

A Digital Opportunity for Patients to Manage Their Health: Turkey National Personal Health Record System (The e-Nabız)

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Background: Health records changed over time in the countries, and also Türkiye passed from paper versions to personal health records (PHR) and put patients at the center of the system by allowing them to become the master of their health data.

Aims: Presenting the current state of the e-Nabız application nationwide in Turkey, and to evaluate the benefits of patients' online access to electronic health records and the system's interoperability.

Study Design: A descriptive observational study

Methods: In the Turkish PHR system (e-Nabız), services to patients to manage their health are categorized and analyzed within the scope of national digital health services. In addition, the data validation in the e-Nabız within itself has been systematically expressed.

Results: The Turkish PHR system allows users to use 30 different services for treatment, prevention, health promotion, and health-

related and interrelated areas. Moreover, some statistics regarding the categories specified in the e-Nabız system are included. Today, data is flowing from 28,608 system-integrated health facilities and 39 e-Nabız integrated public institutions. In addition, 4.5 billion transactions are done by people by 2023 and 220 million users are queried by physicians to reach patients' labs and results. Plus, the e-Nabız is adopted by 82% of the Türkiye population.

Conclusion: There is no universal model for the content of the PHR. Given its importance to the patient, the content evolved and will continue to grow over the years. With the advent of coronavirus disease 2019, the system is equipped with three new services. The importance of these services over time and in the future has been demonstrated with increasing momentum.

INTRODUCTION

Manual recording of patient health information by the healthcare team has taken a completely different form today.¹ In the 1920s, healthcare professionals recognized the importance of patients' health records. By the 1980s, financial and administrative areas in health facilities began computerization, and computers assumed their position in different fields, such as laboratories, radiology, and pharmacy. Research in the 20th century started providing evidence for the potential critical use of electronic health records (EHR).

Personal health record (PHR) is the last link in the chain of health data digitalization. It is "an electronic application through which patients (and others for whom they are authorized) can maintain and manage their health information in a private, secure, and confidential environment".^{2,3} PHR has the same content as EHR in that it contains all patient medical history information. However, PHR data can also be generated by patients, physicians, and hospitals and through diagnoses, pharmacies, treatments, and electronic

infrastructure; in this case, the control belongs to the patient.⁴ PHR empowers patients to self-manage their health, which improves patient-provider relationships and patient and data safety and quality of care and saves costs.⁵⁻⁷ In addition, several countries have developed PHR initiatives in this direction;⁹⁻¹³ they show distinction from two perspectives: Regional PHR systems or nationwide PHRs.^{11,14,15,17} However, only a few systems have reported the usage of nationwide patient portals.^{18,19,20} This article analyzes an example of the nationwide PHR system in Turkey: e-Nabız.

MATERIALS AND METHODS

e-Nabız has 38 different homepage components and studied contents. After analyzing the details of each component, we detected and removed five duplicates. In addition, this article excluded the three new services concerning coronavirus disease 2019 (COVID-19). Then, based on their contents, we grouped the 30 components into 11 subgroups and four categories to determine the main functions available for patients (Figure 1).



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Validation of Components

The e-Nabız system's data verification is one of the most critical issues that should be evaluated. Substantial big data exists because the system contains the whole health-system data. Given that these data cannot arrive without error, to give an example related to parameters, namely, time, site, average use (drug box, etc.), expert opinions, standardizations, minimum and maximum limits, and human nature, we conducted comparisons with national figures (e-Nabız or Turkey Insurance Institute). These conditions are easily removed from the e-Nabız database for data cleaning concerned with logical analysis. In addition, an open data structure is offered to everyone in the Health Coding Reference Server system.

Categorical Classification

Following the content analysis, the components of the platform were grouped into 11 subgroups, namely, healthcare, patient, wearable devices, index calculation, monitoring, donation, facilitate access, appointment, sharing, securing, and feedback, and then into four categories, such as treatment, prevention and health promotion, healthcare, and additional services.

Treatment category

First, treatment services included the data entered by three sources: Healthcare staff, the patient, and the sensors (Table 1 composition of treatment category).

Healthcare staff

Concerning the treatment, patients can view in detail the totality of their data, including hospital visits, prescriptions, reports, diagnostics, images, and medication. They can also obtain simplified readings or additional information. For example, for drug prescription, patients can view the image of the box and its leaflet by clicking on the prescribed drug. This feature can help patients, undergoing multiple treatments, to manage their medication intake. Moreover, 28.9% of hypertensive patients do not use their medication regularly because they lack knowledge about the dose, the right time of intake, and prescribed properties.²¹

Another example is the generation of graphics over three months for the different levels of hemoglobin A1c (HbA1c) samples. According to data from the Turkey Diabetes Program 2015-2020, lifestyle changes can prevent between 40% and 58% of type 2 diabetes cases.¹³ Citizens can also process wearable device data on the system and monitor them through e-Nabız, providing various

benefits, such as diet, physical activities, and visualization that can improve the quality of life standards. In addition, healthcare professionals can implement cost-cutting actions and generate follow-up models with data-driven insights. Data about anti-diabetic medicines, insulin, level of treatment modality for HbA1c alteration in patients, and controlling the dietary lifestyle of patients can be followed through the e-Nabız diabetes systems. In addition, technological advances will allow viewing of these data in a three-dimensional (3D) patient's body in PHR; it can be called a "virtual patient," that represents the patient's virtual condition. This condition may be the most significant visualization possible for PHR and represents the most advanced version of e-Nabız's "smart assistant" feature.

Patients

Patients can manually add information about their allergies or health for cases of emergency. For example, patients having an allergic reaction can take a picture of their skin situation and download it in the documents section to show the primary concern to their doctor who uses this feature for acute symptoms. Furthermore, emergency medical technicians can read the data about patients and give the first response as soon as possible in the case of anaphylaxis.

Sensors

e-Nabız is also compatible with any wearable device and can retrieve all data (step count, etc.). For example, the evolution of step counts over the last year can be viewed. In this way, users can analyze their level of sedentary behavior during the day and take action to achieve their goals regarding physical activity. World Health Organization emphasizes that physical inactivity is one of the common risk factors for chronic diseases (obesity and diabetes) and the fourth risk factor that causes death worldwide.¹⁴

Prevention and Health Promotion

e-Nabız offers prevention and health promotion services (Table 2 composition of prevention & health promotion).

Index calculation and monitoring

The platform provides essential opportunities for patient self-management, such as calculating the risk of heart attack,²² body mass index (BMI),²³ or risky situations concerning influenza that the health ministry system can calculate. Based on the results, vaccines can be distributed to those in need with the permission of exclusive primary care physicians via the risk index calculator of e-Nabız.

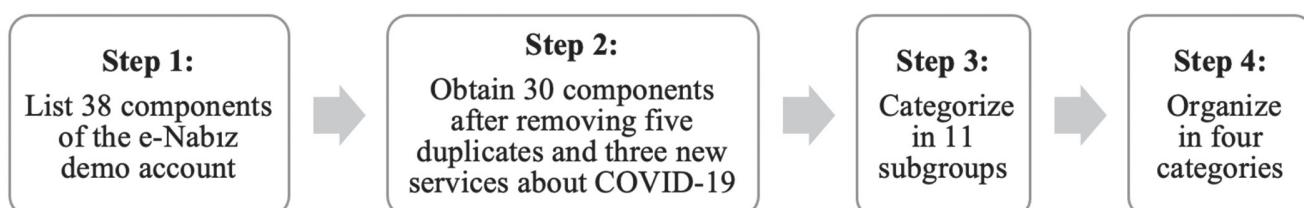


FIG. 1. Methods for the analysis of components of e-Nabız.
COVID-19, coronavirus disease-19

The prevalence of obesity is increasing in Turkey, similar to other countries in the world. According to the preliminary study report of "Turkey Nutrition and Health Survey-2010," the prevalence of obesity in Turkey reaches 30.3%.²⁴ Thus, the population should measure their obesity status, and e-Nabız is permitted to display the BMI directly on the PHR homepage. In addition, the system provides information on the city with the highest obesity rate, complication development associated with obesity, and obesity physicians for the system that can be decided by e-Nabız by policymakers.

Donation status

In Turkey, certain patients are waiting for organ donors.²⁵ e-Nabız has a section for this purpose to encourage donations. Filling in a form enables a person to take the first step toward organ or blood donation. Moreover, these features of e-Nabız are essential to creating convenience and awareness for those who want to donate organs and blood. e-Nabız is also crucial in terms of planning for waiting patients.

Healthcare Services Category

The third category includes healthcare services (Table 3 composition of healthcare services).

TABLE 1. Composition of Treatment Category.

| Components | Contents | Subgroups |
|-----------------|---|------------------|
| Visits | Show details, share, evaluate, and hide visit data | Healthcare |
| Prescriptions | Prescriptions, medication side effects, medicine usage information, and medication reminders | Healthcare |
| Reports | All information about reports | Healthcare |
| Diseases | All information about diseases diagnosis and possibility to show details | Healthcare |
| Tests | Test and COVID-19 tests results, possibility to make graphs-tables and download pdf | Healthcare |
| Images | Telemedicine images and list view with possibility to show images, send by e-mail and hide visit data | Healthcare |
| Medications | All details about medications and co-payment | Healthcare |
| Smart assistant | 3D body anomalies, mouth and dental, events visualization | Healthcare |
| Allergies | All information about manual entry allergies, diagnosed allergies, and skin prick tests | Patient |
| Emergency notes | Possibility to enter health care information for facilities in case of emergency | Patient |
| Documents | Possibility to upload images which you want your physician to see to this area | Patient |
| Sensor data | Graphs for week/month/3 months/year for blood pressure, heart rate, blood sugar, weight, steps, BMI, calcium, food calories, number of falls, active calories, flights climbed, oxygen saturation, respiratory rate, sleep analysis, body temperature, and cycling distance | Wearable devices |

COVID-19, coronavirus disease-19; BMI, body mass index

TABLE 2. Composition of Prevention and Health Promotion Category.

| Components | Contents | Subgroups |
|--------------------------------|--|-------------------|
| Body mass index | Calculate | Index calculation |
| Risk of heart attack | Calculate for the patient or for someone else | Index calculation |
| Influenza | Influenza risk situation | Index calculation |
| Vaccinations calendar | Graphs for percentile, vaccinations information, and vaccination calendar with possibility to download pdf | Monitoring |
| Bone marrow and blood donation | Information about red crescent and possibility to make donor request | Donation |
| Organ donation | Possibility of making an organ donation | Donation |

Facilitate access

Health services aim to facilitate patient access to health facilities. Patients can find the nearest health facility through the platform. Moreover, locations of pharmacies can be viewed directly on the map in e-Nabız, which provides patients with routes to nearby and accessible pharmacies without losing time.

Appointment

e-Nabız also allows patients to search for their interlocutors around the system. *Neyim Var?* ("what is wrong with me?") is a symptom checker that permits patients to enter their complaints under the guidance of the application. At the end of the questionnaire, the patient can view the possible diagnoses and recommended polyclinics they can visit for consultation. Users can then schedule an appointment to a central system called Central Physician Appointment System (MHRs) or manually add their selection to follow their schedule.

Additional Services

The fourth category concerns additional services (Table 4 composition of support services category).

Sharing

Users can configure their data through the edit profile tab. A user can authorize the family physician and the physician who examined them, all physicians of the hospital, where the examination was conducted, and all physicians of the ministry. Thus, the PHR is a patient-managed and secure platform that respects personal privacy. Thus, users are more likely to participate in the platform and provide accurate and complete information when they feel their privacy is protected.²⁶ In addition, using the e-mail or citizenship number of the receiver, patients can share their health data with their relative or another physician anywhere in the world. After mutual agreement with the parents, the parents can consult the PHR of their children under 16 years old.

Security

The login and logout functions of the application are performed securely through the e-government platform. Users can also view the last access's internet protocol address (IP), date, and time. In addition, a two-step verification system is used to increase the security level at the entrance to the system to the highest level to prevent people other than the users from entering the system. Moreover, patients are given one-time access to doctors using a one-time password when necessary.

Feedback

The system allows a user to interact with the platform at various stages; report information that does not belong to them, add or hide data, etc. In addition, a tab is dedicated to receiving feedback and ideas for the development of the application. Moreover, previous requests made can be tracked. Finally, e-Nabız allows users to evaluate their healthcare and write comments.

RESULTS

The number of e-Nabız users has risen in Turkey over the years. A total of 11 million citizens used e-Nabız in 2018; the number increased over the years and reached 68 million active users by 2022, that is, 80.0% of the population. In addition, e-Nabız has an adoption rate of 84% among users aged 0-4 years. Especially, parents use the control mechanism in e-Nabız for their children belonging to the 0-4 age group. However, the highest usage rate has been observed in the 25-29-year-old age range (87%). Furthermore, 54% of users that enable sharing of the burden of chronic disease to the society are in the 65-85-year-old age range, and the usage rate of the 90+-year-old population, which has very limited access to technology, is 33% (Table 5 e-Nabız Usage Rates of Turkey Citizens 2021). Meanwhile, 52.2% of all users are male and 47.8% are female. Data is flowing from the 28,608 system-integrated health facilities and other 39 e-Nabız-integrated public institutions (ministries, etc.). e-Nabız has been available to citizens since 2015, garnering a total history of 4.5 billion transactions. In addition, 220 million users are queried by physicians to reach patients' laboratory and radiology results. Since 2019, the number of people (4.2 million) requesting for duplicate radiological images from physicians through the e-Nabız system has decreased. The registration of radiological images in the system prevented patients from requesting their radiological images again. As a result, a total savings of 27.5% [750 Million TL (Turkish Lira)] was achieved in radiological images. In addition, citizens can access their images regardless of their location in Turkey, and they can be provided with remote health services.

Prescriptions

When evaluating the system results throughout Turkey, the transfer of prescription processes to online platforms has led to significant

TABLE 3. Composition of Healthcare Services Category.

| Components | Contents | Subgroups |
|-----------------------|---|-------------------|
| Closest hospital | Maps with selection options | Facilitate access |
| Closest duty-pharmacy | Maps with selection options | Facilitate access |
| Neyim var* | Redirecting toward another app, which permitted entering complaints and see possible diagnoses and also recommended polyclinics | Appointment |
| Family physician | Possibility to see and change information | Appointment |
| Appointment | Make or manually add an appointment | Appointment |

TABLE 4. Composition of Support Services Category.

| Components | Contents | Subgroups |
|--------------------|---|-----------|
| Edit profile | Personal information, person to contact in an emergency, and security settings | Sharing |
| Sharing | Possibility to share temporary or permanent information with others thanks to the ID and phone number of persons, see children's information and see information shared with me | Sharing |
| Secure exit | Exit of app | Securing |
| Clarification text | Complete text | Securing |
| Notifications | Date, IP, and hour of last connections | Securing |
| Evaluate hospitals | Evaluations of cares | Feedback |
| Feedback | Possibility to make feedback, share ideas concerning the PHR, and see previous feedback | Feedback |

ID, identification number; IP, internet protocol address; PHR, personal health records

paper savings. Currently, Turkey's usage rate of prescription procedures is 83.0%. Around 460 million e-prescription use has emerged from 2019 until 2022. In addition, e-Nabız sends notifications to the doctors for antibiotic prescriptions. In 2020, the rate of prescriptions, including antibiotics, was reduced from 31.1% (2015) to 24.3%.

Appointments

The online appointment system (CPAS) and "Neyim Var?" application, by placing the data processed in e-Nabız in the background, ensure that patients' new appointments will be notably more targeted. In addition, since the launch of "Neyim Var?," 8.83 million users have logged into the system. The system has allowed 921,000 people to schedule clinical advice appointment. Moreover, 90,462 correct diagnosis has been made, and considering that phone conversation for one diagnosis normally lasts for 5 min and taking into account hospital examinations, the use of the system has resulted in great savings. In addition, the appointment status of citizens can be monitored, and the capacity needs can be determined in the infrastructure used through e-Nabız. For example, the demand

TABLE 5. e-Nabız Usage Rates among Turkey Citizens (2021).

| Age interval | e-Nabız users | Total population | Ratio of e-Nabız users in total population |
|--------------|---------------|------------------|--|
| 0-4 | 4,940,318 | 5,913,609 | 84% |
| 5-9 | 5,656,183 | 6,624,202 | 85% |
| 10-14 | 5,395,513 | 6,438,152 | 84% |
| 15-19 | 5,372,255 | 6,229,709 | 86% |
| 20-24 | 5,712,808 | 6,741,580 | 85% |
| 25-29 | 5,605,692 | 6,476,899 | 87% |
| 30-34 | 5,233,845 | 6,341,787 | 83% |
| 35-39 | 5,075,415 | 6,386,208 | 79% |
| 40-44 | 5,188,475 | 6,547,162 | 79% |
| 45-49 | 4,407,263 | 5,662,261 | 78% |
| 50-54 | 3,686,493 | 4,754,484 | 78% |
| 55-59 | 3,201,477 | 4,707,180 | 68% |
| 60-64 | 2,471,722 | 3,611,916 | 68% |
| 65-69 | 1,933,364 | 3,156,448 | 61% |
| 70-74 | 1,274,086 | 2,175,024 | 59% |
| 75-79 | 729,507 | 1,392,718 | 52% |
| 80-84 | 393,509 | 861,409 | 46% |
| 85-89 | 171,028 | 456,548 | 37% |
| 90+ | 67,521 | 202,977 | 33% |

of people in Turkey is considered proportional to the capacities of provinces. Accordingly, the system is in high demand in areas, such as dentistry, pediatric immunology and allergy, pediatric pulmonology, dermatology, and otorhinolaryngology. However, a demand has been observed for these specialties in provinces, such as Sakarya, Kocaeli, İzmir, İstanbul, and Kırıkkale. Therefore, patient satisfaction and appointment capacity have increased on a critical provincial basis and in Turkey. Notably, the patient care capacity per physician in Turkey increased from 20.3 in July 2022 to 63.7 in January 2023.

Feedback and Evaluations

In the last three months (beginning from October 2022), 186,000 doctors were surveyed through the system for evaluation. The system not only views patients through the eyes of doctors but also doctors through their patients' perspective. In the 98,127 surveys conducted in the last three months, the rates reached 78.2%; whereas, the average rate in the past few years was 79.0%.

Securing

To access patients' private data, a request is made by the doctor to the patient. After the request, a unique numeric code is sent to the patient's phone. The patient notifies the doctor of this code, which allows the doctor to access data. The use of this system has increased by 16 times in the last four years, from 3,000 people in 2018 to 52,000 in 2021. The code can be used by doctors to access patient data once. In 2018, a total of 3,127 citizens requested a password for their doctor to look at their data, and this number increased to 51,033 in 2021.

Organ and Blood Donations

The e-Nabız system has also played a significant role in increasing organ donation. The procedure-free system provides easy access with a single button. By 2021, a total of 821,273 people have approved organ donation. Compared with the population of Turkey, organ donation is available at a rate of 9 per 1,000. A total of 154,000 organ donations were made through e-Nabız in 2018 and 338,000 in 2022. In addition, 201,000 blood donations were made by citizens until 2022.

DISCUSSION

The primary mission of EHRs is to provide information flow within the health system with the collected patient data access for the accurate, up-to-date, complete, and integrated information about patients and provide them with advice in instances where health services are provided.³¹⁻³³ Integrated EHR positively impacts the quality and continuity of healthcare services from both the patient and system perspectives.

Digital healthcare standards and structures in Germany have a "bottom-up" structure, and Turkey has a "top-down" structure strategy. The "bottom-up" structure allows the market to decide what works and succeeds for the benefit of citizens and patients. "Top-down" structures implement regulatory measures by

adapting laws to ensure that technical standards are used for the transfer, processing, and storage of people's data. In addition, this EHR system structure cannot be used by Turkey only. For example, Estonia has set a national standard indicating that all information from 2009 onwards should be included when it started publishing EHRs. By contrast, in many other countries, the regional government or healthcare provider decides the extent of historical data that should be used (developed countries). When implemented in Denmark, an overview of personal medical history dating back to 1977 was offered; whereas, the overview of referrals to general practitioners only dates back to 2003.²¹

When focusing on international situation, universal model for PHR is not available, but several recommended standards exist (cf. Table 6 recommended standards for PHR components). The Turkish PHR meets 12 of the 14 recommended standards, except family history and home monitoring.³⁰

e-Nabız gives patients a central role of permitting us to empower them in different cases.^{34,35} For example, if a patient is in intensive care unconsciously, intensive care doctors can access critical private patient data only in emergencies. Briefly, the break-the-glass protocol can be applied. During the COVID-19 period,

TABLE 6. Recommended Consensus Standards for Personal Health Record Components.

| Standards | Tab in e-Nabız |
|-------------------------------------|--|
| Critical | |
| Immunizations | Vaccinations calendar → vaccinations |
| Medications/prescriptions | Prescriptions |
| Allergies/adverse reaction | Prescription → allergies & medications side effects |
| Family history | No found |
| Lab/test results | Test → test results |
| Procedures/surgeries | Visits |
| Desired | |
| Health providers | Closest hospital + closest duty-pharmacy + MHRS + family physician |
| Insurance/payer information | No found |
| Social history/lifestyle | Sensor data |
| Problems, diagnoses, and conditions | Diseases + smart assistant |
| Clinical encounter | Visits |
| Recommended | |
| Vital signs | Sensor data |
| Care plan | Visits → show details |
| Home monitoring | Prescriptions + tests + allergies + documents + sensor data + body mass index + influenza + risk of heart attack |

doctors could examine the patient's allergic background without the user's permission for vaccine appropriateness.

Patients use this information to learn more about their health and participate in decision-making.³⁴ This increase in patient knowledge affects the decision-maker-patient relationship because unlike a paternalist relationship, the decision-maker is now in contact with an informed and active patient.³⁶

e-Nabız also attracts attention internationally. The cyber security and personalized measurements published in the G20³⁷ are essential examples for other countries worldwide. In addition, the European Union Commission Report states that Turkey is one of the leading countries in health digitalization in Europe, with a rate of 88.0%³⁸ and a population of 85 million.

In conclusion, the PHR definition indicates that e-Nabız is a digitalized platform that allows patients to manage their health data in a secure environment and provides them different services. Users are provided access to all their data, which are entered by health professionals, themselves, or received by integrated connected devices that are combined and synthesized for the patient. Furthermore, users can analyze or hide this information. Besides treatment, the patient has the opportunity to conduct health monitoring or make organ donations. On the whole, e-Nabız is an integrated platform that allows finding a way through the system to make appointments, search for facilities, or retrieve documents. As a user, the patient can interact with the platform on several occasions, regardless of whether they aim to give feedback on the PHR or evaluate their received care. The platform is continuously evolving to save great amounts of financial wastes. e-Nabız was coupled to the Social Security Institution Database, especially in 2019. According to the Social Security Institution Health Implementation Communiqué 2018 prices, the control mechanism has been operated from both the social security and e-Nabız databases of the transactions performed since 2019. In other words, hospitals process cost cannot be paid by Social Security without checking from e-Nabız. Thus, a control-based saving of 20 billion TL was achieved without changing the total transactions performed. Replicating these achievements, a savings of 50% in duplicate repetitions, 8% in laboratory examinations and 42% in examinations, such as that for vitamin D, have been achieved. As a result, a sizable patient-oriented database was established to make proper health planning and policies with evidence-based data and increase patient satisfaction, and the system was implemented successfully.

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Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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