

Establishing a Center for Innovation and Artificial Intelligence in a Tertiary Medical Center: Successes and Challenges

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ABSTRACT **Background:** The field of artificial intelligence (AI) is poised to significantly influence the future of medicine. With the accumulation of vast databases and recent advancements in computer science methods, AI's capabilities have been demonstrated in numerous areas, from diagnosis and morbidity prediction to patient treatment. Establishing an AI research and development unit within a medical center offers multiple advantages, particularly in fostering research and tapping into the immediate potential of AI at the patient's bedside.

Objectives: To outline the steps taken to establish a center for AI and big data within an innovation center at a tertiary hospital in Israel.

Methods: We conducted a retrospective analysis of projects developed in the field of AI at the Artificial Intelligence Center at the Rabin Medical Center, examining trends, clinical domains, and the predominant sectors over a specific period.

Results: Between 2019 and 2023, data from 49 AI projects were gathered. A substantial and consistent growth in the number of projects was observed. Following the inauguration of the Artificial Intelligence Center we observed an increase of over 150% in the volume of activity. Dominant sectors included cardiology, gastroenterology, and anesthesia. Most projects (79.6%) were spearheaded by physicians, with the remainder by other hospital sectors. Approximately 59.2% of the projects were applied research. The remainder were research-based or a mix of both.

Conclusions: Developing technological projects based on in-hospital medical data, in collaboration with clinicians, is promising. We anticipate the establishment of more centers dedicated to medical innovation, particularly involving AI.

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KEY WORDS: artificial intelligence (AI), entrepreneurship, innovation, medical data, research

Artificial intelligence (AI) has emerged as a powerful tool that promises to revolutionize diagnosis, treatment, and predictive care. With its potential to analyze complex datasets and deliver precision-oriented solutions, AI is progressively being integrated into various aspects of healthcare.

In this study, we provided insights into the pivotal role of artificial intelligence (AI) in transforming the medical landscape and recount the establishment of an artificial intelligence center in a tertiary-care medical center in Israel. Through a retrospective examination of 49 projects conducted at the Artificial Intelligence Center at the Rabin Medical Center from 2019 to 2023, we illustrated the trend and growth in the application of AI across multiple clinical fields. Our findings reveal an evident upswing in AI-based projects, with a majority led by physicians and a significant proportion designated as applied research. Our research further revealed the integration of AI solutions directly into clinical pathways, facilitated by the close contact with clinicians in the hospital, has the potential to produce innovative and impactful projects. Our findings offer an optimistic outlook on the future of AI in healthcare, where it promises to revolutionize patient care, from prevention and diagnosis to treatment and follow-up.

The term *Artificial Intelligence* (AI) was first coined in 1956 during the DSRPAI summer conference at Dartmouth University, USA. AI alludes to machines capable of learning through information processing, thereby acquiring the ability to *think*, analogous to human cognition [1]. AI's prowess has been demonstrated across various fields including diagnosis, risk prediction, and patient treatment. With advancements in information and computing technologies, coupled with the enhanced electronic storage of medical databases, AI is steadily emerging

as a pivotal tool for advancing understanding and treatments in a myriad of medical specialties, notably in imaging, pathology, and cardiology.

Leveraging AI allows medical practitioners to pinpoint symptoms, deduce diagnoses, and devise treatment plans with heightened precision and customization for individual patients. Furthermore, AI holds potential in drug research and development as well as in personalized medicine. For example, software powered by AI can analyze X-rays, magnetic resonance imaging (MRI) scans, or computed tomography scans for diagnostic purposes, with systems capable of detecting ailments such as skin cancer [2] and diabetic retinopathy [3]. AI can also bolster treatment plans by offering tailored recommendations rooted in patient data [4]. Regarding drug innovation, AI expedites discovery and development processes, mitigating time and costs. Algorithms of AI can sift through colossal data volumes to spotlight potential drug candidates and prognosticate their efficacy and safety [5,6]. Remote patient monitoring systems underpinned by AI facilitate patient tracking through vital signs and symptom analyses, ensuring adherence to treatment protocols in real-time [7]. In addition, chatbots built on large language models can offer round-the-clock therapeutic assistance, alleviating pressure on medical personnel and even aiding in diagnosing psychologically linked conditions [8].

In propelling both academic research and digital health application development, AI plays a transformative role. For application progression, different strategies exist within medical centers. Centers that include a technological commercialization entity are tasked with handling the intellectual property created within the hospital and encompass its registration and subsequent commercialization. Yet, the methodology for fostering and championing innovation varies across institutions. The Stanford Biodesign methodology, created at Stanford University, USA, is focused on the design thinking ethos, on the comprehension of the unmet clinical need, and on the industry's entrepreneurial landscape. This methodology prioritizes a thorough examination of the medical necessity before delving into invention, ensuring a holistic grasp of user perspectives, stakeholder analysis in the pertinent market, intellectual property considerations, business model frameworks, and indemnification. Due to its universal appeal, this strategy has been adopted globally, leading to the foundation of innovation centers across diverse medical domains [9-13].

In this article, we delved into the creation of an AI institute within a hospital-based innovation center, drawing

from the Biodesign method and assessing projects for both research and application. In addition, we highlight the distinctive research pursuits that AI can potentially catalyze.

MATERIALS AND METHODS

We collected retrospective data for all AI-based ventures initiated by employees at the Rabin Medical Center at the innovation center from 2019 to 2023. These ventures encompassed both research projects and practical applications in the realm of digital health.

The Beilinson Innovation Center comprises three main divisions: the Innovation Incubator, which fosters applied ventures within the Biodesign track aimed at implementation and commercialization; the Center for 3D Design and Printing; and the Institute of Artificial Intelligence. Ventures with a practical application related to big data and artificial intelligence receive support through a joint pathway involving both the innovation incubator and the Institute of Artificial Intelligence. In contrast, research-driven projects are endorsed by the hospital's research authority for academic objectives. We described all projects within the domain of AI that span both applied and research tracks. The development stages of projects within the applied track are prioritized to ensure that a working prototype, ready for use and validation, is reached at an early stage. Furthermore, these projects receive business support to address market needs, paving the way for the establishment of new startup companies.

OUTCOMES

We assessed the progression of ventures since the center's inception, with a specific focus on the changes following the establishment of the Artificial Intelligence Institute in July 2021. We also evaluated the ventures by clinical field and by the sector of the leading researcher or entrepreneur. In addition, we compared the proportion of research projects to the applied projects.

Because this review applies to projects within the innovation center, obtaining approval from the Helsinki Committee was not required for the publication of this study. Nonetheless, any research or applied project involving access to patient medical information received Helsinki Committee approval from the Rabin Medical Center.

STATISTICAL METHODS

We calculated means with standard deviations, as well as medians with ranges, for all continuous variables. For categorical, nominal, and ordinal variables, we created

frequency tables and pie charts to illustrate their relative quantitative distribution. Subsequently, we conducted comparisons and assessed correlations among the research variables using *t*-test for continuous data. The threshold for statistical significance was set at *P*-value < 0.05. Data analysis was performed using code in Python 3.

RESULTS

There was a discernible uptrend in the number of artificial intelligence-based ventures at the Rabin Medical Center over the years [Figure 1]. The half-year average number of projects prior to the establishment of the Artificial Intelligence Center stood at 2.8. Following the inauguration of the Artificial Intelligence Center (July 2021), this average rose to 7 projects, marking an increase of over 150% in the volume of activity (*P* = 0.019) [Figure 1].

In addition, the lead researchers of artificial intelligence-based ventures have come from more than 25 distinct departments within the Rabin Medical Center, collaborating and initiating projects with external entities. However, there is noticeable variation in the level of activity among the departments, with cardiology, gastroenterology, and anesthesia at the forefront [Figure 2].

The vast majority (79.6%) of AI-based project initiators were affiliated with the medical sector; 8.2% were associated with the nursing sector, while a similar proportion was linked to the health professions sector (including nutrition, physical therapy, pharmacy). The oth-

ers were related to the organization's management sector or an external source [Figure 3].

Most projects were geared toward the applied track (comprising over 67% of the cases). Approximately one-third were primarily research-oriented, while 8.2% were integrated ventures. These integrated ventures typically originated as research projects and, over the course of their activity, identified an applied opportunity within the innovation incubator track [Figure 4].

DISCUSSION

In this article, we reviewed the stages involved in establishing a center of innovation and artificial intelligence within a tertiary hospital. The Rabin Medical Center's innovation center was founded in 2019. In 2021, a dedicated center for artificial intelligence was established. This center has enabled researchers within the hospital to develop algorithms across various artificial intelligence domains. The establishment of this dedicated AI center has significantly expanded the scope of activities. Furthermore, this activity spans across numerous departments, with most projects led by medical professionals; however, employees from other sectors have also been involved. Notably, most projects belong to the applied pathway.

The initiation of artificial intelligence centers operating within medical centers is a relatively new and growing phenomenon. Some hospitals already operate dedicated innovation centers for research and development.

Figure 1. The number of artificial intelligence projects (research and applied) by year at the Rabin Medical Center Innovation Center **[A]**. The number of projects up to the second quarter of 2021 and from the third quarter of 2021 (coinciding with the establishment of the Center for Artificial Intelligence) **[B]**. The X-axis represents the years, and the Y-axis indicates the number of projects.

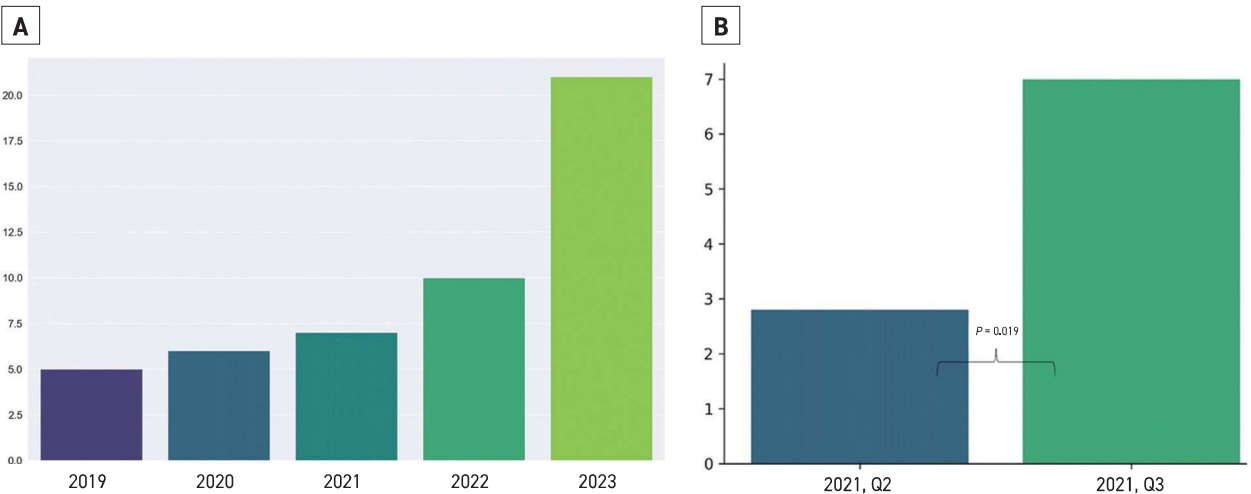


Figure 2. Distribution of affiliations of artificial intelligence projects across departments from 2019 to 2023 at the Rabin Medical Center Innovation Center

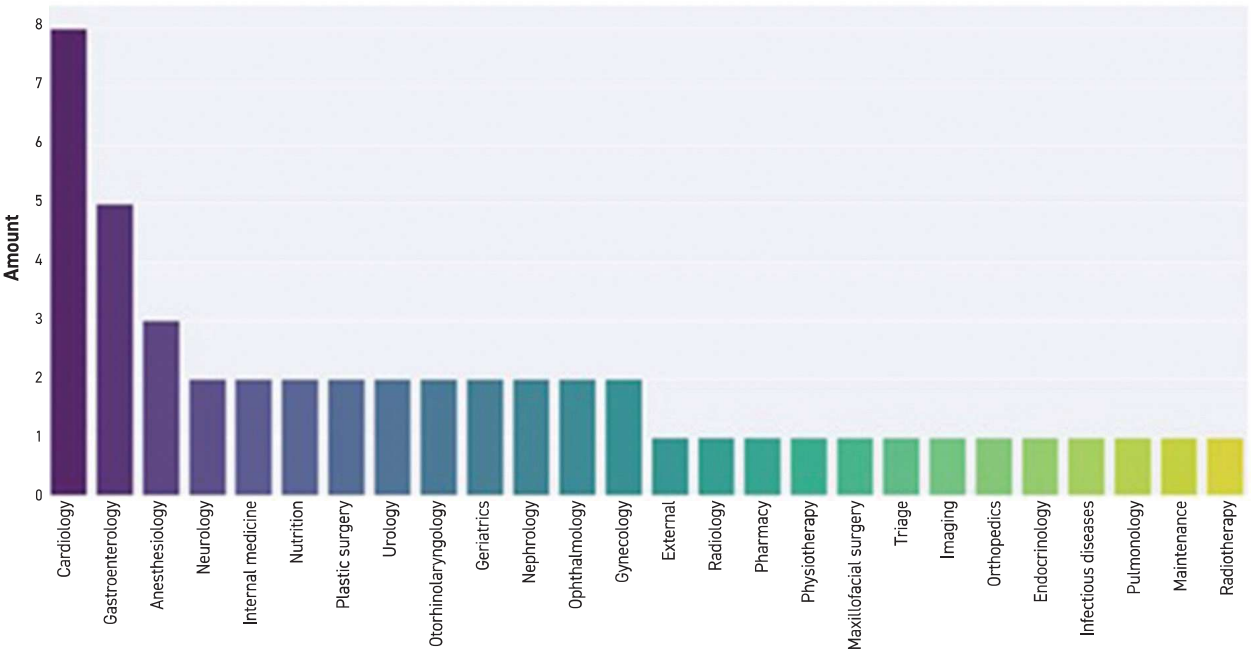
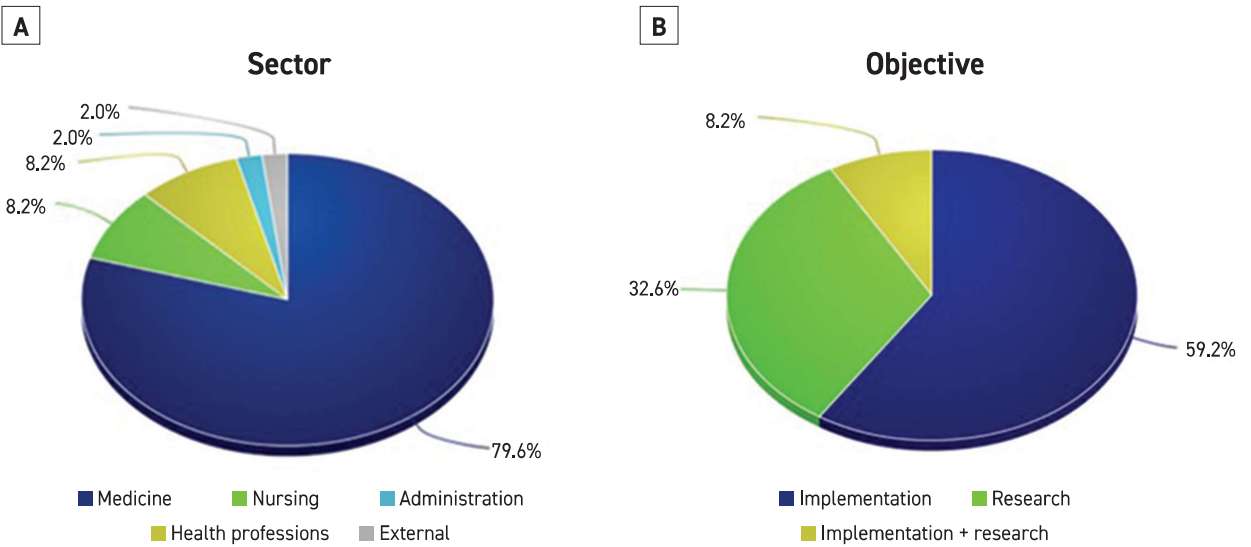


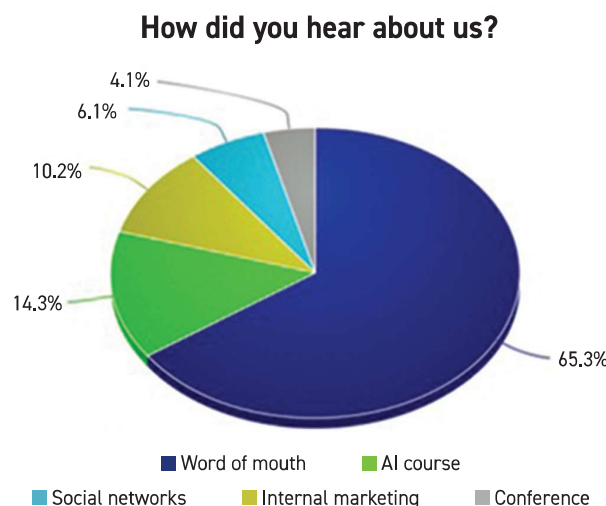
Figure 3. Distribution of artificial intelligence-based ventures from 2019 to 2023 at the Rabin Medical Center Innovation Center by sector and objective



For example, the Johns Hopkins Precision Medicine initiative (inHealth) focuses on accelerating the development and integration of precision and personalized medicine through artificial intelligence [14]. Hospitals are also incorporating AI units to enhance decision-making processes, with AI algorithms assisting doctors in disease diagnosis, outcome prediction, and personalized treatment planning. For example, Mass General Brigham Hospital's

data science office oversees the entire life cycle of AI products and services, from conceptualization to clinical implementation [15]. The strategies for AI integration in hospitals vary, with many establishments collaborating with technology firms, universities, and external start-ups to develop AI capabilities through cross-disciplinary partnerships. Notably, Mayo Clinic and Google established a 10-year strategic partnership in 2019 to leverage

Figure 4. Distribution of the ways medical center employees learned about the innovation center and subsequently started artificial intelligence projects 2019–2023



Google Cloud for data storage and use AI tools to address complex health challenges [16]. While the development of AI technologies in conjunction with medical centers is increasing, this phenomenon is still in its early stages, and many centers are just beginning.

At our center, we emphasize developing software independently whenever possible, in collaboration with academia and industry. Consequently, we have gained unique experiences in developing AI technologies within a hospital setting. Several key findings have emerged from this endeavor: First, successful project development within a medical environment necessitates a close collaboration between clinicians and technologists. This collaboration carries two key implications. Software professionals must possess a deep understanding of clinical knowledge, the unique therapeutic and regulatory aspects of the healthcare system, and the needs of the treatment teams. Technological breakthroughs must arise at the intersection of technological capabilities and medical requirements, and one effective way is ongoing engagement with clinicians. The establishment of a research and development center within a hospital, operating within a non-sterile environment naturally intertwines the technological development process with clinical practices. In addition, hospital staff must gain fundamental knowledge in artificial intelligence. Thus, we have developed an accelerated course for Rabin Medical Center employees. The course is offered biannually at no cost to medical center employees, and prior knowledge in

AI is not a prerequisite. During the course, we focus on imparting relevant AI knowledge in the medical context. The positive outcomes of this training initiative include an increase in the number of initiatives proposed by the medical center employees and streamlining the development process. Imparting AI knowledge to medical center staff fosters effective communication and precision in technological development.

In addition, it is crucial for the Artificial Intelligence Center team to remain open-minded to ideas that can be nurtured within the hospital. Innovative concepts can be suggested by any employee, including those in sectors traditionally less active in research, and these ventures can hold substantial value for the healthcare system. The diverse expertise enables us to comprehensively explore opportunities for technological advancement within the hospital.

Those initiating AI ventures must be able to define, consolidate, and retrieve various types of medical data, including patient characteristics, laboratory test results, diagnoses, and medication history. Other data include MRIs, CTs, ultrasounds, and even genetic information. Furthermore, there is a need for smart anonymization.

We have also observed an increasing emphasis on the adoption of AI methods within specific departments. These departments are incorporating advanced methods into their academic routines and providing support. When the appropriate infrastructure and personnel are available, AI presents an opportunity to make advancements based on medical data. While the speed of technology adoption may vary among departments, there is clear evidence of rapid growth in AI, with expectations of its eventual integration across all clinical fields [17].

As part of the medical center's innovation center, our developments are patient centric. We collaborate with clinicians to understand the relevant therapeutic pathways and the clinical value of our developments. This procedure ensures that our solutions not only meet high technological standards but also contribute significantly to improving patients' life expectancy and quality of life.

These advancements were possible because innovation is research is an integral part of the hospital's strategy. These initiatives have been communicated to department managers and incorporated into their annual work plans.

The ability to conduct research and develop projects based on advanced technologies within the hospital, with direct access to medical staff, equipment, data, and patients, enabled us to develop high quality solutions while ensuring rigorous validation. The increasing interest in the application of artificial intelligence in medicine is ex-

pected to promote a better understanding of the correct and responsible implementation of this groundbreaking technology for the benefit of patients [18].

CONCLUSIONS

Establishing an AI center within a medical institution promotes the initiation of technological projects stemming directly from medical needs. Innovative and groundbreaking projects using AI models can be developed by clinicians in hospital settings. These initiatives can influence numerous facets of patient care, from prevention and diagnosis to treatment and follow-up. AI projects are initiated and shared by clinicians across various departments and sectors. This, in turn, boosts activity in this domain. We anticipate the establishment of artificial intelligence centers in medical institutions globally. More than 14% of referrals to the AI center came from participants in the AI course, second only to recommendations from interpersonal communication. Prioritizing education and making artificial intelligence knowledge accessible to hospital employees are crucial steps in nurturing an organizational culture of innovation and advancing digital health initiatives. The trend of integrating AI-based technology into healthcare services continues to intensify. This technology will become a central tool in the modern physician's toolkit, enhancing the delivery of quality medical care.

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Which of us is not forever a stranger and alone?

Thomas Wolfe (1900–1938), American novelist

To bear up under loss, to fight the bitterness of defeat and the weakness of grief,
to be victor over anger, to smile when tears are close, to resist evil men and base instincts,
to hate hate and to love love, to go on when it would seem good to die, to seek ever after the glory and the dream,
to look up with unquenchable faith in something evermore about to be, that is what any man can do,
and so be great.

Zane Grey (1872–1939), American author and dentist.