

NATIONAL HEALTHCARE TECHNOLOGY INITIATIVE

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Abstract

The National Technology Initiative in health has been shaped with a different perspective compared to many other sectors due to the dominance of a completely human-oriented approach in its focus and execution. When the investments made in the field of health in the last 20 years are considered, we can easily see the building blocks that were built on the way to the "National Technology Initiative". Health is the service sector that prioritizes human life, the most important and the highest expectation of society. Just as it is human in its focus, there is also a human in meeting this expectation. Therefore, when you make the quality of health care a priority and strengthen this area with qualified human resources, you can have a very strong projection in terms of technology. In this context, we can summarize the path to "National Technology Initiative in Healthcare" as qualified human resources as the primary element, then sustainable service quality, together with these the implementation of innovation-oriented policies, strengthening multidisciplinary penetration, and finally realizing a big development-oriented move. The main priority of health is measured by human life and the quality of the service provided. When you realize this basic priority, you will eliminate a big deficiency on the way to the technology move with the strong human capital. In the last 20 years, we have brought health service quality and satisfaction rates to the highest level in the world. The strong support and motivation obtained after this have enabled us to quickly implement the digitalization policies, which are the main elements of the high technology segment of the health system. In our country, the "Health Information Systems Action Plan" was officially introduced in 2004. In 2014, all health facilities, including public, private, and university, were made to interoperate on a single platform methodology, and in 2015 the e-Nabız System was introduced at the disposal of all health stakeholders. After the data standardization, which is the prerequisite of digitalization, was perfected in the entire sector, many projects focused on digital infrastructure were implemented quickly. In this article, within the scope of "National Technology Initiative in Health", the motivation that guides our country, especially in health digitalization and making Türkiye a strong player in this field on a global scale and the projects realized in this process will be discussed.

Keywords

National Technology, Human Capital, e-Nabız System, Health Digitalization, Sustainability, Innovation, Development

Introduction

Although the importance of healthcare digitalization is realized quite late in Türkiye, its significance has been met with a rapid and comprehensive national adaptation at the moment of realization. The foundations of healthcare digitalization in Türkiye started in the early 2000s. Since 2014, national-scale projects have been carried out in the Ministry of Health with a strong vision of healthcare digitalization. Türkiye has become one of the most important and leading countries in the world and its region regarding digital health practices with these projects. Healthcare digitalization is possible by having strong change management, and a qualified and sustainable technological perspective, as in every sector. The digitalization of health in Türkiye is designed in a way to ensure direct and rapid access to national health care services for citizens and health workers. As mentioned above, the success of large-scale national projects on short notice has allowed a change in this perspective. Health information and digital health practices have become one of the strategic sectors of the countries, especially in 2019, along with the COVID-19 pandemic that started in the Republic of China and was declared a global pandemic by the World Health Organization (WHO, 2020). In this new era, the need to restore and reconfigure the digital health infrastructure has emerged. for all countries. At this point, the performance reinforced with the principle of uninterrupted service has become an important parameter measuring the performance of Türkiye's digital health infrastructure. In this section, the historical process behind the Republic of Türkiye's global scale-development in digital health will be discussed. In addition, the country's digital health practices that are exemplary to the world and are reaching a high-tech exporting level will be evaluated. It will be addressed that how the benefits and roles of delivering healthcare to society in better quality and how they benefit from managing the COVID-19 pandemic.

Historical Background and Development of Healthcare Digitalization

The process of evaluating health information systems in health care and policymaking in Türkiye begins with the Turkish Health Information System Action Plan published in 2004. In the Eighth Five-Year Development Plan of the Undersecretaries of the State Planning Organization for the years 2001-2005, under the title of "Information and Communication Technologies", "Legal, administrative and technical arrangements that will facilitate access to the services provided by technological developments and convergence between sub-sectors will be carried out rapidly in information and communication technologies, taking into account the demands of users" and "Establishment of information infrastructure in the public sector and related policy (TBMM, 2000). The issues of identification will be addressed with an approach appropriate to the new role of the public in the information age. The information possessed by the public will be delivered to the public according to the principles of openness and transparency. The approaches included in the Turkish Health Information System Action Plan published by the Ministry of Health of the Republic of Türkiye in January 2004 have been included in the Action Plan of the Health Information System of Türkiye, it is stated that "Necessary legal arrangements will be made in order to ensure national and international integration in health information (Sağlık Bakanlığı, 2004) "The sections of the Decree Law on the General Directorate of Health Information Systems, which came into force by being published in the duplicate copy of the Official Gazette dated November 2, 2011, with the number 663 Decision No. 28103, are in the nature of applying this statement. In the decree, the duties and responsibilities of the General Directorate of Health Information Systems are determined as follows (Resmî Gazete, 2011).

- a) To determine nationwide policies, strategies, and standards related to information systems and communication technologies used in the field of health.
- b) To make and have all kinds of information systems and projects including personal health data and data and information flow related to health status and health services at the country level.
- c) To follow international developments in the field of health information systems and technologies, share country practices and experiences, and cooperate with international organizations when necessary.
- ç) To determine and implement the rules to be followed by public and private law legal entities and real persons who will work in the field of health information and technology, to decide on the suitability of their software and products when necessary, and to authorize their authors.

The General Directorate of Health Information Systems, established in this direction, has ensured that the Ministry of Health is the first public institution in which informatics-based studies are represented in the public sector with the status of General Directorate.

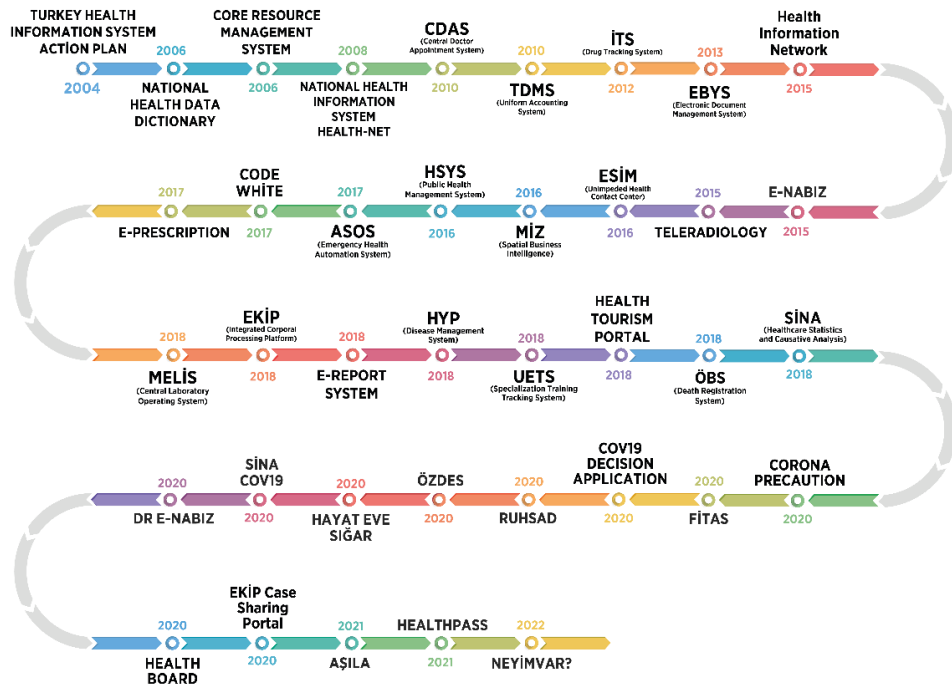


Figure 1. Türkiye's Digital Health Odyssey

Data dictionary and data standardization are the prominent priority areas when we consider the successful realization of digitalization in health and the diversity and density of data in the field of health. The data dictionary, which is created in a comprehensive and continuously updated structure, is like a key that leads to success in all processes of digitalization. A continuous and sustainable digitalization study was planned in our country and within this framework, the National Health Data Dictionary was established by the Ministry of Health in 2006.

- In the same year, Core Health Resource Management System for fulfilling all HR processes has been launched.
- Following the data standardization endeavors, Health-NET National Information System has been put into service in 2008 to centralize the health data in a quality way
- In 2010, Centralized Doctor Appointment System has been launched to facilitate access to healthcare services
- In the same year, Uniform Accounting System has been developed.
- In 2012, Drug Tracking System (ITS) has been developed to ensure end-to-end tracking of drug supplies securely.
- In 2013, all interinstitutional correspondence has been digitalized through Electronic Document Management System
- In July 2014, a novice system architecture and data model have been specified that enables citizens to manage their health, physicians to manage patients' health status, and health managers to administer the local/regional area of responsibility. Besides, all public health-oriented medical and administrative indicators from physicians to their workplaces, from geographical areas to addresses can be generated through the novice system architecture and data model. From that point onwards, a new roadmap has been created along with a comprehensive paradigm shift.
- In 2015, Health Informatics Network has been developed to ensure secure and rapid data transmission for healthcare facilities and people receiving healthcare services.
- In 2015, the e-Nabız Personal Health System has been developed for ensuring citizens access to all their health data and sharing it with their physicians. Along with the system, Health-NET National Information System, which has been put into service in 2008 has been revoked because of its shortcomings in terms of scope and meeting the actual needs.
- In the same year, a telemedicine/teleradiology system has been put into service to ensure ubiquitous access to medical images and reports,
- In 2016, ESIM (Unimpeded Health Communication Center) has been put into service to provide video translation services for citizens with hearing impairment.
- Again, in 2016, the MIZ (Spatial Business Intelligence) application has been developed for monitoring and mapping all healthcare processes.
- In the same year, Public Health Management System and Product Tracking System have been launched. Product Tracking System enables users to track all the medical devices and cosmetics from production/import to the end user.
- In 2017, ASOS (Emergency Health Automation System) and Code White Mobile Application have been developed.

- In the same year, the e-Prescription application has been launched to enable digital prescriptions instead of paper prescriptions.
- In 2018, Central Integrated Laboratory Operating System (MELIS) has been put into service for the lab processes of primary healthcare facilities. MELIS enables data transmission between the software of primary healthcare facilities and LBYS software.
- In the same year, the Integrated Corporate Processing Platform (EKIP) has been developed for ensuring the holistic tracking of the healthcare workforce and facilities.
- Again, in 2018, the e-Report system for the digitalization of all reports, the Disease Management Platform (HYP) for chronic disease management, the Specialization Training Tracking System (UETS) for monitoring the training programs of students receiving specialization training, and the Health Tourism Portal for foreign patients, Additional Payment Information System (EKOBS) for healthcare facilities, Death Registration System for registering all deaths in the country and Healthcare Statistics and Causal Analysis (SINA) application has been developed for monitoring all administrative, economic and medical processes on a single platform by providing AI-assisted decisions out of data compiled from the systems, from the physician working somewhere in the country to healthcare managers and the highest healthcare authority.
- As of 2020, along with the pandemic breakout, HSYS Epidemic Detection, and Management System, Filiation and Isolation Tracking System, Korona Precaution application, Hayat Eve Siğar application, Special Children Support System (OZDES), Mental Health Support System (RUHSAD) and Dr. e-Nabız Telehealth project have been put into service.
- As of 2021, AŞILA application for vaccination management and HealthPass application for ensuring secure vaccine data utilization and transferring on leaving the country under international standards

The Role and Importance of Human Capital

Ensuring digital health applications are designed in a sustainable and continuously developing structure is directly related to the existence of a robust vision and qualified human capital. In the last 20 years, human capital investments, especially in the field of health, have greatly increased service quality and patient satisfaction, while at the same time digital transformation has played an important role in the quest for healthcare digitalization. Human resources, which are continuously invested and whose development is supported every day on the way to adapt to the world, lead the adoption and development of digital processes in the same direction. It briefly examined how investments in human capital contribute to both important parameters in health and how they have brought health digitalization to the top after this process.

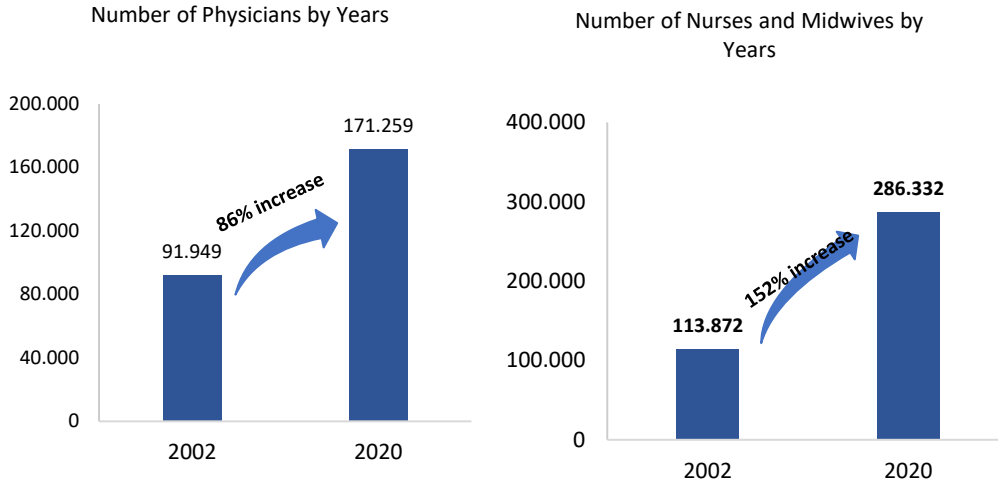


Chart 1. Number of Physicians by Year **Chart 2.** Number of Nurses and Midwives by Year
(Sağlık İstatistikleri Yıllığı, 2022)

As stated in Chart-1, the total number of physicians in health facilities covering all public, private and university hospitals in 2002 was 91,949. In the 18 years, investments in human capital increased by 86% and this figure reached 171,259. The number of nurses, which is one of the basic elements of health care in Chart-2, they were 113,872 in 2002, increased by 152% in 18 years, and reached 286,332 in 2020. Based on these graphs, it will be examined the contribution of robust investments in human capital to both the quality of health care and the digitalization of health below. The main purpose of medical science is to keep people alive. For this reason, a strong investment in people is required to keep people alive. It can be seen below that the direct impact of the increases in physicians and nurses in Chart-1 and Chart-2 on the infant mortality rate, under-5 years mortality rate, maternal mortality rate, and life expectancy at birth, which are important indicators in the international context. One of the main global development indicators is healthcare services. Subjecting health services to measurement and evaluation in terms of development is directly related to the death and life expectancy of people. The infant mortality rate was 31.5 per thousand live births in 2002 when we make this assessment based on the last 18 years in terms of our country, while this figure decreased to 8.5 per thousand live births in 2020. The mortality rate under the age of 5, the death rate, which was 40 per thousand live births in 2002, decreased to 10.6 per thousand live births in 2020. The maternal mortality rate decreased from 64 per hundred thousand live births in 2002 to 13.1 per hundred thousand live births in 2020. Finally, when we examine the life expectancy at birth, life expectancy increased from 72.5 in 2002 to 78.6 in 2020.

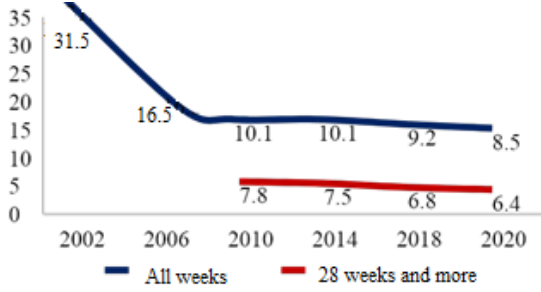


Chart 3. Infant Mortality Rate

(Sağlık İstatistikleri Yıllığı, 2022)

(Per Thousand Live Births)

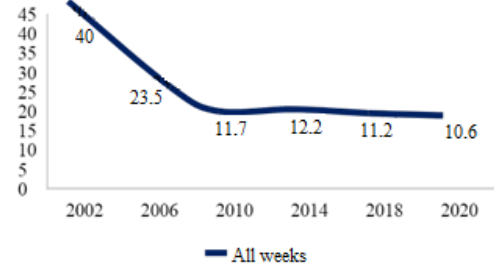


Chart 4. Mortality Rate

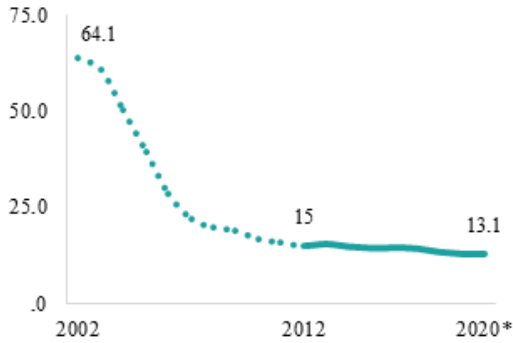


Chart 5. Maternal Mortality Rate
(per hundred thousand live births)

(Sağlık İstatistikleri Yıllığı, 2022)

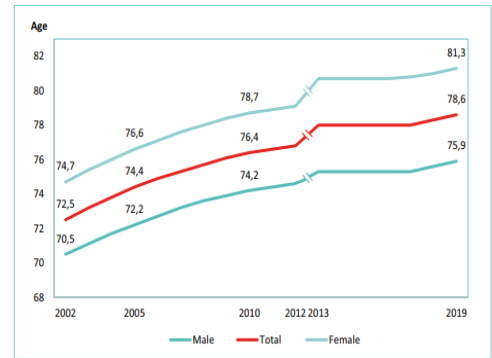


Chart 6. Life Expectancy at Birth

From a societal point of view, the most prominent measurement and evaluation indicator of the health sector is the patient satisfaction ratio in healthcare services. The reflection of the investment made in human capital in our country on the satisfaction rate of health services on a social scale is seen in Chart 7. The satisfaction rate in health services, which was 39.5 percent in 2003, showed a very strong increase rate in 17 years and increased to 72.1 percent in 2020.

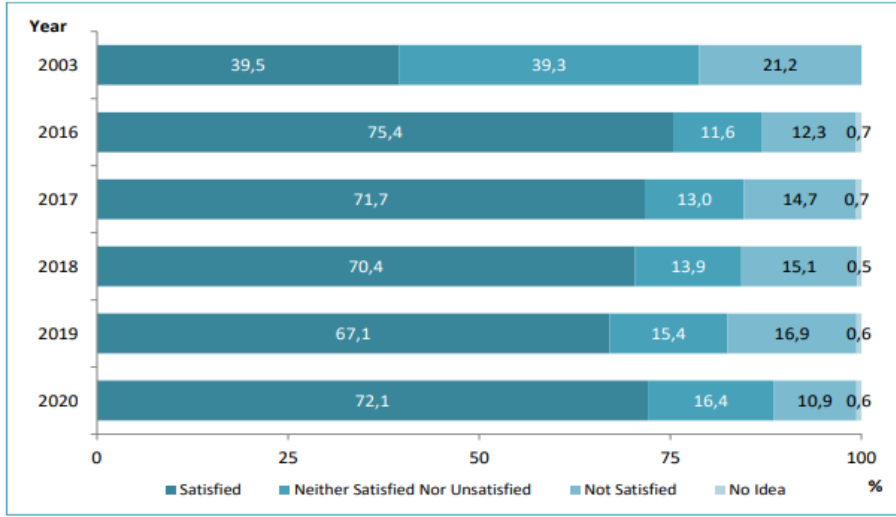


Chart 7. Satisfaction rate in health services (%) (Sağlık İstatistikleri Yıllığı, 2022)

Human Capital, Health Service Quality and National Digitalization Movement in Digital Health

So far, we have reviewed the impact of investments made in human capital in the last 20 years on basic health indicators and their contribution to patient satisfaction in health services on a societal scale. Our basic national strategy was to invest in people to keep people alive first. In the following period, after reaching the optimal level of the health system in terms of quality and satisfaction, we implemented a comprehensive roadmap in terms of digital health applications on a world scale. Thanks to the developed projects, we digitalized the whole healthcare process in Türkiye, from the womb to the death. Before explaining the projects, we have implemented on a national scale, it will be meaningful to specify where we are in comparison with internationally developed countries in terms of health digitalization in this process. It has been said that one of the pioneering conditions of digitalization in health is data standardization and data integration. To provide uninterrupted service on a national scale, all health facilities need to talk to each other and at the same time, health care providers need to access all health data in a safe way independent of time and place.

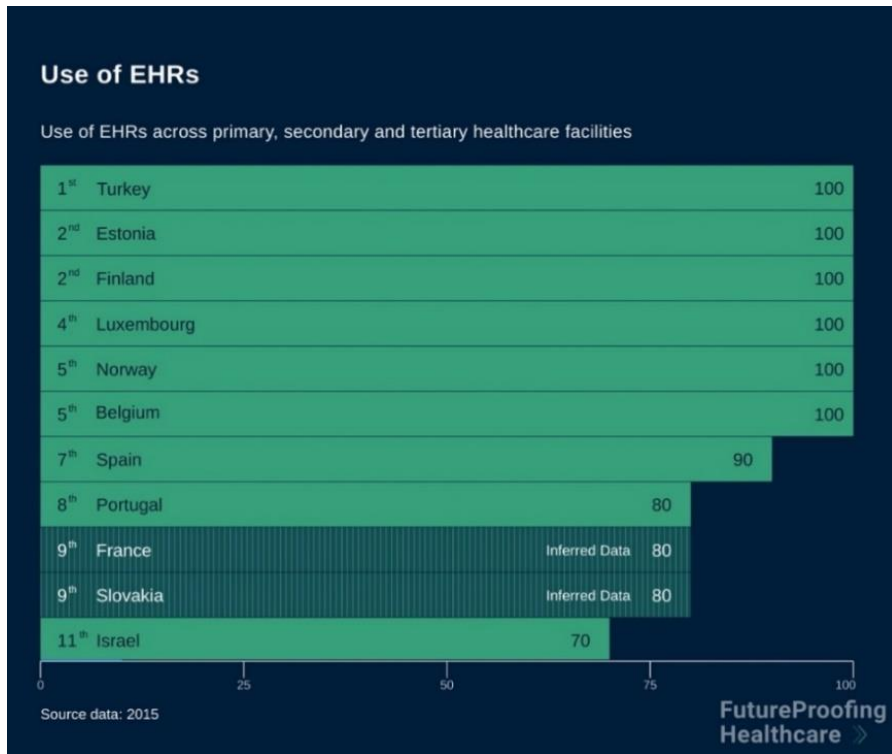


Figure 2. Use of EHRs (Future Proofing Health Care, 2022a)

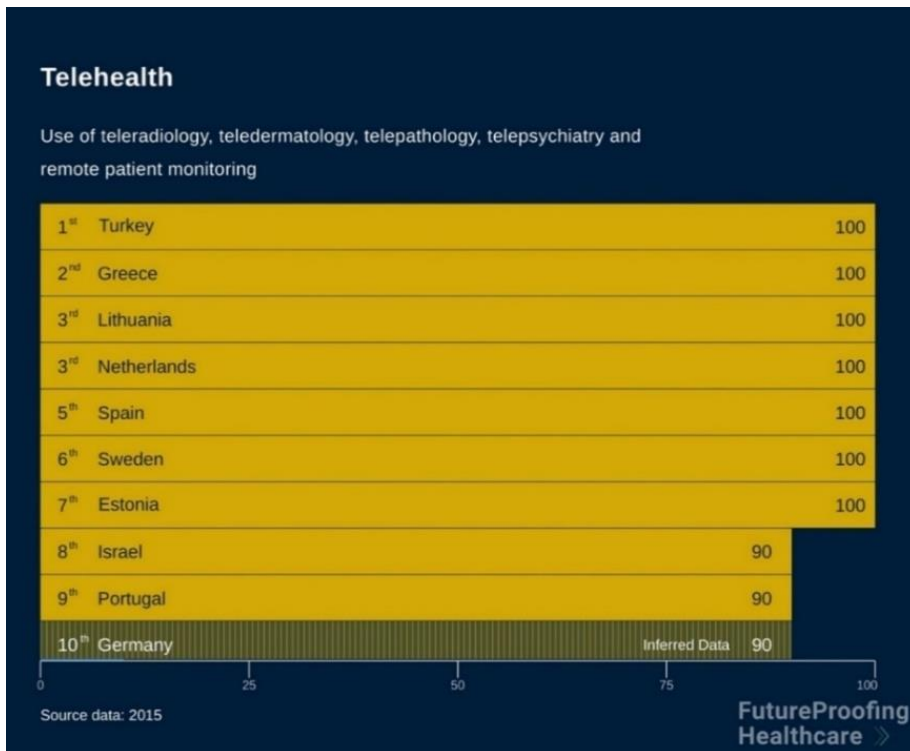


Figure 3. Use of Telehealth. (Future Proofing Health Care, 2022b)

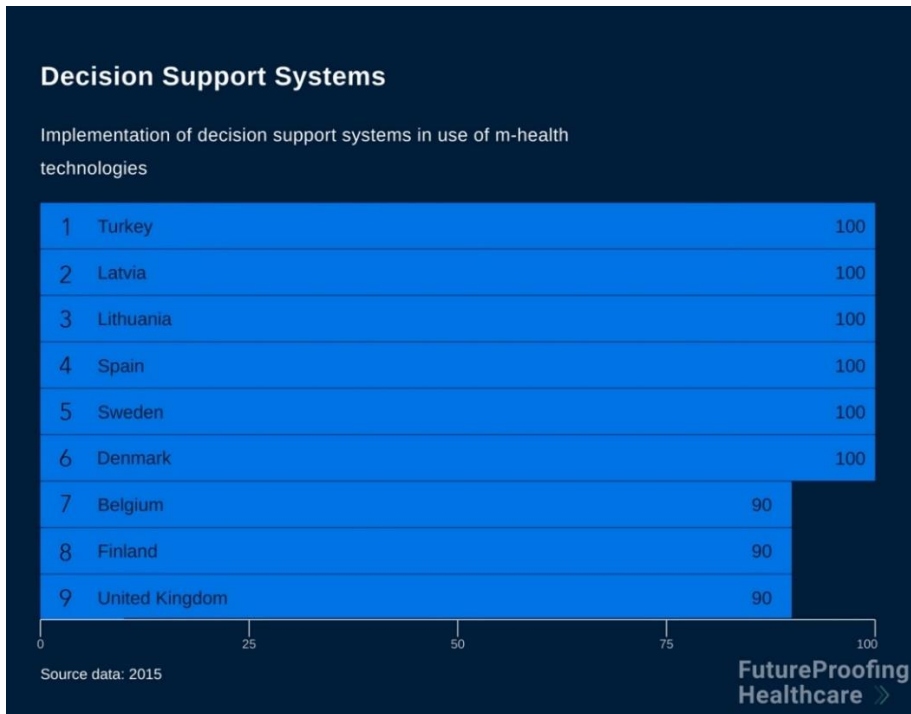


Figure 4. Decision Support Systems (Future Proofing Health Care, 2022c)

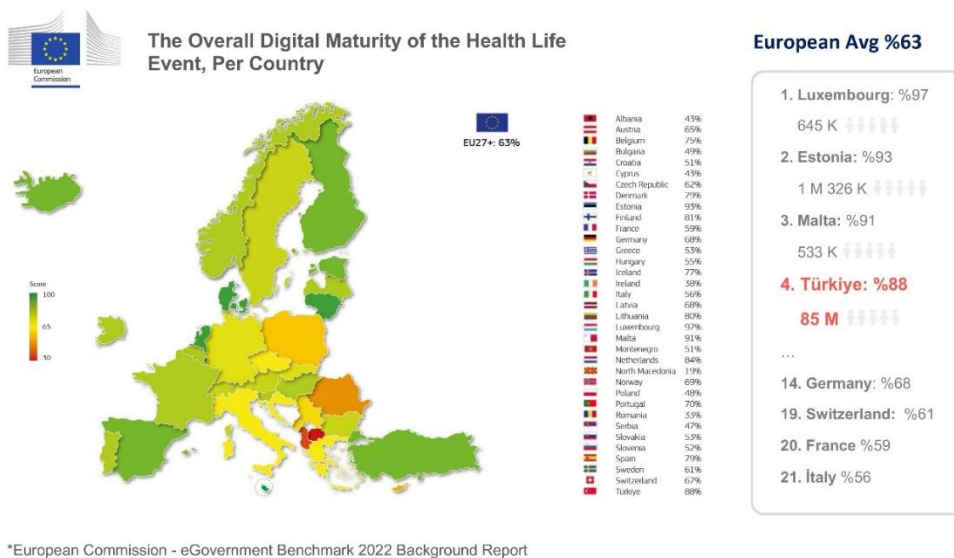


Figure 5. European Commission - e-Government Benchmark 2022 Background Report

The Shining Star of Digital Health: e-Nabız Personal Health System

In line with the changing understanding of life and the individual needs that differ based on this, information technologies have been integrated into the field of health, and applications and infrastructures aimed at facilitating individuals' access to treatment and treatment opportunities have been put into service. At the beginning of these services,

Personal Health Record System comes to the forefront. Patients' access to their health records is a global issue of gradual importance. In line with this global agenda on healthcare technologies, the e-Nabız Personal Health System was put into practice to make health records available to the access and control of citizens, to maximize the level of health literacy by including individuals in healthcare service delivery, and in parallel with these, to strengthen the cost-effectiveness capacity in health services and to ensure sustainability in health services in the long term.

As for the story, a part of the ISOS (Istanbul Health Automation System) application, which was developed within the scope of the ISOS (Istanbul Health Automation System) application that we started to work on in 2009 within the framework of the needs of the province and which the Ministry of Health later stopped using the Sağlık-Net application, consists of a narrow comprehensive model that does not contain patient data and collects info using anonymized key indicators, which does not contain patient data, and to increase institutional efficiency, we were able to realize it in Istanbul Anatolian North Public Hospitals Association. In the second half of 2014, both the elimination of institutional needs and our obligation to develop a personal health record system on a national scale that allows the citizens who own the data to access their health data allowed us to realize our old dream in the period of the ISO study on a national scale. As a result of these long-term studies, the e-Nabız Personal Health System, which requires the digitization of every stage of the production of health service data and is the world's most comprehensive and largest national e-health system in its field, was opened to the use of everyone who receives health services in our country on April 3, 2015.

e-Nabız, into which more than 1500 hospitals (including public, private, and university hospitals), approximately 9.000 medical centers, polyclinics, and clinics; 27.000 family medicine centers and software like HIS, FMIS (Family Medicine Information System), Laboratory Information Management System (LBYS) and more than 40 nationwide systems like Teleradiology, CDAS (Centralized Doctor Appointment System), Central Integrated Laboratory Operating System (MELİS), Public Health Management System (HSYS) and e-Report have been integrated, has ensured the data aggregation on a single platform.

Thanks to e-Nabız, all citizens can access their health records via mobile phones, tablets, and computers including all kinds of detailed information about their examinations such as laboratory tests, radiological images, prescription and drug information used, emergency information, diagnosis, all kinds of reports given from their mobile phones, tablets, computers on 24/7 basis, and if they approve, they can share all or part of them with their physicians or relatives for as long as they desire within the scope of the specified rules. In addition, citizens can make appointments, notify blood donation and donate organs through e-Nabız. In the wearable device-friendly e-Nabız system, citizens can save their health information obtained from smart bracelets or devices such as wireless glucometers and wireless blood pressure devices to their e-Nabız accounts. Besides, citizens can make appointments, notify blood donation and donate organs through e-Nabız. Citizens can log in to e-Nabız via e-Government password, mobile signature, or electronic signature through the e-Government. Users can contact their family physician, if they approve, and obtain their temporary e-Nabız password as SMS. In 2015, the application reached a user count of nearly 3 million in the first year, and by April 2022, this figure has exceeded 66 million. Besides, 170.000 physicians have accessed patient history data 158 million times.

These features have made e-Nabız the most comprehensive and large-scale personal health record system in the world.

Benefits of e-Nabız

The data system provides a secure communication infrastructure between the service provider that produces the health data and the user receiving the service. Also, it allows all health stakeholders (patients, doctors, decision-makers, etc.) to manage processes through one single platform since the e-Nabız System is designed on the axis of an integrated architecture. the e-Nabız system offers permanent, sustainable, and continuously developing opportunities for all problems encountered and likely to be encountered in the area of health, thanks to the integrated structure.

With the e-Nabız system, an array of contributions is ensured that the cost-effectiveness principle, which is one of the most important instruments of health service delivery policies. This feature is realized by minimizing duplicate transactions and visits. In addition, the e-Nabız system facilitates the development of health literacy and raises awareness of preventive health practices in society through the active participation of citizens in their treatment process. On the other hand, active decision support is provided to decision-makers and policymakers in developing effective health policies.

e-Nabız Personal Health System allows a high level of communication between the patient and the physician. However; chronic diseases, which constitute approximately 70% of the health burden, are kept under control much more effectively with e-Nabız. Citizens with any chronic disease can closely follow their disease processes and stay in contact with their doctor if desired regardless of time and place thanks to e-Nabız. In this way, both patients and doctors can manage the diagnosis and treatment processes more effectively and quickly. It is realized that duplicate monitoring can be prevented with the e-Nabız system. Patients can save time and resources by not waiting for the medical images to be taken and the results of the analyzes and examinations to be reported and the report to be sent to the physician to whom they apply by the prevention of duplicated monitoring. Considering risky diseases such as cancer, it is very important to shorten hospital waiting times.

In the COVID-19 disease, where comorbidity (additional disease) is worth considering, e-Nabız is significant for physicians to access other health data of patients for pandemic management and follow-up. Patients can access their PCR results, chronic disease reports, and all health records online via e-Nabız. Thus, patients do not have to leave isolation to access these specified health records. Also, vaccinated patients can access their vaccination cards through e-Nabız and HES applications.

the e-Nabız system became superior to its peers in the world regarding its scope and number of users. In 2016, e-Nabız lead the way by winning the best practice award within the scope of the United Nations Development and Sustainability Initiative.

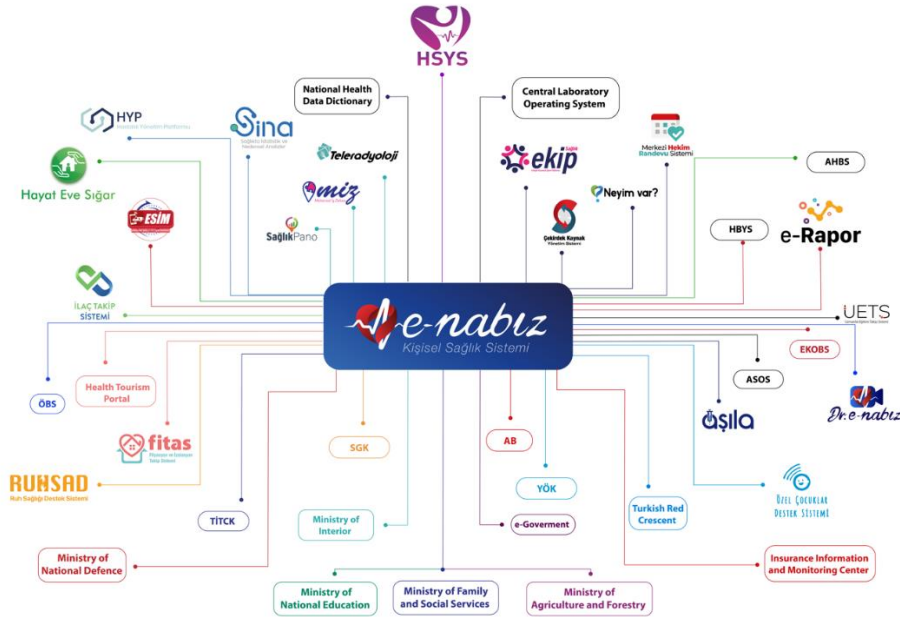


Figure 6. *e-Nabız Personal Health System*

Telemedicine/Teleradiology System

Teleradiology System, commissioned in 2015, is a central repository where medical documents and reports are stored and medical images are indexed. The system allows access to patients' medical data as well as access to patient data of clinicians in different hospitals.

The system uses existing and developing web technologies. It provides timely and efficient access to images, reports, and associated data regardless of their location to patients and clinicians. The system helps to reduce the timing problems and physical obstacles experienced in the sharing, distribution, and viewing of documents between institutions within the country and which cannot be solved by PACS systems. There are four main areas where teleradiology is used. The system allows citizens to access their medical images and reports via e-Nabız. First of all, citizens can view, download and share their images and reports via e-Nabız. Secondly, physicians can access medical images and written reports taken in different hospitals belonging to their patients following their permission. Thirdly, radiologists can provide reporting and second opinion services to hospitals that do not have sufficient human resources. Another area of use is examination verification. The system provides pre-invoicing verification services to SSI. Along with this service, billing of unperformed or incomplete audits is also prevented. Again, the system compiles the data regarding the radiation dose amounts that patients have been exposed to during imaging for controlling the utilization of unqualified or maintenance-free devices.

The teleradiology system has been designed for the whole of Istanbul in 2010, also commissioned within the affiliated hospitals of Istanbul Northern Anatolia Public Hospitals Association in 2013 as a limited version, and in 2014, it has simultaneously been put into service with e-Nabız after the remodeling and improvement process in line with the national needs. Today, the Teleradiology system has transformed into the greatest project of its kind

which has been utilized in 2.000 hospitals (public, private, and university hospitals) and healthcare facilities.

As of 2022, the total number of examinations indexed to the system exceeds 350 million. Thanks to the Telemedicine / Teleradiology system, digital images are archived for the desired time frame, and users are provided with secure access to these images and reports from anywhere at any time. This prevents duplicate examinations, increases the diagnosis and treatment rate, prevents the citizens from being exposed to radiation unnecessarily, and helps reduce health expenditures. According to the regulation made in 2018 in cooperation with the Social Security Institution, radiological examinations taken in all hospitals, including public, private, and university, cannot be invoiced by the SGK MEDULA System without being sent to the Telemedicine System. With the data verification system installed, 29% savings were achieved. By making it obligatory for physicians to check the patient's previous images before making a request, an annual saving of 150 million TL was realized.

During the COVID-19 pandemic, an AI application has been developed that diagnoses COVID-19 from Computed Tomography images to help physicians diagnose COVID-19. In this study, CT images were classified in a short period and provided the physician with an idea within the scope of COVID-19 diagnosis. In addition to the classified disease, the area in the lung where the disease is active is shown as a percentage and a heat map is created. In this context, according to the CT image of the patient, pneumonia, COVID-19 positive, and COVID-19 negative status are determined.

Another AI-assisted application developed within the system is the Mammography CAD application. It is developed to detect lesions and calcified areas in mammography images with the help of artificial intelligence. In this context, it is ensured that the calcified areas and lesions in the mammography images are marked by the system. The application is aimed at detecting breast, lung, or prostate cancer, helping to diagnose the tumors, and distinguishing benign lesions from malignant ones.



Image 1. Telemedicine/Teleradiology System

Healthcare Statistics and Causal Analysis (SINA)

As a domestic decision support system of the Ministry of Health, Healthcare Statistics and Causal Analysis platform is developed to manage the institution's resources more effectively and to increase the ability of central and provincial organization users to make effective and rapid decisions.

SINA graphs the data collected from all health facilities with the e-Nabız Personal Health Records System infrastructure. The system enables provincial health directors, provincial health directorate presidents-vice presidents, chief physicians/deputy chief physicians, private hospital responsible managers, district health directors, and all active physicians to monitor the health statistics transmitted to the Ministry of Health from health service providers.

Physicians working in the public sector; To be able to see and control instant and historical health service delivery information (examination, surgery, examination, imaging, satisfaction score, etc. services in detail), statistics for the physician branch are shown to them on the SINA platform and institutional, provincial and Türkiye data are shown on the SINA platform in comparison with the health service provided by physicians in the screening. Thus, it has been ensured that an awareness of their work is created in health service providers and that those who manage this service make healthier decisions with up-to-date data. At the same time, by showing the locality rate of the prescribed drugs, incentives have been provided to prescribe the drugs produced in our country and it is aimed that our public capital will remain in the country.

Following the first COVID-19 case in Türkiye, graphic screens for COVID-19 follow-up were created on the system with the integration of the Public Health Management System. These infographics' access rights are given to both the Ministry's senior management and provincial administrators. With the help of this system case profiles, epidemic progression rate, filiation follow-up, etc. data can be analyzed.



Image 2. Healthcare Statistics and Causal Analysis

e-Report System

the e-Report system was developed in 2018 to ensure that all health reports given by health institutions affiliated with the Ministry of Health are given electronically and with e-signature. The reports generated in the health institutions are shared with the relevant institutions and organizations online within the framework of the relevant legislation. Our citizens can access their reports through e-Government Gate and e-Nabız. Eighteen institutions that have signed a protocol with the Ministry of Health and completed their integration process can verify their reports through the e-Report System. The two-way integration between the Ministry of Health and the relevant institutions provides quality and on-site service to the citizens. The process initiates at the healthcare facility and concludes at the relative institution online with the help of the aforementioned integration procedure. There are fourteen types of reports (birth notice, driver, psycho technical, rest reports, etc.) issued in this way. The most remarkable of these are e-birth reports. "e-Birth Report", which is a component of the e-Report System, has been developed for people to make birth notifications in health institutions. In this context, apart from our citizens; birth reports for unidentified, stateless, and foreign newborns can be given through the system.

In the first phase of the process, it was ensured that the birth reports (birth certificates) for births that took place in health institutions were created in a verifiable standard format with e-signature. In the second phase of the process, the information about the births that took place in health institutions and the e-signed birth reports were forwarded to the General Directorate of Population and Citizenship Affairs (MERNIS Platform) via the e-Report / Birth Report Component. The second phase of the process includes the "registration process" and the "birth notification". At the end of the process, all births in hospitals are recorded and these reports are shared with NVI. Accordingly, it is ensured that the District Population Directorate officers take action based on the requests and the birth reports they receive via the system. In the third phase of the process, upon the request of the mother or the father (within the marriage union), the birth and required information about the newborn are received through the e-Report / Birth Report Component. The e-signed birth notification forms are forwarded to NVIGM MERNIS. The infrastructure development for the realization of the "population registration process" was completed by determining the National ID Number with the registration of the newborn to the population. The identity card created with the request initiated at the hospital is automatically printed and sent to the delivery address specified by the family. In this way, the citizen can receive his identity card from his home without going to any population directorate.

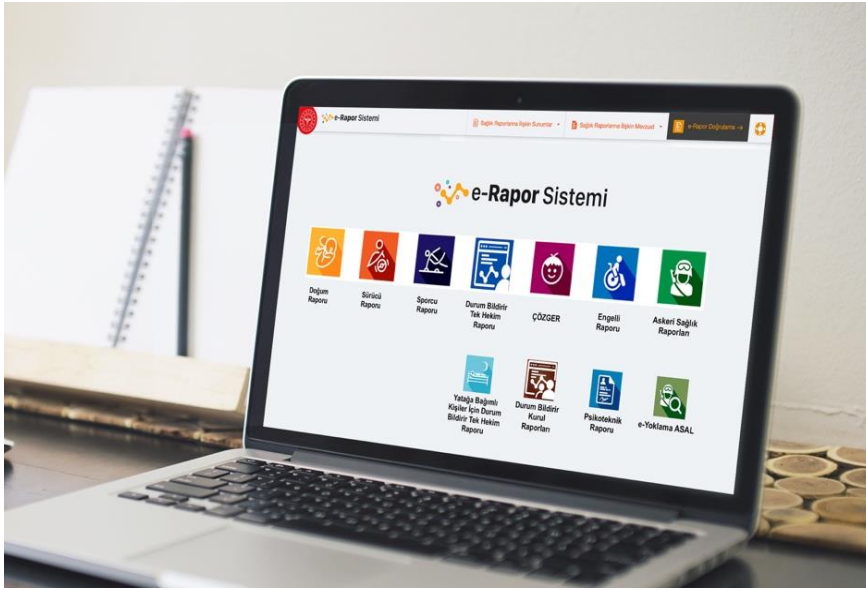


Image 3. e-Report System

Integrated Corporate Processing Platform (EKIP)

Integrated Corporate Processing Platform (EKIP) is a project designed with the vision of e-transformation of the Core Health Resource Management System (CHRMS). It has been in use since 2004. Validation and the verification of the data can be completed via CHRMS. It also helps to reduce and eliminate deficiencies. It is eligible to be expanded for improvement with the new features to improve the current processes. Additionally, previous digital platforms are upgraded with CHRMS. The current business processes carried out by the Ministry of Health are digitalized with the EKIP with a focus on producing fast results and making better decisions. One of the goals of the EKIP is the unite human resources management and healthcare facility management for better results. This united system aims to minimize errors and create more reliable outputs by taking into account the data gathered from health personnel and health institutions (in public, private, and foundation university hospitals).

In EKIP, private, public, and university hospital information affiliated to the Ministry of Health besides, information and movements of the workforce working in the health sector are kept and monitored securely within the institution's servers. In the EKIP, approximately 1,500,000 staff and 50,000 health facilities' data are stored and processed. Personnel employed by different laws within the Ministry, affiliated organizations, and central and provincial organizations; information such as identity, address, personnel, staff (position), service, education, foreign language, discipline, military service, salary scale, working capital are recorded in an up-to-date manner, followed and controlled by using the EKIP.

The requirements in the investment planning, control, monitoring, and supervision processes of all health facilities (including public, private, and university) are monitored electronically. All information specific to the health facility such as institution information, equipment, staff, inspection, and license information are recorded. Personnel movements, licensing procedures, and audit processes for private health institutions are carried out end-to-end.

The personnel who are registered in the EKIP system can view all the information kept in the system by logging into the system with their User ID and password. This component, which is the front face of the EKIP, is called the EKIP Portal. On the portal, operations can be carried out that allow the personnel to reach their needs quickly; such as written, audio, and video communication, interactive training, case sharing, assignment follow-up, permission request, service certificate request, and work license request.

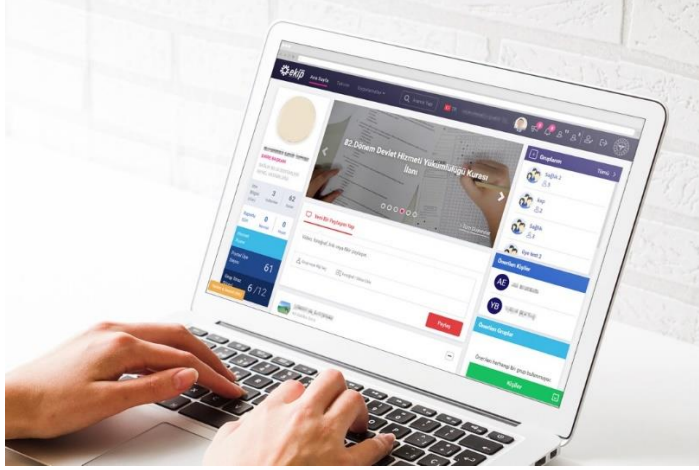


Image 4. Integrated Corporate Processing Platform

Public Health Management System (HSYS)

The health service delivery aims to construct an integrated structure for primary health care, public health service, and preventive health service, which have different applications in use. The aforementioned integrated structure is required to collect quality data, analyze the collected data, report the analysis, make all processes comply with international standards, and be manageable from a single center. In this context, the Public Health Management System has been developed. The project, which started being developed in 2015, included 40 different applications, including preventive health services such as immunization (vaccine), cancer screening (cervix, breast, colorectal), tuberculosis, hearing screening, and heel blood screening. To ensure the integrated follow-up of the COVID-19 pandemic in our country and to create a database that will benefit from every aspect, the Epidemic Disease Detection and Management System has been put into operation as of March 2020 within the Public Health Management System (HSYS).

Since the day the first COVID-19 case was seen in our country, the infrastructure of the Public Health Management System has been activated on the same day and integrated into the entire health system including public, private, and university hospitals. The Public Health Management system includes both case and contact tracing besides the integrated follow-up procedures of the pandemic.

On the same day, the Laboratory Information Management System and the Public Health Information Management System were integrated to ensure that the COVID-19 test results could be viewed in the system immediately after leaving the laboratory. Additionally, the Teleradiology System for the follow-up of the video examinations of the cases, especially Computed Tomography (CT), the e-Nabız Personal Health System for the access of the cases to their results and the detailed health data of the cases for the physicians, the Death Notification System (OBS) for the follow-up of the death cases, and the Filiation and

Isolation Tracking System (FITAS) for the filiation (source searching) study are all integrated for the better pandemic management.

While those who tested positive for COVID-19 were followed up within the system, the source of transmission and contact tree graphs were created by adding the lists of the people contacted at the same time, and thus a comprehensive follow-up system was put into practice.

After the system was activated, it started to be used at the border gates on the same day, and the citizens brought to our country from abroad were recorded in this system. Also, people with symptoms who are required to stay in hospitals, and people without any symptoms who are required to stay in home isolation (or in dormitories) for 14 days are periodically monitored by family physicians with the help of the aforementioned system.

The treatment and isolation of the patient are meticulously conducted with the help of a detailed screen that belongs to the patient within the system. The screen also includes all the parameters required for the prevention and spread of the disease. Citizens who are monitored during the quarantine period are also called by phone every day through this system and monitored for their condition and symptoms. The people who are in contact with the infected cases in the places they are in during the process (home, workplace, hospital, school, travel, etc.) are also monitored, and the contact tracing process is carried out in the same way for those who turn into positive cases by contacting these COVID-19 positive people. The system is created with an algorithm where all treatment processes can be monitored instantly starting from the detection of the case to the discharge of the person.

To carry out the pandemic process smoothly; it is aimed to follow up on cases, case contacts, citizens coming from the borders besides people traveling between cities. Additionally, smooth pandemic management requires spreading these procedures in the 2nd and 3rd step health facilities of public, private, and universities besides the integration with other public institutions. Epidemic Disease Detection and Management System has been developed within HSYS to ensure the integrated follow-up of all these processes between laboratories and 1st, 2nd, and 3rd level health facilities, to provide the necessary infrastructure and services to the mobile applications (to be developed in this context) and to create a database that will benefit in every aspect.

HSYS has integration with 40 different applications which are e-Nabız Personal Health Record System, Doctor Information Bank (DBB), Hayat Eve Sığar (HES), Laboratory Information Management System (LBYS), Central Integrated Laboratory Operating System (MELİS), Spatial Business Intelligence (MİZ), Filiation and Isolation Tracking System (FITAS), Central Population Management System (MERNİS), Social Security Institution (SGK), e-Report, Ministry of National Education, Ministry of Family and Social Policies, Ministry of National Defense (ASAL), Ministry of Interior Home Isolation Query, Ministry of Interior Epidemic Control Practice (ISDEM), TÜİK Immunity and Incidence (Incidence) Screening.

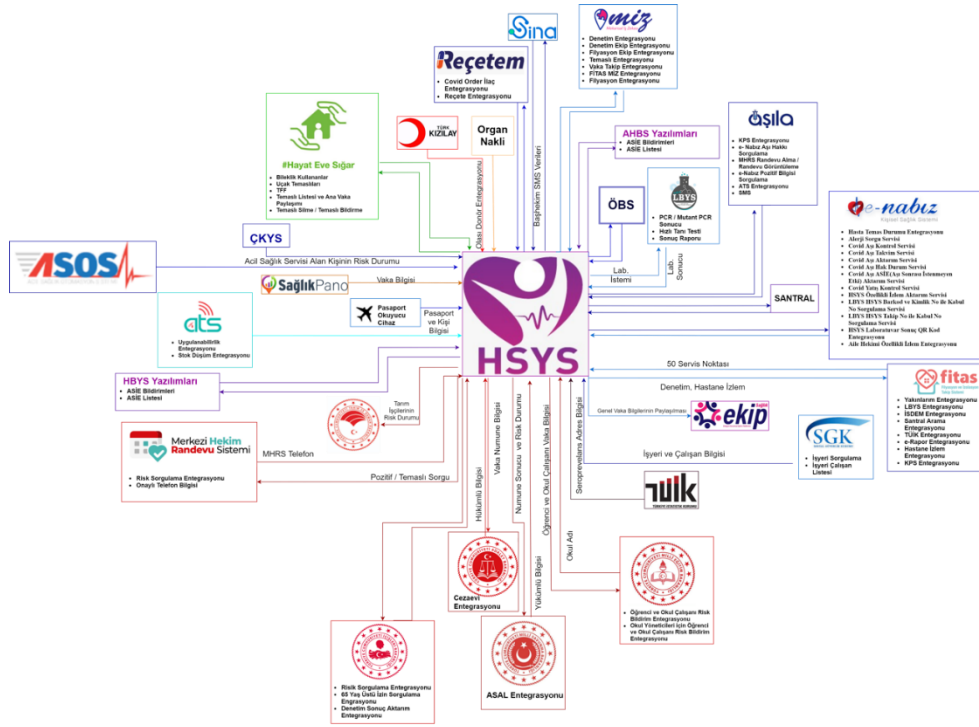


Figure 7. Public Health Management System (HSYS)

The Filiation and Isolation Tracking System (FITAS)

The Filiation and Isolation Tracking System has been put into practice by the Ministry of Health to prevent the spread of the Covid-19 virus, support the measures to be taken to minimize its effects, find the cause of the first emergence of the infectious disease, and to reach the contacts at risk quickly. This application aims to reduce the filiation time, which is the most important factor in the spread of the disease, with the efficient use of resources. Filiation teams consisting of three people carry out the filiation process by reaching the case and its contacts by following up as soon as the case arises. Thanks to field studies, the spread is prevented and the possibility to start treatment by providing early diagnosis to people in the risk group is increased. In the study carried out in 81 provinces, the teams make filiation records with mobile devices in the field. Since the day the first Covid-19 case was announced in Türkiye, an epidemic spread map has been prepared by conducting filiation studies for the cases. It was ensured that follow-up information such as intensive care, intubation, and treatment related to the daily follow-up of the hospitalized patients were carried out.

The purpose of the FITAS application, which ensures that the health data of the people in contact with the positive cases are regularly followed, is to dry the source of transmission with contact tracing within the scope of preventive health services and to make patient follow-up more efficient in the digital environment by entering the cases who had preventive health services on-site instantly into the system. Türkiye is among the countries that adopt the filiation application as a principle and use it the earliest.

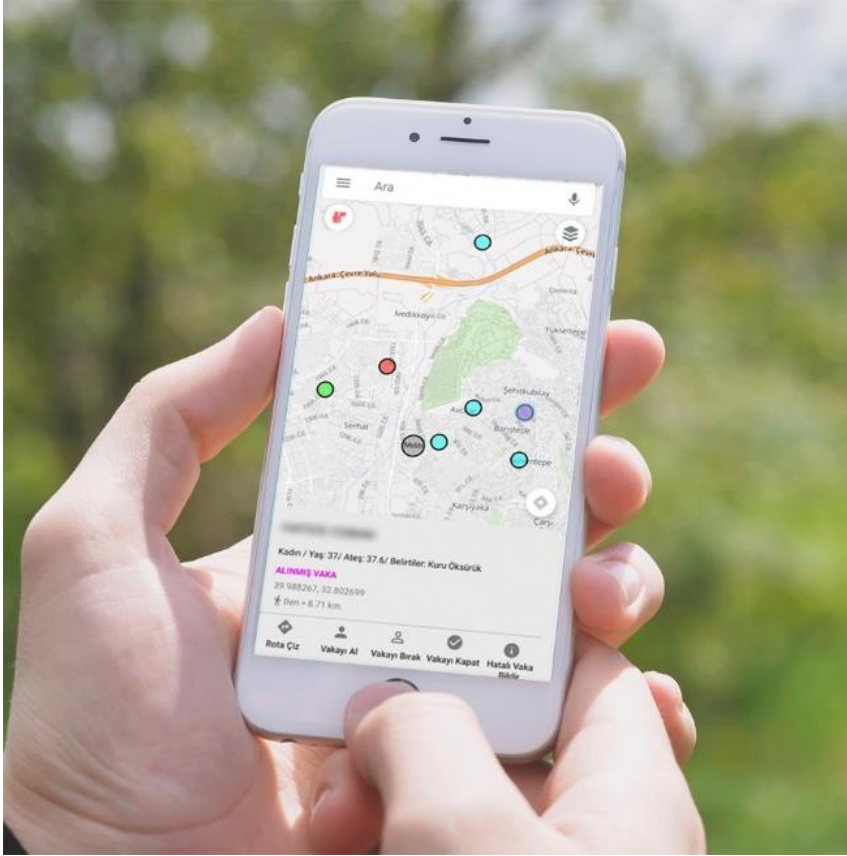


Image 5. The Filiation and Isolation Tracking System

Hayat Eve Sığar Application (HES)

The Ministry of Health makes use of every opportunity offered by information and technology in the fight against pandemic management. The Ministry of Health controls and follows the whole process through health information systems and also offered the control and follow-up opportunity to its citizens with the Hayat Eve Sığar (HES) application. The aim of the Hayat Eve Sığar mobile application, developed in cooperation with our Ministry and all operators (GSM operators), is to protect citizens from COVID-19 and to take early measures.

Citizens can see the risk situation and disease intensity for the region where they live or in the location they want to go via the map through the application they downloaded to their mobile phones. Thanks to the smart algorithms developed, citizens can add their families or relatives to their lists in line with the approvals of their relatives in the application. With the help of this procedure, our citizens have been able to keep their relatives away from risky areas. The application also lets the users examine the Türkiye Daily Coronavirus table. HES Code application is developed within the HES application. The use of the HES Code is mandatory during the pandemic for the control of the health status of the citizens in the fields of land, air, sea transportation, private clinics, visits to public institutions, etc. The HES Code can be received through the application. HES Code of the citizen can be controlled and verified by the institutions. Determination of the positive person who is visited or traveled recently, the follow-up procedure of the people who recently contacted

with the positive case is started. In addition, citizens were able to report the imprudence they saw through the application by using the 'report it' features. Therefore it is ensured that the Ministry of Interior is integrated into the process and audited reports. In addition, contacts and positive people in compulsory isolation can see the remaining isolation periods in practice.

During the pandemic, the app has been downloaded more than 118 million times, 221 million HES Codes have been created, and more than 15 billion risk checks have been carried out.

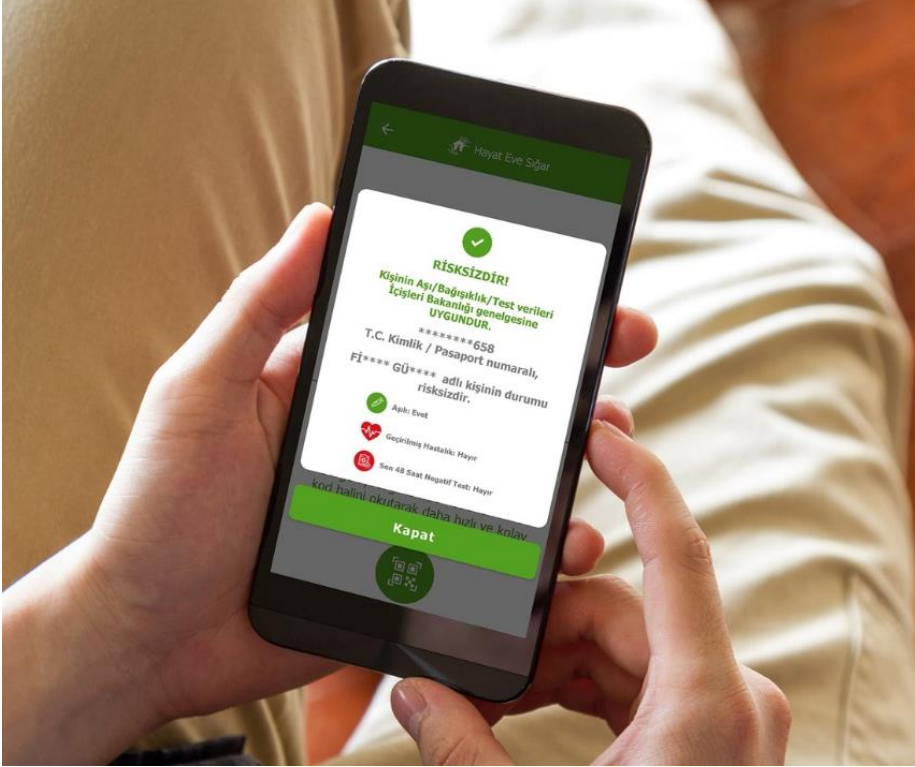


Image 6. Hayat Eve Sığar Application

NeyimVar? Application

Six percent of the daily examinations in Türkiye have been applied to the wrong branch and this impropriety leads to delays in diagnosis and treatment as well as repeating applications. To solve this problem, the Ministry of Health has developed an AI-based NeyimVar application with the aim to provide patients with pre-diagnosis predictions and direct them to the correct branch and physicians. As an application equipped with e-Nabız integration and the smart algorithm, NeyimVar provides diagnosis predictions and makes patient history evaluations as well as supports the physician with the briefing about the patient's general state of health and complaints also presenting the diagnosis prediction just before the examination.

Citizens can log in to the system via e-Government and e-Nabız accounts. Besides, they can be informed about the possible diagnosis and the related branch by answering the directed questions. After this process, citizens can get their examination appointments through the Centralized Doctor Appointment System (CDAS).

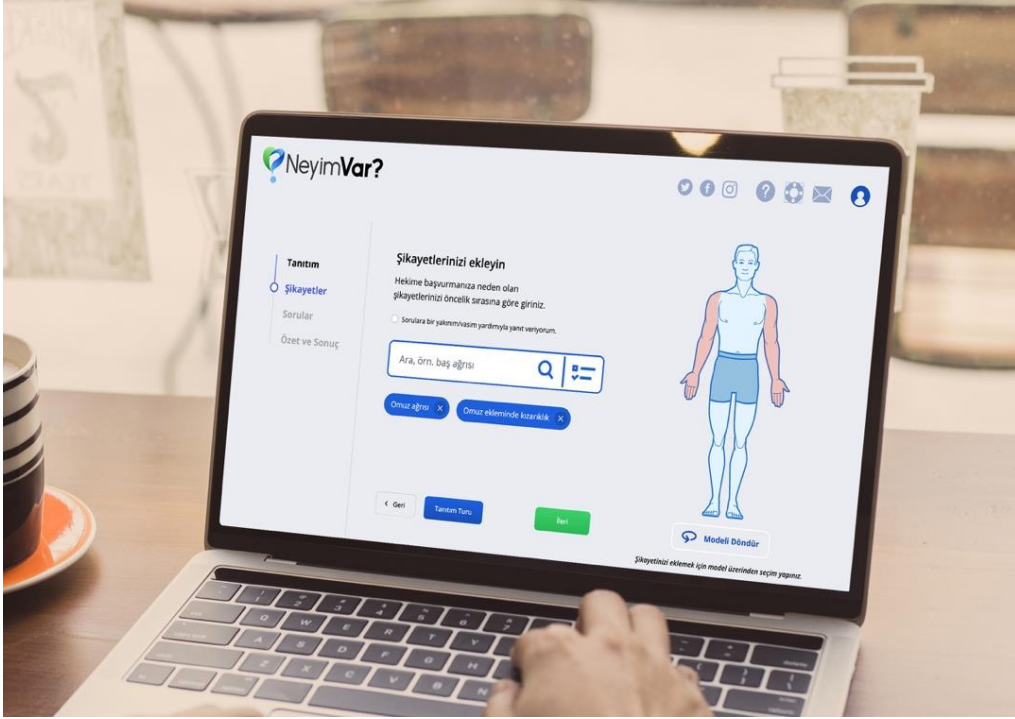


Image 7. NeyimVar Application

Conclusion

The Healthcare sector is the fastest evolving area in terms of technological development. The fact that Türkiye has strengthened the healthcare-oriented physical capacity and human capital in the last twenty years and has overtaken developed countries in this respect has proven a basis for healthcare digitalization. The digital transformation odyssey which started with the planning process in 2004, has yielded its products as of 2015 Türkiye has digitalized all the administrative, economic, and medical processes and has ensured uninterrupted data flow among healthcare facilities, and has founded a multilayered healthcare system with service provision to all healthcare actors. In addition to the prominent projects thoroughly specified in this section, all processes within the healthcare system have been digitalized accordingly. The greatest benefit derived from this infrastructure has been acquired during the global COVID-19 catastrophe and all processes have been administered in a digital environment since day one.

Following this process, telehealth services will be the new milestone as a global topical issue. As one of the latest services in Türkiye, telehealth has been planned for a long time and has been launched lately. Telehealth services, thanks to the contributions of technology, will ensure that healthcare services will go beyond hospital walls and will be controllable in all aspects of life.

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After his graduation from Ondokuz Mayıs University Medical School in 1998, Dr. BİRİNCİ worked in Umraniye Training and Research Hospital as Deputy Chief Physician, and as Deputy Provincial Health Director of İstanbul. Then he was assigned as CIO to İstanbul Northern Public Hospitals Association, after which he became Deputy Undersecretary of the Ministry of Health. He was assigned as Deputy Minister of Health of Türkiye. Dr. BİRİNCİ completed Health Institutions Administration, and Leadership and Global Entrepreneurship master programs. He is currently attending Health Institutions Administration doctoral program. Dr. BİRİNCİ has designed and implemented many public e-Health projects: e-Nabız Personal Health System, Türkiye National Telemedicine Project, Health Statistics and Causal Analysis Application, Disease Management Platform, Integrated Corporate Transaction Platform, Spatial Business Intelligence (MİZ), Neyim Var System, Pandemic Management System, Filiation and Isolation Tracking System, Türkiye Vaccine Management System (AŞILA), Hayat Eve Sığar(HES), Health pass, Health Panel, Dr.eNabız System, Corona Prevention, Corona Decision, etc.