merely adopting a technological approach is insufficient for transitioning to smart hospitals; rather, a comprehensive and strategic perspective at the macro level of the healthcare system is required. Accordingly, the development of a national roadmap for smart hospital implementation, involving the Ministry of Health, medical universities, insurance organizations, and the private sector, is considered an essential and unavoidable step. It is recommended that the Ministry of Health and Medical Education, as the main authority, assume a coordinating role and establish a national committee to guide, coordinate, and monitor the implementation of smart hospital projects.

Furthermore, by strengthening high-speed and stable internet infrastructure, integrating information systems such as HIS, LIS, and PACS into national platforms, enacting comprehensive regulations for the protection of health data, implementing encryption protocols and continuous data monitoring to ensure information security and confidentiality, and conducting comprehensive training programs in the field of smart healthcare while recruiting interdisciplinary professionals including IT specialists, cybersecurity experts, and data analysts the country can take significant steps toward supporting the development of smart hospitals. Addressing these obstacles can facilitate the successful implementation of the smart hospital project in Taft City, Yazd Province.

Ethics Approval

The Research Vice-Chancellor of Azad University, Marvdasht branch, IR, approved the study. IR.IAU.M.REC.1403.424

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Conflict of Interest

There are no conflicts of interest.

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