The Path of Digitalization for Public Healthcare Institutions in the Province of Annaba (Eastern Algeria)

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Abstract

This study attempts to discuss the digitalization of Algeria's health care sector, focusing on public hospital institutions operating in Annaba province as a case study. To achieve the aforementioned objective, a descriptive methodology was employed, utilizing various data, statistics, and reports relevant to the topic, obtained through fieldwork conducted at the Directorate of Health and Population in the province of Annaba. The results of the field study indicated that considerable efforts had been made to digitize public hospital institutions in Annaba province, which had contributed to improving the digitalization of public hospital institutions in the province to nearly 50 per cent. However, many challenges remain in the digitalization process in the province's health-care sector, most of which are technological, administrative, human, financial and legislative in nature, and must be addressed with rapid solutions.

Keywords: *digitalization, healthcare, hospital Institutions, patients, Province of Annaba*

Introduction

Most countries consistently strive to achieve stability and continuity, with the health of individuals being one of the highest priorities for governments. Many nations have invested their material and human resources to enhance healthcare, especially in a world currently experiencing significant changes across all levels and various fields. One of the most recent and impactful of these changes is the COVID-19 pandemic, which had severe repercussions, compelling most systems to enter the realm of digitalization to keep pace with scientific and technological advancements across all vital sectors, particularly healthcare.

Algeria is also facing these challenges, making it essential to adopt a specialized digital information system for managing public hospitals that aligns with rapid technological developments. The Algerian government, through the Ministry of Health, is making substantial efforts to modernize the healthcare sector and digitize public hospital institutions. This initiative aims to accelerate and simplify the management process of the healthcare sector by implementing a dedicated digital system. In light of the ministry’s recommendations to expedite

the digitalization of the healthcare sector, it can be said that digitizing public hospitals is not only an urgent necessity but also represents the future of the healthcare system as a whole. To achieve this, continuous efforts must be made to improve healthcare services by leveraging technology and digitizing the healthcare sector. In this context, this study attempts to assess the current state of digitalization in public hospital institutions in the province of Annaba, identifying the key efforts and obstacles to their digitalization, with the aim of providing recommendations that could support the digitalization of the Algerian healthcare sector as a whole.

1. Literature Review

If we look back just five years, we find that local studies addressing digitalization were quite scarce, comprising only a few research papers and theses written in French or Arabic. However, starting in 2020, the Ministry of Higher Education and Scientific Research in Algeria adopted digitalization as one of the key pillars of reform for the higher education sector in the country. This led to the establishment of research laboratories and centers focused on digitalization, as well as encouraging Algerian researchers to study digitalization and apply it to various economic, social, human, political, scientific, and artistic fields. As a result, today, there is a significant number of previous studies conducted by Algerian researchers in English on the subject of digitalization in general. In the economic domain, many local studies have focused on uncovering the reality and impacts of digitalization on the local economy and various macroeconomic variables. Among the most recent of these studies are those by Bouberka, Fadel, & Derrar (2013), Djeddi & Ferkoul, (2023), Tiour, Koridjidj, & Khalifa, (2024), and Boutarfa (2024).

There are also numerous other local studies that have explored the applications of digitalization across different sectors and industries in Algeria, particularly following the global COVID-19 pandemic, which saw a significant boom in digitalization both globally and locally, as it became the optimal tool for implementing lockdowns and social distancing measures. Some of the key local sectors that Algerian researchers have focused on in their digitalization studies include the telecommunications sector (Ouchene & Belkaci, 2022), (Nedil, Zerouli, & Khouatra, 2014), the banking sector (Boukrouh, 2022) (Adnane, 2014), (Khanoussa & Fodil, 2024), commerce and marketing (Chaabna & Wang, 2015), (Bensaad & Annabi, 2024), tourism and hospitality (Guemide, Benachaiba, & Maouche, 2019), (Azizi, Benbordi, & Derbal, 2024), and education (Zermane & Aitouche, 2020), (Abderrezzak & Dahmani, 2024)

Regarding previous local studies that have addressed the topic of digitalization in the Algerian healthcare sector, they are very limited. Among the most recent is a study by Benmoussa & Boubechiche (2024), which aimed to clarify the role of e-health in the management and governance of healthcare institutions in Algeria. To achieve this objective,

the researchers conducted a field study at the Ras El Ouyoun Clinic in Batna, focusing on the uses of the GMAO platform, a digital healthcare platform in Algeria. The study concluded that this digital platform plays a significant role in shaping the strategies and directions of healthcare institutions concerning the acquisition and maintenance of medical equipment.

Another recent study conducted Cherroun & Debla (2024) aimed to discuss a new form of digitalization-based healthcare service, namely Hospital at Home (HAH). To achieve this objective, the researchers used interviews with the head of the HAH service and the medical staff at a hospital in Algeria providing this service, specifically Hakim Saadan Hospital in the province of Biskra (southern Algeria). The study concluded that there is increasing interest in this service, given the large number of patients who need it, as it is an innovative tool for providing high-quality and cost-effective care, particularly for the elderly and those with chronic diseases. However, there are noticeable shortcomings, particularly in the inadequacy of equipment for the medical staff providing this service.

The study by Ben Toumi (2023) aimed to explore the role of health information technology in mitigating the effects of the COVID-19 pandemic. To achieve this objective, the researcher conducted a survey-based study using a questionnaire tool on a random sample of 73 doctors and administrators at private hospitals operating in the province of M'sila (eastern Algeria). The study found that the private hospitals under study make good use of health information technology, which helped reduce the negative impacts of the COVID-19 pandemic by 44.89%.

Bentlemsani (2023) conducted a study aimed at understanding the contribution of digitalization to the management of the Algerian healthcare sector during the COVID-19 pandemic. To achieve this objective, the researcher conducted a field study at the Mohamed Boudiaf Public Hospital in the province of Médéa (central Algeria), using interviews to gather opinions from a group of administrators and doctors at the healthcare institution under study. This study ultimately demonstrated the role of digitalization in mitigating the effects of the COVID-19 pandemic on the healthcare sector in Algeria. However, the biggest challenge facing digitalization, according to the study's results, is updating patient data at the hospital, which typically takes a long time.

In the same year, Kherraz (2013) conducted a study aiming to shed light on the use of information and communication technology (ICT) in developing healthcare in Algeria as a case study. The study also aimed to propose better ways to use technological advancements to overcome the challenges facing Algeria's healthcare system. The researcher divided the study into several parts, the first of which addressed the state of healthcare concerning the use of digital technologies in accessing, processing, and storing information. The study then highlighted the various drawbacks of the misuse of ICT in healthcare settings, identifying causes and consequences.

Another study Brahimi & Dergal (2022) aimed to evaluate the initial steps of digitizing Algeria's healthcare sector. To achieve this objective, the researcher conducted an analytical study of one of the most prominent digitalization projects in Algeria's healthcare sector, adopted by the Ministry of Health—the "SIHATIC" project. Using a questionnaire tool, the researcher surveyed a random sample of 53 employees from healthcare institutions in the province of Oran (western Algeria). The study concluded that there is significant use of digital technology in the healthcare institutions under study. However, the results of digitalization implementation in Algeria's healthcare sector have not been satisfactory so far, indicating the need for further efforts in this area.

2. Theoretical Framework

2.1 Basic Concepts of Digitalization

Digitalization is a modern concept that emerged with the development and evolution of information and communication technology. The term refers to the use of digital technologies to transform business models and processes, creating new opportunities for wealth (value) generation (Jovanović, 2020, p. 66).

Digitalization also represents various procedures that allow the transformation of available intellectual content from traditional physical storage media into an electronic (digital) format that can be circulated and reduced to numbers and codes (Frenzel, Muench, Bruckner, & Veit, 2021, p. 02).

Digitalization is defined as a technical process that converts previously created paper-based data from analog format to digital format using binary systems (Rittera & Pedersen, 2020, p. 181). This process enables the immense capability to store, process, and transmit this information via computers (Chen, Despeisse, & Johansson, 2020, p. 03).

Digitalization is characterized by several key features, summarized as follows:

- **Time Reduction:** This refers to the ease and speed of accessing stored information through electronic media (Plesner, Justesen, & Glerup, 2018, p. 03).
- **Space Reduction:** Digitalization eliminates geographical boundaries, effectively making all locations adjacent (Päivi , Maarit , Jukka , & Susanna , 2017, p. 64).
- **Formation of Communication Networks:** A collection of technology and information-based equipment unite to form communication networks, which enhances the flow of information among users and allows the exchange of information with various other activities.
- **Interactivity:** Users of this technology can be both receivers and senders simultaneously. Participants in the communication process can exchange roles, creating interaction between individuals, institutions, and various actors (Päivi , Maarit , Jukka , & Susanna , 2017, pp. 64-65).

- **A synchronicity:** Digitalization allows users to receive messages at any time, meaning they can use the system whenever it suits them (Khan, Khan, & Aftab, 2015, p. 140).

The general importance of digitalization is reflected in (Azim, Yatin, Jensonray, & Mansor, 2018, p. 172):

- Ease and speed of obtaining information from its sources.
- Wide and in-depth access to information.
- Reduction of information acquisition costs.
- Ability to print stored information when needed.
- Provision of storage space, along with the protection of information.

2.2 The Nature of Digitalization in the Healthcare Sector

The digital and information revolution is one of the significant events that the world witnessed during the last two decades of the twentieth century. The focus on information and communication technology has become an urgent necessity to keep pace with the developments that characterize our current era, which have impacted all fields (Frączkiewicz-Wronka, 2021, p. 25). Amidst all these changes and increasing competition, the healthcare sector, like other service sectors, strives to adopt various strategies that will digitalize the healthcare sector and improve the quality of healthcare services provided (Panchbudhe, Pund, Jha, & Bankar, 2021, p. 115).

Healthcare professionals face a set of challenges that complicate the management of patients' health, among the most significant of these challenges is the absence of an electronic record that ensures the informational documentation of patients and their treatment paths. Consequently, citizens are compelled to maintain paper documents related to their medical files (prescriptions, medical analyses, radiological images). Additionally, the healthcare sector also suffers from a lack of documented data regarding health operations and their beneficiaries, whether in the public or private sector (Frączkiewicz-Wronka, 2021, p. 26).

Digital health or the digitalization of the healthcare sector is a relatively modern term used to describe the dual use of electronic information and communication technologies in the healthcare sector. It refers to providing consultations, information, and medical services to patients through electronic media, enabling the patient to follow up on medical examination results, laboratory analyses, and access information and services through hospital local network applications or the internet (Rajan & Shalini, 2019, p. 242).

The digitalization of the healthcare sector relies on applications of artificial intelligence, cloud computing, and electronic health records. The latter is a record designed to display all activities related to an individual's medical health, such as patient data, appointment scheduling, prescription requests, health information, medical communication with clinics, and prescription renewals in an electronic format. It also allows the patient to participate in the

preparation of their medical record, which should be designed to include all activities related to the patient's medical affairs (Blix & Levay, 2018, pp. 07-08).

The digitalization of the healthcare sector contributes to making information accessible to a larger number of stakeholders through digital platforms, facilitating access to healthcare services. It also simplifies searching through digital databases and retrieving information in various ways, enabling accurate diagnosis and follow-up of medical conditions. Additionally, it improves the quality of healthcare services and reduces their cost. Moreover, it eases communication between healthcare sector professionals and the exchange of expertise among them. Digitalization also enables the continuous updating of information and the provision of original data. Furthermore, it aids in monitoring and geographically and demographically tracking epidemics (as was the case during the COVID-19 pandemic) (Rajan & Shalini, 2019, pp. 242-243).

3. Methodology

The primary purpose of this study is to analyze the digitalization trajectory of public healthcare institutions operating in the province of Annaba. This analysis is conducted by discussing several key points, including the nature of the health map in Annaba, the current state of digitalization in public healthcare institutions in the province, and analyzing the various efforts and obstacles in the digitalization of the healthcare sector within the province. The discussion of the various aforementioned points provides us with a clear understanding of the trajectory of digitizing the healthcare sector in Algeria, which began relatively late compared to other global healthcare systems. The first attempts at digitizing the healthcare sector in Algeria date back to the early 2000s, progressing slowly until the global COVID-19 pandemic accelerated the pace of this digitization process.

Furthermore, this study aims to raise awareness among the officials of the Algerian Ministry of Health and managers of public hospitals in Algeria, particularly at the local level, about the importance of digitalizing the healthcare sector as a necessary tool for better governance and improving the quality of healthcare services. Another equally important objective of this study is to draw attention to the topic of healthcare digitalization in Algeria and to provide a preliminary study on this subject, which is relatively new for Algerian researchers, with previous local studies in this area being very scarce.

To achieve the aforementioned objective, this study primarily utilized a descriptive approach, analyzing and discussing the results of previous studies in the theoretical part of this paper. For the practical part, the study relied on a guided interview with the Health Director of Annaba province. Several open-ended questions were raised, closely related to the subject of the study, such as the strategies adopted for digitizing the healthcare sector, the efforts undertaken to achieve this goal, and the obstacles hindering the successful implementation of this process,

in addition to analyzing all data, statistics, and reports pertinent to the subject, which were obtained from the Health and Population Directorate of Annaba province. These documents were originally in French, and we translated them for use in the analysis. These documents included: plans for the digitization of the public health sector in Annaba Province, the status of the health map of Annaba Province, the annual reports of the Directorate of Health and Population of Annaba Province, and statistical bulletins related to the digitization of the healthcare sector in Annaba Province.

It Is worth noting that the Health”and ’opulation Directorate of Annaba province is a decentralized state service under the supervision of the Minister of Health, Population, and Hospital Reform and the provincial governor. It was established by Executive Decree No. 97/261 dated July 14, 1997, which defines the specific rules for the organization and operation of provincial Health and Population Directorates. The organizational chart of the Health and Population Directorate in the province was established by the joint ministerial order dated May 12, 1998, and comprises six main departments and eighteen offices. These departments include: the Human Resources and Legal Affairs Department, the Planning and Resources Department, the Infrastructure and Health Professions Department, the Prevention Department, the Population Department, and the Health Activities and Pharmaceutical Products Department.

The Health ’nd Population Directorate of Annaba province is involved in carrying out the following tasks: implementing health laws and regulations, executing national and local health programs, providing treatment and promoting healthcare, combating drug addiction, managing the sector’s human and financial resources, conducting social communication and awareness activities, collecting, analyzing, and managing health, epidemiological, and demographic data, managing healthcare infrastructure, providing emergency and disaster response services, monitoring and evaluating health investment programs, implementing health education programs, and overseeing professional competitions and examinations.

4. Results and Discussion

4.1 Overview of the Health Map of the Province of Annaba

The health map is a tool used within the national health system to comprehensively plan health services across the country in general, and at the local level in particular. This map aims to guide and coordinate all resources and activities dedicated to ensuring complete healthcare coverage.

The health map enables the identification of health needs and the implementation of necessary improvements in both the public and private health systems. This includes the appropriate distribution of resources and the correction of any regional or local imbalances. It also contributes to monitoring and controlling costs to effectively meet the health needs of the

population. Multiple factors are considered in this process, such as epidemiological data, demographic data, geographical data, and socio-economic data. Additionally, the orientations of the national territorial planning scheme are taken into account.

Annaba is located in the northeast of Algeria, approximately 600 km east of Algiers and 150 km from Constantine, and about 80 km west of the northeast Tunisian border. According to the most recent general census of housing and population in 2020, the population of Annaba is 802,768. The population is rapidly increasing, particularly in the districts of Annaba and El Bouni, which imposes a demand on the local authorities in the province of Annaba to provide health facilities and institutions capable of meeting the needs of the residents. The local authorities in the province have focused on establishing and organizing public hospitals, with a total of 10 structures including a university hospital center, specialized healthcare institutions, and public primary health institutions, among others, to ensure coverage for the entire population of the province. The following figure illustrates the types and number of public hospitals in the province of Annaba:

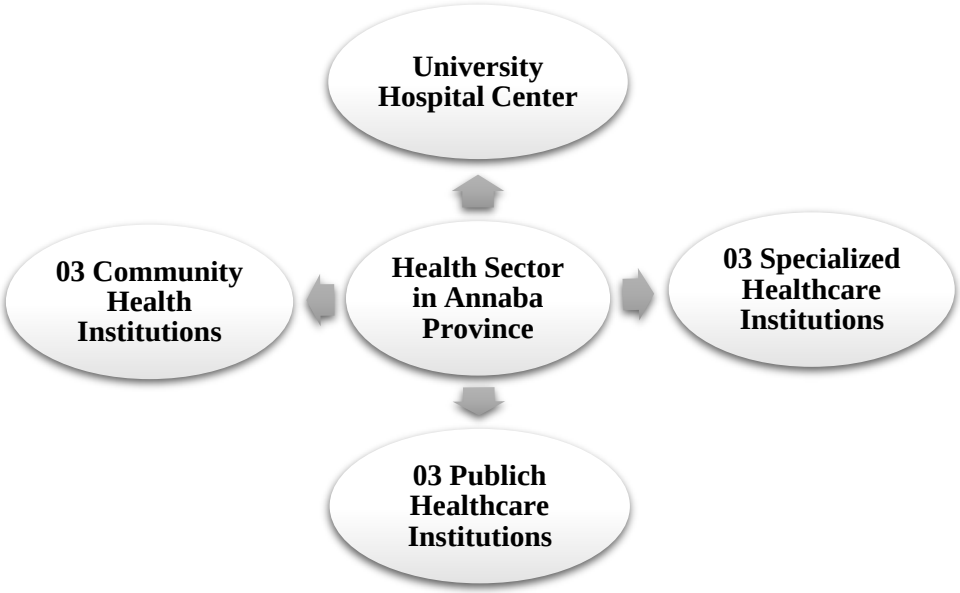

Figure 1: Structure of the Public Health Sector in Annaba Province

Source: Data from the Directorate of Health and Population of Annaba Province

Accordingly, the local authorities have worked to distribute their healthcare structures fairly, ensuring that all citizens benefit equally from the provided health services, thereby upholding the principle of equality before public services. The following map illustrates how health institutions are distributed across Annaba Province:

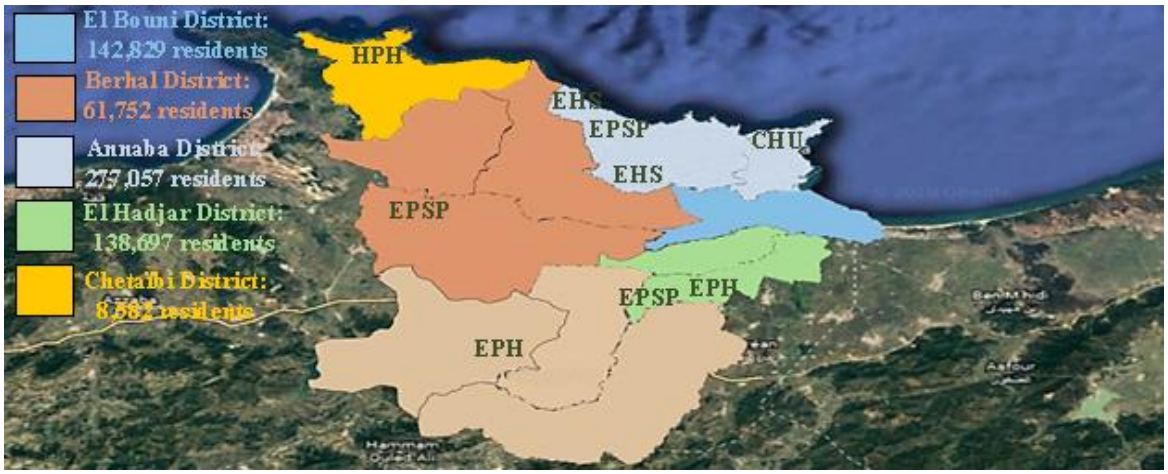

Figure 2: Percentage of Digitalization in the Health Sector in Annaba Province

Source: Data from the Directorate of Health and Population of Annaba Province

What is observed from the health map of the province is the local authorities' effort to distribute health services equally according to pre-established and approved criteria. This effort begins with the university hospital center, which is established with a regional focus. The term "regional" here refers to geographical regions rather than political or social regions. To clarify, each group of specific eastern provinces, namely Annaba, El Tarf, Skikda, Souk Ahras, and Tébessa, shares one university hospital center.

As for the specialized hospital institutions, of which there are four, they have been established in the two largest districts of the province, with two institutions each in the El Bouni and Annaba districts. It is worth noting that these types of hospital institutions are specialized in treating a specific type of disease or a specific category of patients from the entire province, as well as from the previously mentioned neighboring provinces.

Regarding public hospital institutions, the standard practice is to have one public hospital for every 80,000 inhabitants. For example, although the population in both the Ain Berda district and the Shattibi district does not reach the required threshold, each has its own district hospital, contributing to better healthcare services. Meanwhile, the El Hadjar district, with a population of 138,697, has only one public hospital. This is due to the presence of a community health institution within the same district, creating a balance between the two institutions.

However, what is noticeable from the health map of the province of Annaba is that the two largest districts, Annaba and El Bouni, lack public hospital institutions. The local authorities have instead relied on community health institutions and the university hospital center, which creates pressure on the previously mentioned institutions, especially since the combined population of the two districts is 419,886, accounting for 65% of the province's total population.

Additionally, the local authorities recognize that certain areas with populations exceeding 5,000 inhabitants, which are somewhat isolated—such as Saroul, Ain Jbara, El Kantra, Bou Sdera, Bou Zarroura, and Ain Sayd—require attention. As a result, the local authorities have begun constructing treatment rooms in these areas, with operations expected to start soon.

Furthermore, the local authorities have initiated studies to establish three more hospital institutions in the Berrahal and El Bouni districts. This initiative aims to reduce the pressure and burden on the hospital institutions in both Annaba and El Bouni districts.

4.2 The Reality of Digitalization in Public Hospital Institutions Operating in the Province of Annaba

The health sector in the province of Annaba is experiencing a significant delay in digitalization. According to the latest statistics conducted by the Directorate at the beginning of 2023, in response to a directive from the relevant ministry, the overall digitalization rate of the sector reached 50.3%. This percentage does not reflect the efforts made by the local authorities at the provincial level. The following figure illustrates the pace of digitalization in the health sector across the province of Annaba:

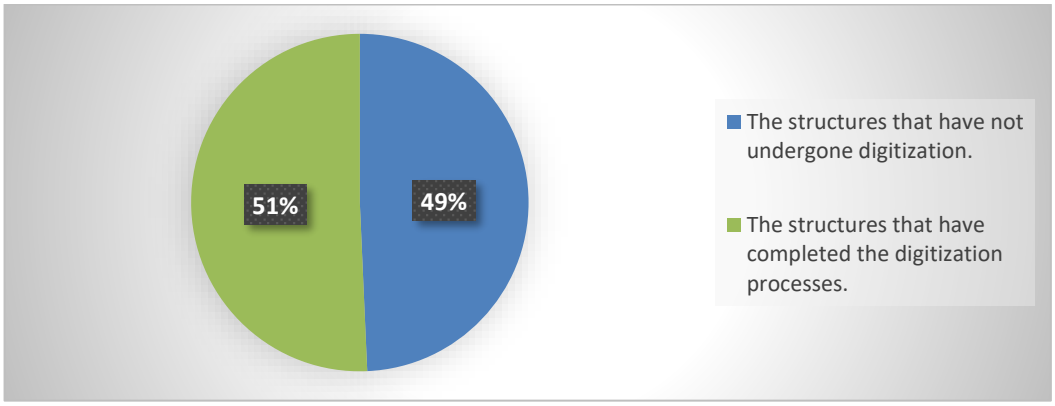

Figure 3: Digitalization Rate of the Health Sector in the Province of Annaba

Source: Data from the Directorate of Health and Population of the Province of Annaba

As previously mentioned, the percentage of 50.3% reflects the shortfall the sector faces in digitalization, particularly since the project of digitizing public hospitals is not a recent initiative but has been ongoing for several years. This project aims to improve the overall performance of the sector and to build and support an information system infrastructure specific to the Ministry of Health. The digitalization of public hospitals has been a primary goal of the ministry for years.

Analyzing the performance of public health structures in the province in terms of sector digitalization reveals that most of the delay originates from community health institutions. There

are three such institutions located in the Annaba, Berrahal, and El Hadjar districts. The following figure illustrates the progress in digitizing all health structures across the province:

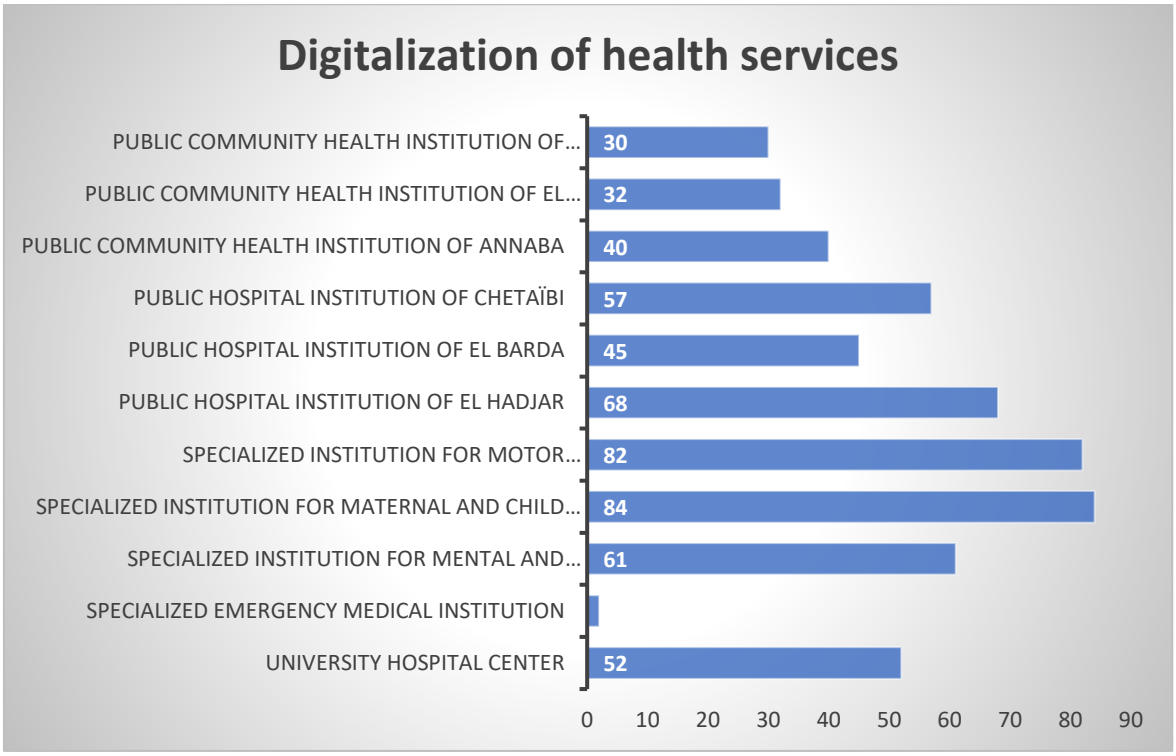

Figure 4: Progress Rates in Digitizing Public Hospitals Operating Annaba

Source: Data from the Directorate of Health and Population of the Province of Annaba

Here, we find that the three specialized hospital institutions—Specialized Hospital for Maternal and Child Health, Specialized Hospital for Motor Rehabilitation, and Specialized Hospital for Mental and Psychological Diseases—have surpassed a 60% digitalization rate, with the three hospitals recording rates of 84%, 82%, and 61%, respectively. These are the highest rates recorded in the overall sector digitalization, in addition to the El Hadjar Public Hospital, which recorded a progress rate of 68%. The university hospital center, meanwhile, reached a digitalization rate of approximately 52%, which is a significant figure considering the number of hospitals under its management (Ibn Rushd Hospital, Dorban Hospital, Ibn Sina Hospital, Sainte Thérèse Hospital, Ophthalmic Surgery Hospital, Cancer Treatment Hospital). The Shattibi Public Hospital and El Hadjar Public Hospital recorded rates of 57% and 45%, respectively. However, community health institutions recorded the lowest digitalization rates in the sector overall, with the community health institution in Annaba district achieving the highest rate among them at 40%. The other two institutions, located in El Hadjar and Berrahal districts, recorded lower rates of 32% and 30%, respectively.

Sector officials attribute this delay in digitalization within community health institutions to the difficulty of coordinating between the various structures of each institution. The three community health institutions are responsible for a total of 78 treatment rooms, 25 multi-service

clinics, and 23 school health units. Additionally, most of the treatment rooms, multi-service clinics, and school health units in El Hadjar and Berrahal districts, in particular, were established in municipalities and areas that already suffer from a lack of local development and infrastructure. For example, multi-service clinics in Ain Jbara, El Kantra, Bou Sdera, and Ain Sayd are all located in remote and somewhat isolated areas, far from the provincial center. Thus, the priority for these areas is to provide health services that cover all their residents, with digitalization efforts to follow.

The lowest digitalization rate is found in the Specialized Emergency Medical Hospital, which has not exceeded 5%. This is because the hospital was initially planned to start offering services at the beginning of 2025. However, due to increased pressure on the university hospital center, which is the primary facility for emergency surgical intervention in the province of Annaba and neighboring provinces, local authorities, in coordination with the relevant ministry, decided to allow the hospital to start offering some of its services within the available capacities. At the same time, efforts continue to equip it with the necessary equipment and supplies so that it can be fully operational in the coming years.

Returning to the digitalization rates recorded in the hospitals, sector officials also attribute the low rates to the lack of resources in medical analysis laboratories and MRI services, which require specialized and costly equipment for digitalization. The following figure illustrates the shortcomings in the digitalization of medical analysis laboratories and MRI services.

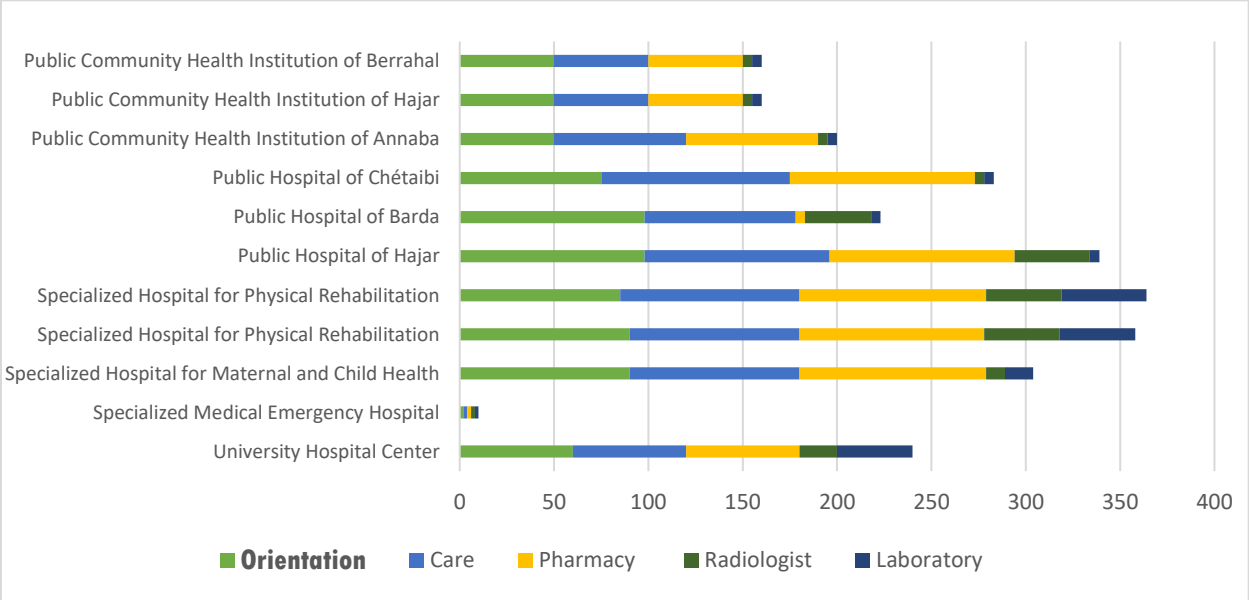

Figure 5: Digitalization Rates of Hospital Services Operating in the Province of Annaba

Source: Data from the Directorate of Health and Population of the Province of Annaba

From the previous figure, we observe that the pace of digitalization is significantly higher in the areas of reception (orientation), treatment (care), and hospital pharmacies compared to medical analysis laboratories and MRI services. This difference is due to the fact that digitizing reception, treatment, and pharmacy services does not require extensive equipment; it only involves using a good-quality computer to input patient-related information, with human intervention being necessary to enter the data into the system. On the other hand, for medical analysis laboratories and MRI services, the process is more complex. It not only involves data entry but also requires advanced equipment that can automatically transfer medical analysis results and MRI images directly to the physician without human intervention. This technology is not yet available in most hospitals across the province, leading to manual processing in medical laboratories and MRI services, which demands more effort and time until the necessary equipment for digital processing is provided.

4.3 Efforts to Digitize Public Hospital Institutions Operating in the Province of Annaba

Modern technology is a vital foundation for the development and improvement of the healthcare sector, as digitalization enhances service efficiency and leads to a qualitative transformation in the advancement of medical care. In this context, the province of Annaba is moving toward a digital health future by taking active steps to improve the performance of its public hospital institutions through digitalization. Below are the key efforts made to accelerate the pace of sector digitalization in general:

Development and Launch of Several Important Digital Health Applications

- Electronic Medical Record DEM-DZ: A digital medical record that contains all the patient's personal and administrative information, diagnostic details, medical history, vital signs, treatment procedures undertaken, approvals for these procedures, laboratory data, and radiological images.
- Maintenance Information System GMAO-DZ: A program for the electronic management, maintenance, and monitoring of medical and paramedical equipment and devices. The goal of this program is to enhance and monitor daily operations related to the maintenance of these devices and equipment, as well as inventorying them and providing regular reports on their status.
- Mandatory Reporting of Infectious Diseases Information System MDO: A system for counting individuals with infectious diseases such as measles and viral hepatitis. The aim of this system is to gather extensive information about patients and their surroundings to monitor their treatment status and compliance with recovery. It also aims to limit the spread of infectious diseases by tracking their prevalence among the province's population.
- Human Resources Information System RH-SANTE: An application for managing human resources specifically for the public health sector in Algeria. It enables the management of

employee data, salaries, and other benefits, as well as tracking performance and evaluations, and provides a range of tools to efficiently manage human resources within public hospital institutions.

Establishment of Digital Training Teams in Each Hospital Institution

With the emergence of digital transformation in hospital institutions, local authorities issued an instruction requiring the establishment of digital training teams. These teams are tasked with training users within their institutions and should include individuals with expertise in their respective fields, as well as prior knowledge of using technological tools such as computers and tablets. The training teams themselves will receive specialized training at the Health Directorate of the province of Annaba. The teams will exclusively include the following categories: general practitioners, specialists, engineers, assistant engineers, biologists, MRI specialists, and administrative managers. Each hospital institution will determine the number of team members according to its needs.

Creation of a Monitoring and Oversight Team for the Digitalization Process in Hospitals

To ensure the smooth progress of digitalization in public hospital institutions in the province of Annaba, local authorities decided to establish a team consisting of the Secretary-General of the Health Directorate, engineers from the Directorate, and four additional employees selected as needed. The primary task of this team is to monitor the digitalization process in public hospitals and report any violations related to the non-use of recommended digital applications by the relevant ministry. This team conducted more than 20 field visits to the main health structures in the province.

Conducting Training Courses on How to Use the Current Digital Applications

In 2023, the Health Directorate of the province of Annaba, in coordination with the concerned hospitals, conducted 50 training courses for 1,520 employees on the applications used in public hospitals. Most of the courses focused on how to use the electronic medical record and how to solve certain technical issues related to the application. In the same context, the Secretary-General of the Health Directorate confirmed that an open training day was scheduled in coordination with Badji Mokhtar University of Annaba for 300 employees of the university hospital center on December 27, 2023, to train them on how to use the current digital applications.

Allocating Part of the Equipment Budget for Hospital Digitalization:

In 2023, a total of 3.15 billion DZD was spent by public hospital institutions to revive the digitalization project and renew digital equipment. In this context, the Secretary-General of the Health Directorate of the province of Annaba confirmed that all public hospitals in the province are required to re-equip their structures using the budget allocated to them. The process of renewing digital equipment for public hospitals is being implemented gradually to avoid

excessive expenses that could impact other operations, such as acquiring much-needed MRI machines and scanners, which are in short supply in the province.

Establishment of Digital Equipment Maintenance Teams in Each Public Hospital Institution

To ensure the smooth operation of all hospital institutions in the province, local authorities issued a decision to form maintenance teams within each hospital. In this regard, recruitment began for specialists in information technology. The Secretary-General of the Health Directorate of Annaba also noted that the number of IT engineers and technicians increased by more than 30% in 2023 compared to 2022.

Creation of an Evaluation Team for the Infrastructure and Digital Equipment of Hospital Institutions

To develop a well-structured future plan for digitizing the entire sector, a team was established to evaluate the infrastructure of hospitals and assess the readiness of their equipment for digitalization. This evaluation includes assessing the quality of digital equipment, the quality of infrastructure related to telephone and internet lines, and based on the assessments, determining the actual needs of each hospital and its capacity to implement digitalization effectively, moving away from traditional practices.

4.4 Challenges to Digitizing Public Hospital Institutions Operating in the Province of Annaba

While the world is rapidly moving towards digital transformation in healthcare, several challenges clearly hinder the digitalization of public hospital institutions in the province of Annaba, including:

4.4.1 Internet-Related Challenges

The internet network in the province of Annaba has experienced significant fluctuations, negatively affecting the efforts to digitize public hospitals locally. These challenges include inconsistent internet quality, with the network suffering from significant fluctuations in speed and service quality. This inconsistency hinders the ability of public hospitals to provide services as planned, making it difficult to meet patients' needs effectively.

Additionally, outdated infrastructure presents another challenge, as the telephone network in the province still relies primarily on copper cables instead of modern fiber optics. This issue poses a significant barrier to improving connection quality and speed. Furthermore, frequent service interruptions delay patient registration, causing inconvenience and delays in reception and treatment processes, especially in emergencies.

Another issue is that the monopoly of Algeria Telecom in the telecommunications market has been a major reason for the low quality of internet service both nationally and locally. This lack of competition and market monopoly has contributed to the problem.

4.4.2 Technological Challenges

The technological challenges faced by public hospitals are twofold: first, the electronic equipment used, and second, the digital applications employed in public hospitals. Regarding the first aspect, most of the computers and digital tablets used in public hospitals, as well as some other technological equipment, are outdated and not compatible with current-generation technology. For instance, most of the computers used have processors with speeds no higher than 2 GHz, which is insufficient even to run the Windows operating system. This limitation creates numerous issues when running applications and computers.

On the other hand, the health applications used in public hospitals were not designed with the technical and human capabilities available at the national or local level in mind. Some applications exceed 6 GB in size, which is incompatible with the capacity of most electronic equipment available in hospitals. Moreover, many of the applications contain numerous windows and options that are not currently activated or used, which increases their size and creates problems when running them. This issue arises because the applications are not locally made and therefore do not align with the current goals and plans set by the Ministry of Health.

In response, public authorities recognized this issue and established the National Agency for the Digitalization of the Health Sector. This agency has been exclusively tasked with overseeing the digitalization process in the health sector, including designing locally-made applications that take into account all technical and human aspects, as well as information security concerns, which will be discussed later.

4.4.3 Information Security Challenges

Information security challenges pose a significant threat to public hospitals, particularly concerning the privacy of health information and the overall local health system. There are fears of potential breaches of the information systems in public hospital institutions, which could compromise patient data and their privacy. Such breaches could damage the administrative information system, especially sensitive information like medical records and appointment schedules.

Moreover, most patients are uncomfortable with sharing all of their health information and are reluctant to disclose it, fearing that it might be used by other entities, such as employers. This reluctance highlights the lack of trust in digital technology and transactions due to concerns about privacy and security in electronic health services.

4.4.4 Administrative Barriers

These barriers stem from several reasons, including:

- Weakness in Planning and Administrative Coordination: This refers to shortcomings in planning and coordination by senior management regarding digital transformation programs. This includes the failure to implement the necessary organizational changes to facilitate this transformation, such as not establishing departments dedicated to digitalization within hospitals and instead merely forming committees or task forces. This creates the impression that hospital digitalization is a temporary and transient idea rather than a strategic initiative for the entire health sector.
- Lack of a Clear Strategic Vision: There is a deficiency in the clarity of the strategic vision concerning the digitalization of hospitals. This lack of clarity makes the transition toward future digital hospitals more challenging due to the absence of clear and directed guidelines for this transformation, as well as the absence of short-term, medium-term, or long-term plans and objectives. Furthermore, there are no clear indicators to evaluate the performance of public hospitals in the field of digitalization. For example, a short-term goal for hospitals could be to achieve a 30% completion rate in the overall hospital digitalization project, in addition to reaching a 20% digitalization rate for all medical records of citizens in the province of Annaba.
- Employee Resistance to Change: There is resistance among hospital staff to adopting modern technologies due to fears of changes in positions and future career paths. Additionally, they perceive the implementation of digitalization itself as an additional burden on hospital staff, including doctors and nurses, especially given the severe shortage of digital equipment and their lack of qualification to work with these technologies.
- Adherence to Traditional Administrative Methods: The continued use of traditional administrative methods that do not align with the requirements and challenges of the digital age hinders the ability to transition to digitalization in all areas. For instance, most administrative transactions in hospitals are still conducted in their traditional paper-based form, which is due to the lack of actual activation of electronic authentication and signature.

4.4.5 Human Resource Barriers

The challenges of digitalization in improving public hospitals in Algeria also include a range of human-related obstacles. These obstacles are characterized by weak technical and cultural awareness within hospitals on both social and organizational levels, as well as a lack of training programs covering modern technologies in the medical field. This is attributed to the

weak expertise in modern technologies among leaders and the lack of financial incentives provided to them. Moreover, there is resistance among some employees, particularly older ones, to using modern technologies due to their inability to adapt to them and their weak language skills, which delays the digitalization process. Additionally, the shortage of highly skilled technicians and administrators presents further obstacles to adapting to the digital environment in the healthcare sector in the province of Annaba.

One of the most notable observations is that the training programs and courses in hospital digitalization in the province included 1,520 employees in 2023, representing only 12.58% of the total 10,500 employees in the health sector. This percentage is considered insufficient, especially given that the digitalization of public hospitals encompasses all aspects of hospital operations, whether related to providing healthcare services to patients or the administrative work itself.

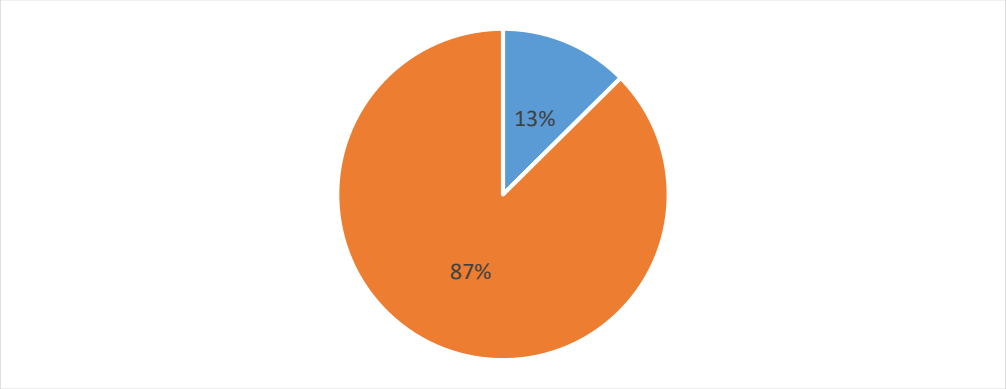

Figure 6: Percentage of Trained Public Health Sector Employees in Annaba

Source: Data from the Directorate of Health and Population of the Province of Annaba

4.4.6 Legislative Barriers

The electronic legal system in Algeria, in general, is characterized by weaknesses and shortcomings in several aspects, most notably in relation to electronic authentication and signature. Therefore, the legal system must align with the requirements of digitalization by establishing an electronic legal framework that protects and documents all electronically conducted activities. This can be achieved through:

- Developing Legislation and Regulations: Digital operations require improving current systems and regulations to be more effective and suitable for application in the digital arena, considering the rapid technological changes.
- The Need for Effective Regulatory Bodies: Establishing regulatory bodies that listen to reports from committees specialized in digital transformation and take the necessary actions to enhance digital readiness, ensuring compliance with security standards.
- Enhancing a Secure Digital Work Environment: It is essential to establish clear conditions for securing the digital work environment and impose deterrent penalties on those who

breach or jeopardize digital programs, thereby contributing to strengthening security and trust in the digital environment.

4.4.7 Financial Barriers

Public hospital digitalization projects face significant financial challenges, which manifest in various ways, most notably the lack of financial resources allocated for renewing and upgrading equipment and departments equipped with the necessary computers and digital devices for hospitals. Additionally, there are limited financial resources required for essential training and qualification processes, and the very high cost of purchasing electronic medical devices presents another obstacle for public hospitals in acquiring such equipment.

The health sector budget for the province of Annaba reached 105 billion centimes in 2023, with 75% of it allocated to operating expenses, primarily for paying health sector employees' salaries. Meanwhile, 25% was allocated to equipment expenses, of which only 3% was designated for the public hospitals' digitalization project, equivalent to approximately 3.1 billion centimes. This amount was allocated for revitalizing digital equipment and infrastructure across all healthcare facilities in the province, which include a university hospital center, four specialized public institutions, three public hospital institutions, and three public health institutions. This percentage is insufficient to cover the shortages that public hospitals face in terms of digital equipment and infrastructure. This explains why the public hospital digitalization project at the provincial level encounters several barriers related to internet speed, the readiness of digital equipment, and their capacity to handle the volume of digital applications used in public hospitals.

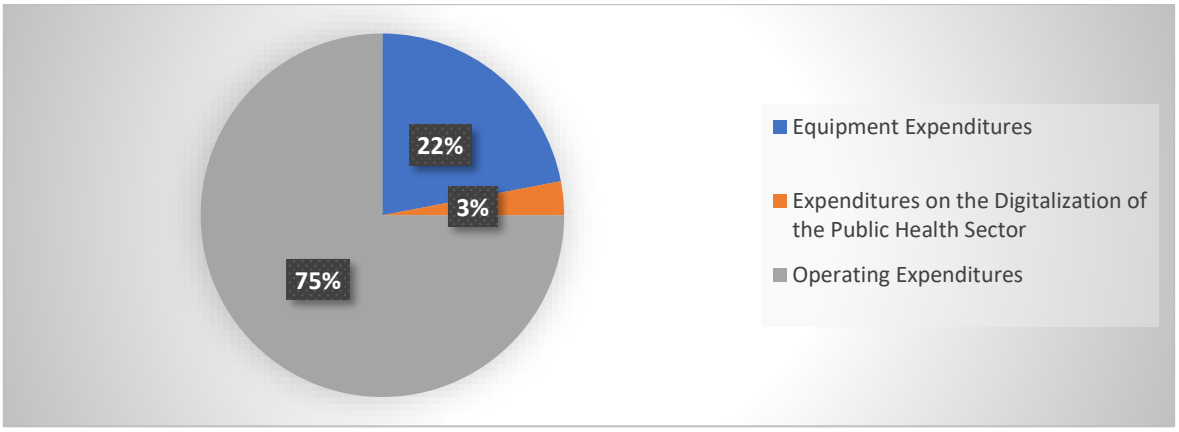

Figure 7: Health Sector Budget for the Province of Annaba

Source: Data from the Directorate of Health and Population of the Province of Annaba

Conclusion

The widening digital divide in many countries and organizations has prompted them to adopt integrated digital strategies and projects that align with their institutional structures. This transformation relies on recognizing the importance of digitalization, the need to renew focus on management, and the pursuit of integrating the digital environment using available resources and capabilities, especially in vital sectors such as healthcare.

The advancement and modernization of healthcare institutions depend on their readiness to adopt modern management methods and requirements. This management must align with current transformations, moving from traditional management to modern management. Additionally, human resources must be valued as a key element contributing to the development of healthcare institutions and the improvement of their performance and the quality of public services.

The Importance of digitalization In the healthcare sector lies In achieving the desired goals for the sector, where the system plays a vital role in improving efficiency in healthcare institutions and adapting to global developments. This requires the creation of leadership competencies capable of fully leveraging this technology to develop electronic health practices. The digitalization of the healthcare sector reflects a significant interest from decision-makers in Algeria in digitalization issues in general, and the digitalization of the healthcare sector in particular, and its contribution to providing modern healthcare services. This is a positive indicator of the quality of the healthcare sector's outputs in Algeria.

The results of the field study have shown that significant efforts have been made to digitize public healthcare institutions in the province of Annaba. These efforts include the launch of several important digital health applications, the formalization of committees to monitor hospital digitalization and maintain their digital equipment, training of health sector employees, allocation of necessary funding for digitalization, and other efforts that have contributed to improving the digitalization rate of public healthcare institutions in the province to approximately 50%. However, many barriers still hinder the digitalization process in the province's healthcare sector, most of which are technological, administrative, human, financial, and even legislative in nature, and these must be addressed and resolved promptly.

This study has concluded with a set of important recommendations, including:

- Valuing the Proposal to Reorganize the IT Function in the Healthcare Institution: This includes activating a specific law for the IT sector and establishing an organizational structure that aligns with the digitalization system.
- Creating a Reference Guide to Achieve Healthcare Compatibility (Interoperability): This will contribute to achieving integration between systems.
- Full Implementation of Electronic Signatures: As a necessary requirement.

- Establish virtual private networks (VPNs): To connect Algeria‘s public healthcare institutions of various classifications (CHU, EHS, EPH, EPSP) with one another and with the Ministry of Health and Population‘s data centers. This would ensure the secure exchange of sensitive medical data.
- Develop a dedicated health cloud: For securely and reliably storing medical data at the Ministry of Health and Population level, while allowing local health and population directorates to access the data from anywhere and at any time.
- Implement an integrated network management system: To monitor network performance, troubleshoot issues, and improve efficiency.
- Apply the latest cybersecurity solutions: To protect data from breaches and cyberattacks, including the use of firewalls, intrusion detection systems, and data encryption.
- Enhancing the Level of Employees Involved in Digitalization: To improve their competencies.
- Raising Awareness and Involving Stakeholders in the Field of Digitalization: To ensure broader engagement.
- Encouraging the Private Sector and Private Clinics: To participate in efforts to develop digitalization.
- Opening Opportunities for Startups to Provide Technical Solutions: For the implementation of the digitalization project, through public-private collaboration, with a dedicated financial envelope.
- Collaborating with Legal Experts: To establish the appropriate legal framework for implementing the digitalization project in the healthcare sector.
- Allocating Necessary Financial Resources: To build the infrastructure in healthcare institutions, considering the costs of these technologies.
- Intensifying Awareness Campaigns about the Importance of Digitalization in the Healthcare Sector: Including introducing relevant partners.
- Establishing a Platform to Receive Client Suggestions: To contribute to the modernization and success of the digitalization project.
- Strengthening Exchanges with Countries Experienced in Implementing Digitalization Projects in the Healthcare Sector: To benefit from their expertise.

References

ABDERREZZAK, B., & DAHMANI, F., 2024. The Significance of Digitalization Projects in the Algerian Higher Education Sector for Enhancing Educational Quality. *Afak for Sciences Journal, 9*(3), pp. 90-101.

ADNANE, A., 2014. Management of Banking Operations and the Impact of Technology on the Future Banks (Case Study of Algerian Banks). *International Journal of Economic Performance, 7*(1), pp. 180-205.

ARRIBI, C., & BOUTARFA, S., 2024. Digital Transformation: Opportunities and Challenges of Digitalization in Algeria. *Economic Researcher Review, 12*(1), pp. 37-55.

AZIM, N., YATIN, S., JENSONRAY, S., & MANSOR, S., 2018. Digitization of Records and Archives: Issues and Concerns. *International Journal of Academic Research in Business and Social Sciences, 08*(09), pp. 170-178.

AZIZI, A., BENBORDI, H., & DERBAL, S., 2024. The Reality of Digital Marketing in the Hotel Sector: New Day Hotel Case Study in Algeria. *Education & Administration: Theory and Practice, 30*(6), pp. 3587-3602. doi:10.53555/kuey.v30i6.6214

BEN TOUMI, S., 2023. The Role of Health Information Technology in Eliminating the Effects of the COVID-19 Pandemic in Private Hospital Establishments: A Study of a Sample of Doctors and Officials' Perspectives at Private Hospital Establishments in M'sila. *Journal of Economic Papers, 14*(1), pp. 1-16.

BENMOUSSA, S., & BOUBECHICHE, R., 2024. The Role of E-Health in Health Institutions Governance in Algeria: A Case Study of the GMAO Platform at the Public Institutions for Approximate Health, Ras El-Ayoun. *Management & Economics Research Journal, 6*(2), pp. 230-254.

BENSAAD, K., & ANNABI, B., 2024. Digital Marketing and Its Impact on SMEs' International Expansion in Algeria. *Management & Economics Research Journal, 6*(2), pp. 508-525.

BENTLEMSANI, Z., 2023. Digitalization of the Health Sector During the Corona Pandemic - Case Study of the Public Hospital Mohamed Boudiaf in Medea. *Journal of Legal Studies, 9*(2), pp. 803-827.

BLIX , M., & LEVAY, C., 2018. *Digitalization and Health Care.* The Expert Group on Public Economics.

BOUBERKA, M., FADEL, S., & DERRAR, H., 2013. Digitalization and the information society in Algeria: Digital Transformation Actors and Key Variables. *Ekonometria, 27*(2), pp. 21-44. doi:10.15611/eada.2023.2.02

BOUKROUH, B., 2022. E-Payment Adoption in the Era of Digital Transformation: The Case of the Algerian Banking System. *Journal of Contemporary Economics Studies, 7*(2), pp. 487-496.

BRAHIMI, M. A., & DERGAL, H. M., 2022. Towards the Digitalization of the Health Sector? Case of the SIHATIC Project in the Context of the COVID-19 Pandemic. *The Journal of MECAS, 18*(1), pp. 68-82.

CHAABNA, S., & WANG, W., 2015. Analysis of the State of E-Commerce in Algeria. *International Journal of Marketing Studies, 7*(2), pp. 44-58. doi:10.5539/ijms.v7n2p44

CHEN, X., DESPEISSE, M., & JOHANSSON, B., 2020. Environmental Sustainability of Digitalization in Manufacturing: A Review. *Sustainability*(12), pp. 1-31.

CHERROUN, R., & DEBLA, F., 2024. Hospital at Home: A New Model of Healthcare Services Innovation - Case Study of Hakim Saadane Hospital, Biskra City, Algeria. *Universal Journal of Public Health, 12*(1), pp. 17-27. doi:10.13189/ujph.2024.120102

DJEDDI, S., & FERKOUL, F., 2023. Algeria Economy (2000-2020): Reconciling Growth, Sustainability, and Digitalization. *Journal of Contemporary Issues in Business and Government, 29*(4), pp. 166–178. doi:10.47750/cibg.2023.29.04.011

FRĄCZKIEWICZ-WRONKA, A., 2021. Digitalization Of Healthcare Sector as a tool FOR Implementation Of Competition Policy. *ECONOMICS, ENTREPRENEURSHIP, MANAGEMENT, 08*(02), pp. 25-34.

FRENZEL, A., MUENCH, J., BRUCKNER, M., & VEIT, D., 2021. Digitization or digitalization? – Toward an understanding of definitions, use and application in IS research. *Twenty-Seventh Americas Conference on Information Systems (*pp. 1-10). Montreal: Association for Information Systems.

GUEMIDE, B., BENACHAIBA, C., & MAOUCHE, S., 2019. Integrating ICT-Based Applications for Sustainable Tourism Development in Algeria. *Journal of Tourism and Hospitality, 8*(5), pp. 1-11. doi:10.35248/2167-0269.19.8.415

JOVANOVIĆ, J., 2020. Digitalization Of Special Events Projects During The Crisis. *European Project Management Journal, 10*(02), pp. 66-71.

KHAN, S., KHAN, S., & AFTAB, M., 2015. DIGITIZATION AND ITS IMPACT ON ECONOMY. *International Journal of Digital Library Services, 05*(02), pp. 138-149.

KHANOUSSA, A., & FODIL, L., 2024. The Role of Financial Technology in Developing Islamic Banking: The Experience of Al Salam Bank of Algeria. *Journal of Economics and Finance, 10*(2), pp. 241-254.

KHERRAZ, M., 2013. Towards an Effective Integration of ESP in Healthcare ICTS: Challenges and Strategies - The Case of Algeria. In *Advanced Bioinspiration Methods for Healthcare Standards, Policies, and Reform* (pp. 260-275). doi:10.4018/978-1-6684-5656-9.ch014

NEDIL, L., ZEROULI, M., & KHOUATRA, S., 2014. Proposal of a Digital Product Manager Process as an Aid to the Development Performance of a Public Company in the Telecom Sector in Algeria. *NeuroQuantology, 20*(6), pp. 7165-7178. doi:10.14704/nq.2022.20.6.NQ22720

OUCHENE, D., & BELKACI, K., 2022. The Use of AI Applications in Corporate Communications of Algerian Public Institutions: The Directorate-General of Algeria Telecommunication as a Case Study. *Aleph, 9*(4), pp. 1-19.

PÄIVI , P., MAARIT , T., JUKKA , K., & SUSANNA , T., 2017. Tackling the digitalization challenge: how to benefit from digitalization in practice. *International Journal of Information Systems and Project Management, 05*(01), pp. 63-77.

PANCHBUDHE, S., PUND, P., JHA, R., & BANKAR, N., 2021. Digital Innovation in Health Care: A Review Article. *Annals of Medical and Health Sciences Research, 11*(3), pp. 115-117.

PLESNER, U., JUSTESEN, L., & GLERUP, C., 2018. The Transformation of Work in Digitized Public Sector Organizations. *Journal of Organizational Change Management, 05*(31), pp. 1-26.

RAJAN, M., & SHALINI, S., 2019. A study on Impact of Digitalisation on services in the Healthcare Industry. *International Journal of Research and Analytical Reviews, 06*(01), pp. 241-245.

RITTERA, T., & PEDERSEN, C., 2020. Digitization capability and the digitalization of business models in business-to-business firms: Past, present, and future. *Industrial Marketing Management*(86), pp. 180-190.

TIOUR, S., KORIDJIDJ, B., & KHALIFA, H., 2024. The Reality of Digital Transformation on Algerian Macroeconomic Variables: An Analytical Study. *Economics & Law, 4*(1), pp. 18-36. doi:10.37708/el.swu.v6i1.2

ZERMANE, H., & AITOUCHE, S., 2020. Digital Learning with COVID-19 in Algeria. *International Journal of 3D Printing Technologies and Digital Industry, 4*(2), pp. 161-170. doi:10.46519/ij3dptdi.776978

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