Special Article

Motivation of Radiologists for the Application of Artificial Intelligence in the Diagnosis of Breast Diseases

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Abstract
The growing needs of organizations require a greater operational penetration of cutting-edge technologies. The ever-increasing application of Artificial Intelligence (AI), one of the achievements of high technology, is causing a revolution in digital modernization, which in many ways shares the same dynamics as industrial revolution.
Artificial intelligence (AI) has the potential to provide integrated solutions for the operation of any organization, particularly those in the healthcare sector, which are characterized by the complexity of healthcare functions and the significant social importance of their objective, which is safeguarding the ultimate good: health.
Although the advantages of its utilization are irrefutable, certain collateral challenges may engender feelings of unease and self-restraint upon its integration, which those occupying positions, whether as healthcare professionals or managerial personnel, are compelled to confront.
The aim of this article is to document the importance of AI in healthcare settings and to outline strategies for motivating healthcare professionals to adopt its use in a seamless and effective manner. In particular, an attempt is made to identify specific motivations for breast radiologists in a Greek public cancer hospital to consciously and unconditionally embrace the use of AI in the imaging and diagnosis of breast diseases. The motivational methods used are primarily based on Maslow's theory, with additional reinforcing elements derived from the Theory of Traditional Practice (Taylor, 1911), the Theory of Justice and Equity (Adams, 1963), as well as from the Theory of Expectancy (Vroom, 1964/ Porter, Lawler, 1968).

Keywords: artificial intelligence, motivation, healthcare professionals, motivation theories, healthcare units, breast radiologists.

Introduction

AI is the technology that enables digital systems to analyse their environment and act autonomously to achieve specific goals (JRC Technical Reports, 2020, p. 9). Its operation is based on the utilization of extensive databases, which are continuously generated, particularly within the healthcare sector.

We are witnessing an explosion of the new technology with its hesitant and at the same time extensive integration into all aspects of organizational functioning. AI has a variety of applications in healthcare, including both clinical and administrative processes (Mudgal, 2022, p. 4), with an ever-expanding scope. Its development in healthcare is considered imperative due to the increasing

and changing qualitative and quantitative needs, as well as the requirement for increasing competitiveness and alignment with innovative technology worldwide (Davenport & Kalakota, 2019, p.94).

In light of the resistance encountered in the integration of new technological developments, the incorporation of AI is obstructed at several points that need to be managed. One of the key issues is the lack of trust in the technology among healthcare professionals (Petersson et al., 2022, p. 13). The objective of modifying the negative attitude is to be accomplished through the implementation of incentives in accordance with the existing motivational theories (Dikeos et al., 1999, p. 311).

In terms of AI penetration in Greek companies in general, it is only 12% (Insurance EEA, 2024), while when globally 70% of employees are using the latest GenAI technologies (Genetic AI, a subset of 'deep learning' technologies) (Davenport & Kalakota, 2019, p. 94), the corresponding percentage in Greece is only 54%. In any case, there is a deficit in training and limited guidance from employers (Economikos Tachidromos, 2023). Especially in the healthcare sector, the penetration of digital solutions is still relatively low, both across Europe and in Greece (Naftemporiki, 2018), in the latter case mainly limited to the use of individual applications. Examples include the VizAI software (Metropolitan Hospital, 2024) for the early treatment of strokes, ProFound AI™ (YGEIA, 2020) for the detection of lesions in breast examinations, the Mako (Stryker) robotic system (Euromedica Blue Cross) for the surgical treatment of knee and hip osteoarthritis, the PAP-AI application (Thessaloniki Papageorgiou General Hospital) for patient secretarial services.

Subsequently, the significance of AI implementation in healthcare settings is analysed, the most effective motivational theories for healthcare professionals based on their specific needs are suggested, as well as the motivations of breast radiologists at a Greek public cancer hospital are identified, with the objective of a specialized utilisation of AI in the diagnosis of related diseases.

The significance of incorporating artificial intelligence into healthcare facilities

The increase in life expectancy (Naftemporiki, 2018) and thus the ever-increasing need for health services, creates additional requirements such as resource savings, management of huge clinical and other databases and their interconnection, more accurate and faster diagnoses, personalized treatments and medicines, integrated financial management, decision support, and remote health services in the post-Covid era (Klumpp et al., 2021, p.2). The need to meet the aforementioned requirements, to adapt to the current digital landscape and to reduce overall costs (Naftemporiki, 2018) are the main reasons for the incorporation of AI in healthcare.

In the present phase, the principal domains of implementation are as follows:

- Diagnosis and management of rare and chronic diseases, treatment, follow-up and patient care.

- Patient engagement, which may be facilitated through the use of implanted or body-attached 'smart' devices (Saut & al., 2023, p.2).

- Administrative function (request processing, clinical documentation, financial management, medical records management, and patient interaction through chatbots, resource management) (Klumpp et al., 2021, p.5, 14-19), (Davenport & Kalakota, 2019, p. 96).

Overall, the implementation of AI in health units is extremely beneficial, by introducing a novel approach to clinical and administrative processes. Its applications have led to thunderous advancements, including timely, accurate, and efficient diagnosis and treatment, integrated, expedited and easier management of clinical data for improved personalized treatment, enhanced support for patient visits, reduced operational costs, more convenient access and improved health service quality (Klumpp et al., 2021, p. 2-3).

The facilitation of operations by AI applications through the processing of time-consuming procedures contributes to the saving of valuable time and effort, which can

then be utilised for the specialisation, qualitative upgrading and deepening of the subject of health professionals, both at the scientific level and at the level of social skills and human characteristics (Economikos Tachidromos, 2023).

Under business terms, the advent of AI situates organizations within an innovative and technologically advanced milieu, thereby reinforcing their competitive edge and enhancing the value of their services. This, in conjunction with enhanced employee efficiency, facilitates the exploration of new market opportunities and the pursuit of additional funding sources through the engagement of innovation partners (Ministry of Economy and Finance, 2024).

The integration of AI into the patient-health professional relationship, can facilitate a more balanced, safer and efficient framework (Kerasidou, 2020), under the condition of the implementation of safeguards for some controversial points that elicit scepticism and have a negative impact on the weighting of benefits.

The challenges primarily concern digital ethics (Agency, 2024), diagnosis, medical data management, robotic medical staff, socially equitable distribution of resources, personalized treatments (Hickman & Baxter & Gilbert, 2021, p. 18-20; National Commission on Bioethics and Technology Ethics, 2023, p. 5-7; Agency, 2024; Klumpp et al., 2021, p. 16,20). Furthermore, challenges concern legislation that needs to be updated and adapted on the disputed points of sharing and management of sensitive personal data (EU Regulation 2016/679, p. 10), cybersecurity (Cybergreece, 2023), and liability performance in clinical and administrative decision-making (EU Regulation 2017/745, p. 65), (Kitsakis, 2023).

It is also important to consider the lack of transparency in the operation of applications (Kasula, 2024, p.2; Kitsakis, 2023), the phenomenon of indiscriminate use and complete trust in AI without the interference of human reasoning (automation bias) (Nishant & Schneckenberg & Ravishankar, 2024, p. 1), the selection of reliable AI technologies (Baeroe, 2020, p. 2), the high cost of investments without socially equitable reward and without corresponding social need for certain sectors (healthcare) (Kitsakis, 2023). Further attention is required with regard to the potential incorporation of origin-based biases in the data (Bouloutza, 2023), as well as the definition of cost-benefit in economic and safety terms (Economikos Tachidromos, 2024). It is of the utmost importance that the beneficial importing of AI for all involved parts, including healthcare organizations as profit-driven business entities, is achieved.

Specific inhibiting factors for Greece are the lack of interoperability, of competitive standards, incentives and long-term planning. Also, digital illiteracy and a technophobic attitude (Special Secretariat of Foresight Presidency of the Greek Government, 2024, p. 4).

The recent decision to include the smartHEALTH service (Ministry of Economy and Finance, 2024) in the Competitiveness Programme (Competitiveness Programme 2021-2027, 2024) illustrates the necessity to satisfy a more extensive business demand, in the context of the consideration of the benefits that emerge from the utilization of AI in the country's health organizations.

Motivation of healthcare professionals for the implementation of AI

The motivation will be achieved through the utilization of incentives that aim to fulfill specific needs (Dikeos & al., 1999, p.309). In order to identify these needs, a number of factors were taken into account, including:

- the specificities of the tasks (Table 1),

- the present socio-economic conditions,

- expectations, fears and challenges as inhibiting factors in the minds of the personnel.

As it appears in Table 1, the tasks with the highest frequency are the entry of patient data and the operation of machinery and devices. In addition to the quantitative, there is a qualitative ranking too. Therefore, surgical and other procedures are of significant importance, as are drug selection, analysis and imaging.

In terms of priority, the following necessities are detailed identified:

- The financial reward is of primary importance, given the prestige associated with these professions.

- The saving of valuable time, will facilitate the improvement of professional skills and the reduction of work-related stress.

- The increase of the precision, reliability and efficiency of medical, nursing and management practice (Klumpp et al., 2021, p.2-3; Hazarika, 2020, p. 242).

- Job security is a significant factor, largely due to the understandable fear that arises. It promotes safety.

- Further specialization, to achieve more targeted scientific results and consolidate human scientific excellence.

- Reinforcement of the feeling of superiority in relation to technology, through the advancement of social and interpersonal skills (imagination, ethics, creativity, empathy, emotional intelligence) (Economikos Tachydromos, 2023)).

- The technical preparation of professionals that will eliminate the "black box" effect (Kitsakis, 2023), thus will suspend suspicion by removing the lack of transparency.

- The reduction of job stress, as a primary need for the improvement of working conditions (Hazarika, 2020, p. 241).

- Personalized (gene-based) treatment and hospitalization, for improving the quality of services and increasing reliability.

- Identification of "digital ethics" (Kasula, 2024, p.2; Praktoreio 2024), modification of GDPR for the personal data protection (EU Regulation 2016/679, p. 7, 34,65).

- The reduction/elimination of the possibility of error, for service improvement and increase of reliability.

- Ensuring ethical conduct in the doctor-patient relationship, thereby enhancing credibility and social recognition.

- Social recognition as an integral and primary human need.

- Innovation, for enhancement of competitiveness and employment opportunities.

- Self-esteem, that demands enhancement after the replacement of conventional human activities by technology.

- Self-realization, in accordance with the demands of contemporary social conditions.

The selection of the most appropriate motivational theory (Dikeos & al., 1999, p.311) will be based upon its better adaptation to the specified requirements (Table 3).

More detailed:

The Traditional Practice: Has the potential to motivate employees to pursue financial rewards and enhanced working conditions.

Maslow's Theory: The perfectly adapted to this theory individual needs, can belong simultaneously to more than one rungs of the pyramid and this allows the parallel motivation of different rungs.

Herzberg's Theory: Indicates the needs at an exclusively working-level perspective. The theory does not address the fulfillment of fundamental needs, such as working conditions, economic reward, security, social recognition, as it views these factors as neutral disincentives.

McClelland's Theory: is not responsive to the needs that have arisen as a result of the incorporation of AI. They primarily concern basic human needs, psychological and physical (security, financial reward, enhancement of basic human characteristics, self-esteem, self-realization).

The expectancy Theory: incentives' development for health professionals to accept or reject AI, with corresponding benefit or cost depending on meeting or not meeting their needs.

The Theory of justice: incentives that boost the importing of AI, in order to achieve a ratio of "result/offer" equal to one, and not less than one as it is now.

The Parity Theory: use of incentives that after the implementation of AI will equalize the value of the "result/offer" ratio for professionals in Greece with those worldwide.

Currently being experienced economic crisis by Greek society, imposes coverage of

fundamental human needs, with security being of particular importance. Those working in the health sector have been significantly impacted primarily financially, secondarily socially. 'Maslow's theory' is the most appropriate for meeting the needs identified, in terms of quantity (Table 3) and psychology as well, as it is fundamentally anthropocentric (Geleki, 2020, p. 33, 77), not in an exclusively labour but also in a broader context. The theory is supported by elements of other theories, including the 'Traditional Practice' for meeting working conditions' needs, the 'theory of justice' to maximize the outcome of the employee's contribution, the 'theory of parity' for the synchronization of the employees with global trends, and the 'theory of expectations' which directly poses the dilemma "importing or not of AI for multiple needs' satisfaction, adapting or not to modern technological developments, reaping or not the benefits of its implementation".

Motivation incentives for breast radiologists

The case study is for the Radiology Department of a Greek public Cancer Hospital and concerns the utilization of AI applications for the breast imaging and diagnosis.

AI through 'deep learning' technology (Hickman & Baxter & Gilbert, 2021, p. 3) can be implemented for the identification of potentially cancerous tumors, including lesions invisible to the human eye (Davenport & Kalakota, 2019, p. 94).

The responsibilities of the breast radiologist encompass a range of activities, including conducting examinations and writing medical reports, performing biopsies, evaluating of medical records, diagnosing and taking clinical decisions. Additionally, they offer guidance to patients and collaborate with other medical specialties for the treatment of the disease. In addition to these duties, the comprehensive management of the patient requires the recording of extensive clinical data and the recording of the course of the disease.

As outlined in Chapter 3 of this document, the necessities of the specialty, with an emphasis on certain specific, can be classified into the following categories:

- The accurate and valid diagnosis and the elimination of the possibility of error, with a special requirement for early detection and even prediction of disease development.

- Time saving, through the discharge of the simple procedural tasks of the input and management of large amounts of clinical data. It will facilitate further specialization and quality enhancement, while utilizing social skills and ultimately aiming to an even better patient treatment.

- The reward, both material and moral.

-The coverage of the elevated demand in breast imaging production, given the reduced supply of relevant specialities (Hickman & Baxter & Gilbert, 2021, p.1).

- Job security, through enhancing human skills, specialization and demonstrating a spirit of cooperation with other groups of employees, management and AI applications.

- Social recognition, self-esteem and self-realization.

- Innovation, for increase of competitive advantage globally.

- The reduction of work stress, with the aim of improving working conditions quality increase of efficiency.

Considered the motivational theories selected in Chapter 3 and the aforementioned needs, the following motivations were identified:

- Financial reward with a salary increase, a special allowance for specialization, seminars and bonus according to performance and development/implementation of soft skills.

- Opportunity for receiving specialized training and obtaining a certificate of specialization (e.g. breast radiologist, specialist analyst and supervisor of AI applications). Reinforces the necessity for safety through job retention, treatment process and relationship between the patient, social acceptance, self-esteem, self-realization.

- Opportunity for professional development, provided that specialization will take place, as well as adaptation to the new technology.

- Technical preparation and updating for the reception of AI, with special leave of absence for seminars and awarding of training certificates. The role of the radiologist will be promoted and a sense of security will be given a boost, as the preparation will eliminate or reduce the anxiety caused by the unknown and the potential loss of employment.

- Formation of in-hospital working groups on the subject of AI is to be established. It will cover social and collaborative requirements, will improve the interoperability of the organization, will contribute to the seamless collaboration between staff of diverse specialties and AI, provide will radiologists with a holistic view of the hospital encompassing both medical, as well as overall operation (e.g., resource management).

- Opportunities to articulate needs, problems, concerns and recommendations. They will tone collaboration, social interaction and professional relationships and will facilitate the integration of AI by eliminating prejudices, fears and inhibitions (through questionnaires, interviews or group discussions).

- Emphasis on enhancement and development of social skills through training groups and workshops, for promoting the human characteristics that are superior to AI.

- Separation of tasks into low and scientific-high level is intended for toning the sense of parity and avoiding strain.

- Reduction of working hours for toning the sense of fairness and avoiding strain.

- Collaboration with hospitals abroad for exchanging expertise and experience and special salary increments, for stimulating a sense of parity, increasing of experience, raising self-esteem and self-realization.

- Cultivation of a personal and exclusive relationship with the patient, for a more personalized and therefore improved treatment. Aims to the enhancement of the scientific credibility and human relationships over technology (Hazarika, 2020, p. 244). Practically, technology will have an auxiliary role in the doctor-patient relationship.

- Involvement of radiologists as key figures-lecturers in seminars, conferences and scientific presentations. Social acceptance and sociability will be increased. AI will be set backstage, whereas human intelligence will be in the centre reinforced with creativity, imagination, emotional intelligence.

As far as the relationship between incentives is concerned (Politi, 2014, p. 7), most of them are compromising between them, that is one enhances the satisfaction of the others. Only the reduction of working hours could foster an antithetical relationship with financial reward, something that will depend on the reward system selected by management (Daliaris, 2015, p.145-147).

Discussion

Considering the still unexplored functioning of the human brain, researchers can assure that in five years AI will be successful in basic tests, but not in specialized, involving advanced brain functions. Consequently, harmonious collaboration between human and AI will continue to be necessary, so that healthcare organizations will be taking advantage of the undeniable privileges of this new technology.

Crucial selection of health professionals' motivating factors so that they will consent consciously and not under pressure, will contribute to the regular future development. The inclusion of a person-centered approach (for patients and professionals), cost-benefit relationship, appropriate legislative adaptation, external conditions, appropriate patient involvement, administrations' capacity for strategic changes, beneficial modifications of health professions, healthcare practices and organizational culture will also contribute to this objective. Furthermore, broad social access, adequate funding and equitable resource allocation, preparation for adverse technological situations, as well as the relationship with the appropriate stakeholders, will determine the future successful and efficient integration process of AI systems in healthcare sector.

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Table 1: Definition of tasks and frequency of occurrence in health professionals

Health professional	Duties											
	Examination	Diagnosis	Evaluation of medical history	Selection of medication	Surgical and other interventions	Entry data management (clinical and administrative)	Registration of disease process	Patient measures	Nursing	Nursing history	Analyses, images	Handling of machine and appliances
x (times)	10	9	9	5	5	17	8	5	1	1	6	14
Relative frequence of tasks' occurrence (x/18)	0.55	0.5	0.5	0.27	0.27	0.94	0.44	0.27	0.05	0.05	0.33	0.77

Table 2 : Meeting needs through motivational theory

Need	Motivation theories													
	Traditional Practice			Maslow's Theory				Herzberg's Theory	McClelland's Theory			Expectancy Theory		Theory of Justice	Parity Theory
	Economic motivation	Social motivation	Enrichment	Security	Social needs	Self-esteem	Self-realization		Goal achievement	Bonds formation	Authority	Importing	Non-importing		
Financial reward	√			√	√	√	√					√		√	√
Time saving		√						√				√		√	√
Accuracy and validity					√	√	√					√		√	√
Safeguarding of job position		√		√									√		
Specialization				√	√			√				√		√	√
Reinforcement of human excellence		√		√					√			√			

Technical preparation		√		√								√			
Reduction of work stress		√		√								√		√	√
Definition of digital ethics- GDPR modification					√					√			√		
Personalized hospitalization- therapy					√			√				√		√	√
Reduction- elimination of the likelihood of error		√		√		√						√		√	√
Ensuring medical and professional ethics		√		√	√							√		√	√
Social recognition		√			√	√	√			√		√		√	√
Innovation-increase competitive advantage		√		√	√	√	√	√				√		√	√
Self-esteem						√		√	√			√			
Self-realization							√	√	√			√		√	√