



DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE

**HEALTH TECHNOLOGIES REPORT
(19 December 2025)**

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**HEALTH
TECHNOLOGIES**
19 DECEMBER 2025, FRIDAY

PLACE

Marmara University



FOREWORD

Prof. Dr. Sabahattin AYDIN

Chairman of the TÜSAP Executive Board

FROM DIGITAL TRANSFORMATION TO THE DATA OCEAN

Esteemed Rector, Mr. President, and distinguished participants from academia and the sector who have honored our TÜSAP Vision Meeting with your presence; I would like to begin the meeting by greeting you all with respect.

As TÜSAP Meetings, we are about to enter our 10th year. This is our 44th meeting. Unfortunately, due to some disruptions, we have reached today with a one-month delay. We also wish to hold our next “Summit Meeting” with a short delay, in January 2026 at the University of Health Sciences, with the participation of our Minister. As you know, an obstacle may always arise in the schedules of politicians, but for now, we have identified that day as a “barrier-free” day. Hopefully, there will be no surprise issue, and we will come together again at a summit meeting attended by our Minister.

Today, our keynote speaker is Prof. Dr. Hakkı Muammer Karakaş, President of the Türkiye Health Data Research and Artificial Intelligence Applications Institute under the Health Institutes of Türkiye (TÜSEB). I would like to thank him in your presence for honoring us by accepting our invitation.

When I first began my bureaucratic career, while working on health informatics, the concepts that formed our agenda and occupied our minds were concepts such as health informatics, digital transformation, networks, systems, interoperability, and data dictionaries. Of course, this process passed very quickly; we have now almost stopped using these terms. Today, other concepts have taken their place.

From the point we initially called the “data dictionary,” a serious data revolution emerged. We now talk about electronic health records, gene sequencing, sensors, wearable technologies, and medical imaging analyses. In fact, if you pay attention, these too are rapidly losing their historical agenda and current relevance. Because we now have trillions of bytes of data, terabytes and petabytes. In the past,

we used to say “data pool,” but I suppose these are now a “data ocean”; they have gone beyond being a pool. We were trying to swim in this data, and then we realized that this was a very primitive behavior. Now we want to surf in this data ocean; however, developing technology has begun to show us that even surfing is actually insufficient.

New Steps in the Knowledge Pyramid

In this process, we said “big data,” we said “business intelligence,” we said “decision support systems”... If you pay attention, we move forward by making concepts age very quickly. We even began to define special areas of expertise in these fields, such as data mining. However, change is so rapid that we have seen that we need to run ahead of change, and that if we run after it, we cannot catch it.

As you know, there is a classical Knowledge Pyramid (DIKW):

- At the bottom comes Data.
- Above it comes Information — I translate this as “malumat.”
- Then comes Knowledge.
- At the top comes Wisdom/Vision — that is, “Irfan.”

In fact, if you pay attention, all our hesitation is at the lower levels of this pyramid; we are still struggling to swim and surf in the data ocean. The higher steps await us.

However, with Artificial Intelligence and Machine Learning, the digital missile was almost ignited.

All of a sudden, we started to seriously discuss not the data itself, but the results obtained from data. Moreover, we now cover this path not with our own expertise, but through machines. This opportunity truly brings you to the process of reaching knowledge by even going beyond the information stage in the knowledge pyramid; we are still very far behind in terms of wisdom. But it is a reality that we have made very rapid progress, or at least gained momentum, in reaching knowledge.

Risks: Privacy and Disinformation

Although this momentum enables us to reach knowledge faster, it also brings some risks with it:

- We began to discuss issues of privacy.
- Algorithmic judgments and biases occupy our minds.
- Unethical or erroneous practices have entered our agenda.
- While speaking of information, we have now begun to drown in concepts such as disinformation, misinformation, and malinformation.

Beyond all these, after all, we are healthcare professionals and we think with a health-oriented approach. Our aim is for people to access the healthcare services they deserve in the fastest and highest-quality way. Within so much knowledge and speed, our risk of “moving away from humanity” is perhaps the aspect that concerns us most as healthcare professionals.

This comprehensive meeting, held with the participation of a distinguished invited audience, was organized with the contributions of the Association of Research-Based Pharmaceutical Companies (AİFD), the Pharmaceutical Industry Employers’ Association (İEİS), the Turkish Pharmaceutical Industry Association (TİSD), as well as Roche, Yerlika, IQVIA, Biogen, UCB Pharma, Meditel, One Dose, Bayer, AstraZeneca, Amgen, and Johnson & Johnson.

I would like to thank Rector of Marmara University, esteemed **Prof. Dr. Mehmet Emin Okur**, for hosting us in this beautiful venue. I extend my gratitude to Hakkı Muammer Karakaş Hocam, who will broaden our horizons with his experience by kindly accepting our invitation, to our valuable stakeholders, and to all participants who contributed, and I wish you a successful meeting.



PRESENTATION

Prof. Dr. Mehmet Emin OKUR
Rector of Marmara University

ARTIFICIAL INTELLIGENCE AND CONSCIENCE

My esteemed Deputy Minister, Mr. President, distinguished Rectors, and valued participants;

As Marmara University, we are happy and proud to host this meeting. Surely, very beneficial outcomes will be achieved from the gathering of so many competent people; and we are honored to host this.

The subject is health, the subject is new technologies... Artificial intelligence is on our agenda here as well, as it is in every field. I am a business administrator. We actually think as follows: Every enterprise has a dimension. In our view, a hospital is also an enterprise, a school is also an enterprise, and they also have management. However, with truly major developments, the world is changing very rapidly. The world has now begun to undergo the change it experienced over the last 100 years perhaps within just a few years.

The Search for “Authentic Knowledge” in the Fire of Information

The metaphor of the world becoming a “global village” has both advantages and disadvantages. We see its advantages; information is shared very quickly. However, the need to separate what we call “authentic knowledge,” what we call clean knowledge, from this jungle of information places a new responsibility on us. Everything spreads very quickly. For example, during the pandemic period we experienced 2-3 years ago, we saw that diseases and information spread at the same speed. The world becoming a village also carries such risks.

Health is very valuable both for the world and especially for our society. For example, being a professor of business administration does not “bring much value.” But if I were a doctor, the situation would be different. In some places, they call out to me saying “Hocam, hocam!” and immediately start asking things related to health. When I say, “I am a professor of business administration,” the crowd immediately disperses. Even if you are a rector, if you are not a physician, they ultimately say, “you are of no use.”

This situation places a serious responsibility on you physicians; a sacred responsibility such as being a means for people's healing.

I think there is one thing that stands out here and must never be left incomplete: The last century was a century of reason, a positivist century. We started this century with "Artificial Intelligence." Perhaps reason can be tolerated with certain smart devices, and artificial intelligence can take the place of intelligence; however, there is something that cannot be filled with machines, and that is conscience. That conscience perhaps operates most of all in a healthcare professional, and ultimately it is a mechanism that works with compassion.

In every sector, but especially in the health sector, we need a structure in which conscience and compassion come to the fore, and if education is needed, then education. Because we know that there are three sacred relationships:

1. Physician-patient relationship,
2. Teacher-student relationship,
3. Parent-child relationship.

These are relationships that require absolute trust and in which distrust is not calculated. However, at the point we have reached today, unfortunately, we are talking about attacks against physicians and attacks by students against teachers. On the other hand, we also talk about sad incidents such as the abuse of physicians in the opposite direction. In recent days, perhaps the most striking example is that we are talking about a child being able to kill his mother. These shocking examples deeply wound us all. This is exactly where great duties fall upon our devoted doctors, teachers, and parents.

Today, while we discuss how closely artificial intelligence applications are identified with health, we must also evaluate how much we will bring compassion to the forefront. These are absolute values that the world sometimes postpones, but that are "indispensable" for us.

I thank all of you once again for coming. I believe that the outcomes to emerge from here will be beneficial and will be recorded as good notes in our "unclosed book," our book of deeds. With this awareness, I welcome you all and pray to Almighty Allah that our meeting will be conducive to good.





KEYNOTE SPEAKER

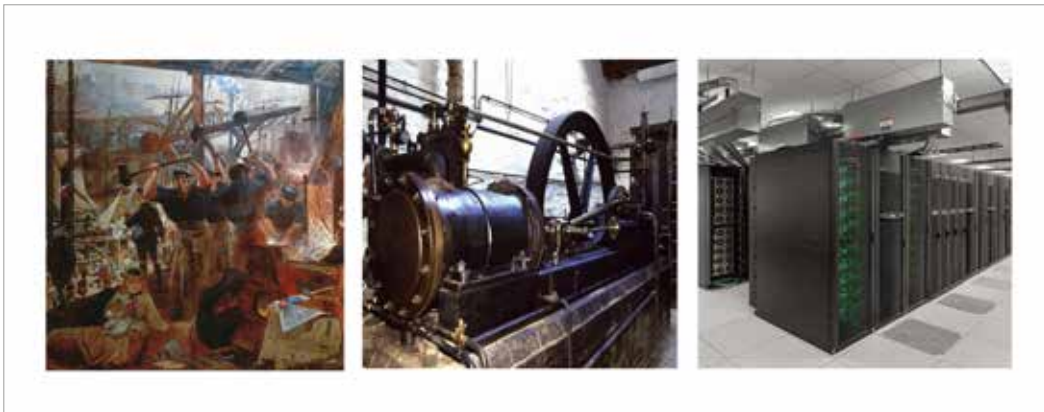
Prof. Dr. Hakkı Muammer KARAKAŞ

President of TÜSEB – TÜYZE Türkiye Health Data Research and Artificial Intelligence Applications Institute

WHAT DOES ARTIFICIAL INTELLIGENCE MEAN TO US?

Esteemed Rector, I am essentially a business administrator as well; I am completing my doctorate in the field of marketing, and my thesis topic is Artificial Intelligence. Therefore, in my presentation, I will approach the subject somewhat from the perspective of business and marketing, that is, through the question of “What does artificial intelligence mean to us?”

Why and How Artificial Intelligence in Medicine?



From the Industrial Revolution to the Present: The Crisis of Efficiency and Sustainability

As you know, the Industrial Revolution took place in the 1700s. For many years, humanity was only able to increase gross total production per capita from around 1,000 dollars to 1,800 dollars. However, with this revolution, production capacity increased tremendously and shaped the modern world. It should not be forgotten that such major revolutions emerge not only through human will, but when conditions become unsustainable, that is, out of necessity.

Essentially, after the Industrial Revolution, no very radical technological leap in efficiency was achieved; only the tools changed. The steam engine was replaced by internal combustion engines, followed by the revolutions of electronic information technologies and the internet. However, current studies show that the internet revolution did not provide the enormous increase expected in production efficiency. On the contrary, today we face a very major sustainability problem.

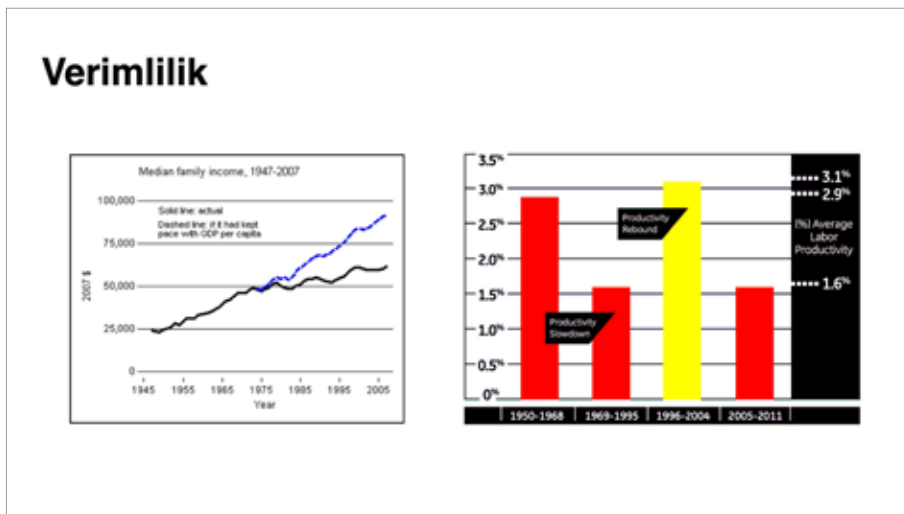
In order to feed the growing world population and maintain the system, we are consuming both natural resources and human labor excessively. Environmental pollution and harsh working conditions summarize how the system has become clogged. “Sustainability” is no longer just a word; it is a matter of survival.



The Limits of Human Resources in Health

The example of the workshop worker in the Far East shown in the visuals is not a misery specific only to that sector. We experienced a similar situation painfully in our own hospitals, especially during the COVID-19 pandemic.

The photograph of a healthcare worker collapsed on the floor from exhaustion showed how devoted our physicians and nurses are, while also proving how deeply the system exhausts people “to the very bottom.” No human being can carry such a burden for a long time.





At this very point, we face the reality that there is an efficiency problem. Artificial intelligence appears before us not merely as a technological innovation, but as a necessity that will stop this burnout and redefine efficiency. Since the Industrial Revolution, we have been producing a great deal, but we have now reached the end of the road.

As seen in the American household income graph in the visual, after the 1970s, the economy grew, as shown by the blue line, but the real income entering citizens' pockets, shown by the black line, remained stagnant. In other words, we cannot increase welfare through old-fashioned methods. The productivity graph regarding recovery and decline in productivity summarizes the gravity of the situation more clearly; labor productivity growth, which was 3.1% in the early 2000s, has today declined to around 1.6%. In other words, we can no longer get anywhere by working more and consuming more resources.

Today, we are now facing a serious sustainability problem. We are trying to keep the system standing by exhausting people. We can solve this enormous inefficiency in health not by exhausting our physicians "to the very bottom," but only through intelligent systems that will guide us in this data ocean.

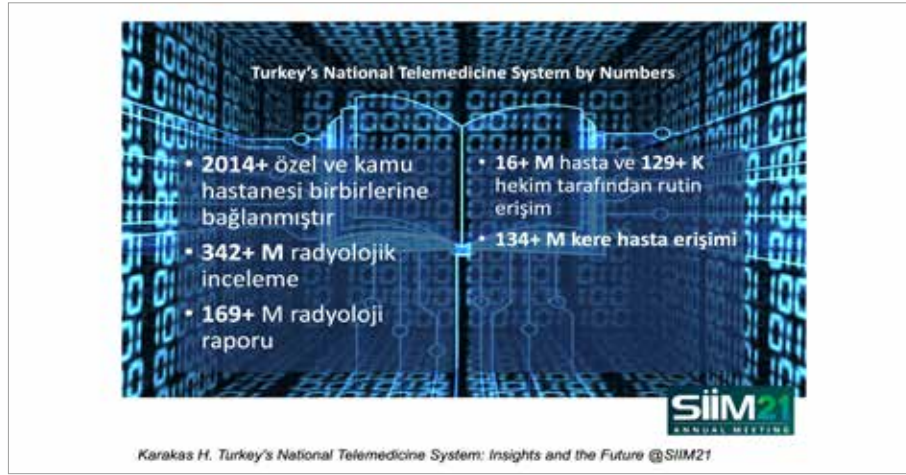


A Concrete Picture of Inefficiency in Health

Inefficiency in the health sector has now reached intolerable dimensions. I have been using this slide for years, but the figures in it still remain valid:

- **Loss of Time:** Nurses were spending a full 21 minutes in every shift searching for missing equipment. Physicians, on the other hand, were spending 2.5 hours of the day only on data collection and menial tasks; they were consuming that valuable time they could allocate to their patients with paperwork.
- **Capacity Problem:** In large American hospitals, only 42% of critical devices such as ventilators and infusion pumps were being actively used; the rest continued to generate costs while sitting idle.
- **Errors and Dose Risk:** Every year, approximately 98,000 medical errors may result in patients being permanently injured or dying. Moreover, among patients receiving the same protocol, the radiation dose level can differ by 13 times.

All these figures point not only to errors, but also to inefficiency in health. This is exactly why what we call "artificial intelligence in health" is not a luxury, but a necessity imposed by circumstances in order to take this burden off physicians' shoulders and solve inefficiency.



From the Data Ocean to Knowledge: Telemedicine and the e-Nabız Transformation

Today, throughout a patient's entire journey — which we call the “customer journey” in marketing terminology — we can obtain data from every point and make sense of these data. The backbone of this work is the National Telemedicine System, which I also made efforts to help establish and which was implemented under the administrative leadership of our Deputy Minister Şuayıp Birinci.

This system has collected billions of data from hundreds of millions of patients:

- Since 2014, all public and private hospitals have been connected to one another.
- More than 342 million radiological examinations and more than 169 million reports have been shared through the system.
- Today, more than 16 million patients and more than 129 thousand physicians can routinely access these data.

This has gone far beyond being merely an image-sharing platform; it first evolved into e-Nabız, and then, through real-time interactive telemedicine applications, transformed into remote access and even virtual hospitals.





The ECG data of a case in an ambulance or the movements of a physical therapy patient can now be monitored remotely and simultaneously by a specialist physician. These massive datasets are the greatest raw material for artificial intelligence strategies.

%3

The percentage of health data that is actively processed and used in decision-making.

Making Sense of the Data Ocean: The 3% Impasse and Analytical Transformation

Today, even when we examine the world's best healthcare systems, we encounter a striking picture: only 3% of the health data obtained can be actively processed and used in clinical decision-making processes. When we include the last analog devices we still use, such as pathology microscopes, this rate will unfortunately fall even lower.

Here, it is necessary to make a fundamental distinction clearly: obtaining data is one stage, storing it is another stage, but transforming that data into knowledge and making sense of it is an entirely different dimension. This is precisely why the concept of "Analytics" is so critical for us.

The scale of the data we are dealing with today is far beyond what we have imagined until now:

- Genomic Data: From just a single patient, depending on the patient's condition, we obtain massive data ranging from 3 GB to 1 terabyte.
- Capacity Challenges: When we shared the volume of these data with Telekom officials, it was stated that these figures constitute "very big data" even for an institution with Türkiye's massive infrastructure.

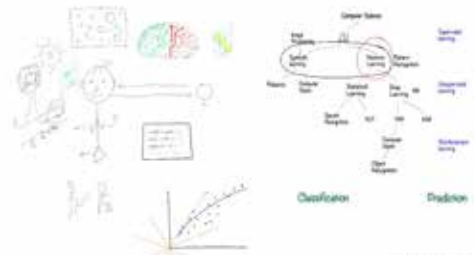
So, who will process this data?

With classical methods, these data are still being processed by humans, that is, by us physicians. However, surfing in this data ocean through human power alone is no longer possible. This is exactly the main reason why artificial intelligence must be seen as a necessity in order to make sense of this data.

Hohlenstein-Stadel, Aslan-Adam, m.ö. 42.000



Kısaca yapay zeka



The Human Brain and Cognitive Capacity

Here, we encounter a limit. The Lion Man (Hohlenstein-Stadel) figurine, dated to 42,000 BC, is the most concrete evidence that human cognitive capacity has not changed since that period. The storage and processing capacity of the human brain has remained the same for the last 100,000 years. Today's children, or we ourselves, are not more intelligent than Leonardo da Vinci. If you brought a human being from 100,000 years ago to the present day, you could make that person a quantum physicist.

In summary, while the biological processing capacity of modern humans remains constant, the amount of data we encounter is increasing geometrically. In order to accelerate this fixed cognitive capacity and make sense of this enormous data, using artificial intelligence as a “second brain” or decision-support mechanism is no longer a preference, but almost a necessity.



Informatics: The Bicycle of the Mind and High-Performance Computing

Steve Jobs has a famous metaphor; he describes the computer as the “bicycle of the mind.” When a child is introduced to a bicycle, the child becomes free and can travel, with great excitement, to distances that would normally be impossible to reach on foot. Modern computers and artificial intelligence are also the bicycle of modern humans; they are tools that will accelerate our limited biological processing capacity and enable us to reach very distant horizons.

What we mean by artificial intelligence is, in fact, the High-Performance Computing (HPC) capability provided by super-powerful computers.





A New Paradigm: Collective Memory

Artificial intelligence borrows certain methods from human intelligence, but this does not mean that artificial intelligence is the same thing as human intelligence. Compared to the multidimensional structure of human intelligence, today's artificial intelligence remains limited to only a few of these dimensions. Human intelligence and artificial intelligence should not be confused with each other. According to the Cattell-Horn theory, which is accepted in the literature, and later the CHC theory, human intelligence is evaluated across approximately 84 different dimensions; it contains a vast diversity ranging from fluid intelligence to crystallized intelligence, and from visual processing to auditory depth.

Artificial intelligence, on the other hand, can currently provide only one, two, or three of these 84 dimensions properly. However, this does not mean that the findings offered by artificial intelligence are “artificial” or worthless. The real power of artificial intelligence lies in the incredible processing speed it demonstrates in the limited dimensions on which it focuses.

When the depth of humans across 84 dimensions is combined with the machine's enormous processing capability, especially in fields such as pharmaceutical research, where millions of combinations need to be screened, we can reduce processes that would take decades to the level of days. In other words, artificial intelligence does not replace human intelligence; it gives physicians a “superpower” in the field of high-performance computing, where human intelligence remains limited.

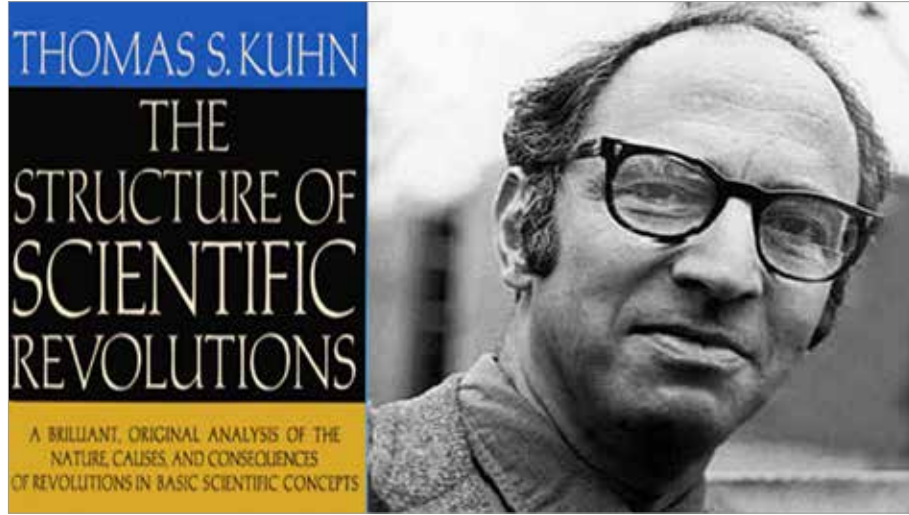


Computer Vision, Quantum, and the Eve of a New Paradigm

“Look, 2015 is a turning point for us; the visual capability of computers surpassed humans in that year. Artificial intelligence, which is now much cheaper and more accessible, is with us at every stage in health, from the diagnosis of the patient to treatment.

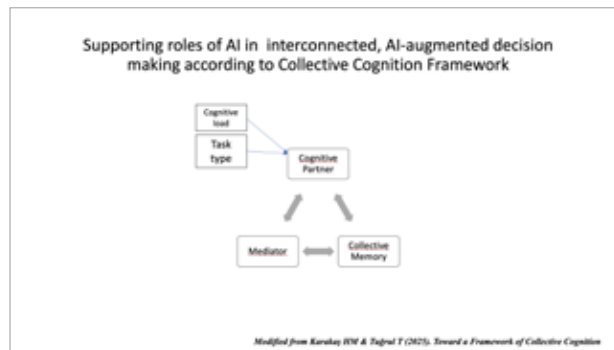
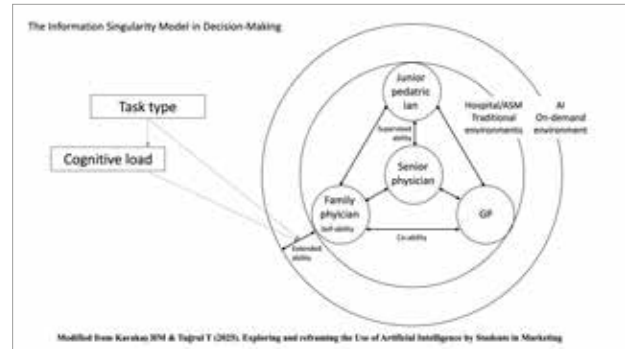
- Individual Level: We can manage the specific diagnosis and treatment processes of a patient.
- Department Level: We can instantly evaluate the current operational status of a clinic.
- Server Level: For example, artificial intelligence can play an active role in monitoring and correcting all processes of a massive hospital such as Johns Hopkins.

However, for these massive operations, we need processing power far beyond what we use today. This is precisely why Quantum Computers have been studied for decades, and indeed, a certain stage has been reached.



As Thomas Kuhn explains in his book “The Structure of Scientific Revolutions,” major scientific revolutions emerge spontaneously at a point of need. They destroy old paradigms and establish their own worlds. We are now exactly on the eve of such a major paradigm shift.

Our fundamental issue is this: We know what artificial intelligence is and what it contributes to us. However, we do not yet have established, proven theories and models regarding exactly how we will benefit from it. Although many practical studies are being carried out in business, marketing, or education, we are at the stage of placing this process on a solid theoretical foundation.





Collective Cognition and Information Singularity: A New Connectivity

However, in my view, artificial intelligence does not only develop us individually; systems such as ChatGPT, Gemini, or DeepL that you use today actually connect all of you to one another. These systems learn from all of us, transmit our knowledge to others, and continuously modify themselves in this process. Whether you are aware of it or not, artificial intelligence connects even people who have never connected with one another.

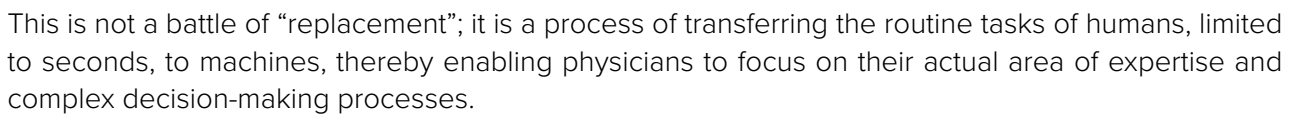
Especially if the weight and cognitive load of the work you do are high, you need it more and are almost drawn into the system. Here, artificial intelligence not only becomes a “Cognitive Partner” for you, but also acts as a “Mediator” that connects people to one another and forms humanity’s “Collective Memory.”

This situation, evaluated in the business literature as the “Collective Cognition Framework,” leads us to the “Information Singularity” model. In this process, the abilities of everyone, from family physicians to senior specialists, combine with the “Extended Ability” offered by artificial intelligence.

So, where is this journey going? We cannot fully predict this. Because while our intuitions progress linearly, the reality of information technology grows at an exponential speed. This creates a very deep gap between our intuitions and technological reality.



Artificial intelligence may not completely replace us, but we know this: If a specialist, such as a doctor, can perform a task in less than a few seconds, that task will probably be automated. We are now walking on the path from a point where everything is done only by humans toward a level dominated by machines.



This is not a change that will happen all at once; it is a journey we are taking step by step along a spectrum. It is the process of building a future that starts from the traditional point where humans do everything manually, and in which routine tasks that can be completed within seconds are first transferred to assisting systems and then to fully autonomous structures.





Artificial Intelligence in Medicine: TÜSEB-TÜYZE's Strategic Role and Product-Oriented Vision

As the Türkiye Health Data Research and Artificial Intelligence Applications Institute (TÜYZE), we have assumed a very critical responsibility in Türkiye's medical artificial intelligence journey. As our Minister, Deputy Ministers, and TÜSEB President emphasize on every platform, the fundamental task assigned to us is to make sense of health data and facilitate the process of transforming these applications into products.

Although TÜSEB was initially established, in a sense, as the reflection of TÜBİTAK in the field of health, today our focus is much more specific: to transform inventions and innovations that have reached a certain level of technology maturity in strategic areas, especially emergency health, military health technologies, and vaccine development, into final products.

SAĞLIKLI TÜRKİYE YÜZYILI PROGRAMI EYLEM PLANI							
Amaç* Amaç 3: Türkiye'nin ekonomik kalkınmasına ve küresel sağlığa katkı sağlayacak, sağlık hizmeti sunmak, milli sağlık teknolojisini ve üretimi geliştirmek Amaç 4: Sağlık sisteminde, saffaf, bütçem tabanlı, bilimsel verilere ve risk yönetimine dayalı, yapay zekanın kullanılacağı, çoklu denetim mekanizmasını geliştirmek							
Eylem No	Eylem Adı**	Faaliyet No	Faaliyet Adı	Sorumlu Birim	İş Birliği Yapılacak Birimler	Başlangıç Tarihi	Bitiş Tarihi
1	SAVEM Sağlık Veri Merkezi Projesi	1	TÜSEB bünyesinde tutulacak tüm sağlık verilerinin saklanması, işlenmesi ve korunulduğu merkezin inşaatı, donanım, yazılım ve personelinin temini	TÜYZE	ASAM, TBE, SSGM	1.01.2025	31.12.2025
2	AİP Yapay Zeka Validasyon Platformu Projesi	2	Sağlık alanında kullanılan yapay zeka yazılımlarının doğruluk temelli validasyonu ve akreditasyon süreçlerinin gerçekleştirileceği kapalı bir platformun geliştirilmesi	TÜYZE	TUSKA	1.01.2025	31.12.2025
3	RADS Radyolojik Karar Destek Sistemi Projesi	3	Kamuya ait tüm radyolojik görüntüleme cihazlarına yerleştirilecek, hasta dayalı karar alma sürecine dayanan ulusal karar destek sisteminin geliştirilmesi, NIRS sistemlerine uygulanması ve SGK bağlantısı	TÜYZE	TUSKA	1.01.2025	31.12.2025
4	METRA Yapay Zeka Destekli Mamografi Erişim Tanı ve Raporlama Sistemi Projesi	4	Ulusal Mamografi Tarama Programı bünyesinde kullanıma üzere, çok gelişmiş bir mamografi yapay zeka sistemi geliştirilmesi ve validasyonu	TÜYZE	SHGM, THGM	1.01.2025	31.12.2025
5	GENOM Türkiye Ulusal Genom ve Biyoinformatik Projesi	5	15.000 genom finansal hedefine ile uyumlu araştırma, geliştirme ve analiz platformunu gerçekleştirilmesi, Klinik analizlere yönelik altyapının kurulması	TÜYZE	ASAM, TBE	1.01.2025	31.12.2025
6	PROTAN Yapay Zeka Destekli Yüksek Rezolüsyonlu Prostat MR Tanı Sistemi Projesi	6	Çok yüksek manyetik alan gücünde elde edilen MR görüntülerinden prostat kanserini, tipini ve yayılımını en doğru şekilde tespit edecek yapay zeka destekli tanı sisteminin dünyadaki ilk aşamasının gerçekleştirilmesi	TÜYZE	TKİ	1.01.2025	31.12.2025
7	TİDAP Tıbbi Cihaz Dağıtım ve Planlama Sistemi Projesi	7	Sağlık Bakanlığı tıbbi cihaz planlamada kullanılabilecek optimizasyon yazılımının geliştirilmesi	TÜYZE	SHGM, KHGM, HSGM	1.01.2025	31.12.2025
8	MEDINOVA Tıbbi Cihaz İnovasyonu ve Üretimi İzleme Sistemi	8	Ülkemizde yüksek kalitede tıbbi cihazların üretimini sağlamak üzere, TÜSEB bünyesinde MDR yazılım ve portalı oluşturulması	TÜYZE	TÜSEB Bakanlık	1.01.2025	31.12.2025

Criteria for Successful Innovation and Guided Projects

“However, we need to clarify this: A successful innovation is not merely a good research and development (R&D) or engineering process. Success is not limited only to implementation either; it is essentially related to commercializability and scalability. All of these must exist together.

That is why, when a project comes before us, we ask ourselves the following four fundamental questions:

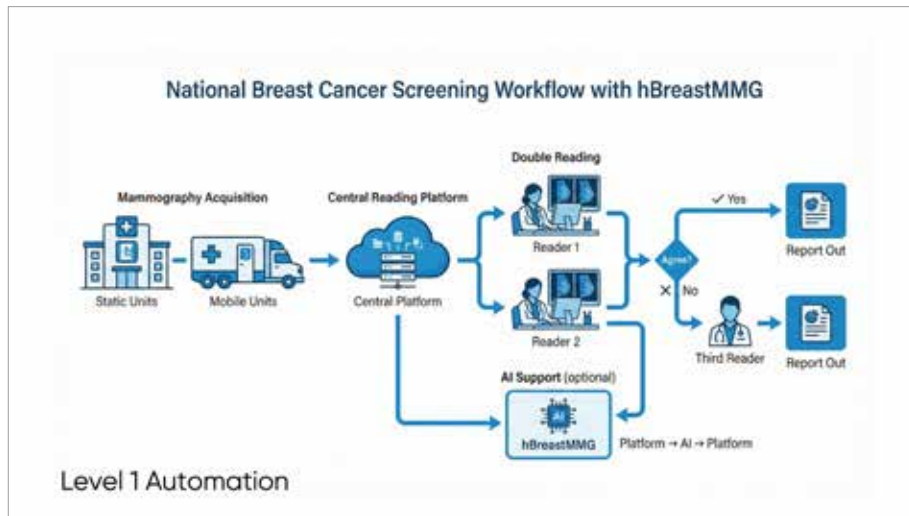
- Is the innovation necessary?
- Is it feasible?
- Is it commercializable?
- Is it scalable?

Under the umbrella of TÜYZE, we approach projects not merely as an institution that provides support, but as a solution partner. Our aim is to develop models that will enable the answer to be “Yes” to all four of these questions through different methods. If we cannot meet these criteria, we have to leave that project there. Because we focus on producing real value through guided projects aimed at the urgent needs of the state, the nation, and people.

As TÜYZE, we determine these strategic projects at the beginning of the year in parallel with the Presidency's strategic objectives. For example, we implement projects such as METRA (Artificial Intelligen-

ce-Supported Breast Cancer Early Diagnosis and Reporting System), GenomTürk (National Genome and Bioinformatics Project), and REDİS (Radiology Decision Support System) with our own resources and through our public and private sector partnerships.

Strategic Projects and the Advanced Level in Artificial Intelligence: The METRA Example



Let us concretize this through the METRA (Artificial Intelligence-Supported Breast Cancer Early Diagnosis and Reporting System) project, which we also demonstrated live at the Turkish Medical World Congress, namely the project for screening mammography examinations with artificial intelligence:



GLOBAL STANDARTLARDA MİLLİ PERFORMANS

450.000+ KETEM verisi ile TUYZE sunucusunda eğitilen modelimiz, global rakiplere benzeryakın performans gösteriyor.



Sonuç: Daha az veriyle eğitilmesine rağmen Türk popülasyonuna en uygun ve yüksek doğruluklu model.

KETEM ENTEGRASYONU VE OPERASYONEL GÜÇ

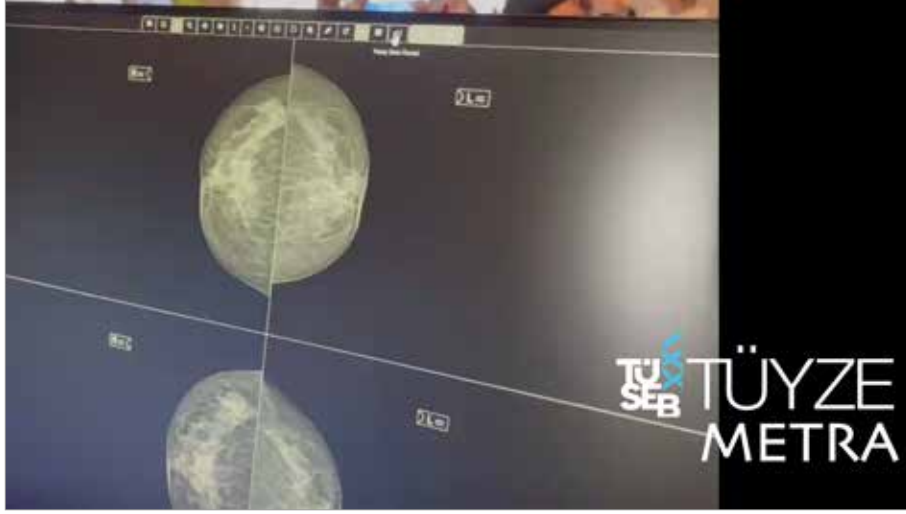
- YÜKSEK İŞLEM KAPASİTESİ**
Günde 16.000+ mamografi (4.000+ birey) otomatik olarak işlenmektedir.
- BACKLOG YÖNETİMİ**
Birikmiş tarihsel vakalar taranarak raporlama kuyrukları hızla eritiliyor.
- "3. GÖZ" GÜVENLİK AĞI**
Radyolog bağımsız karar verir; METRA "isteğe bağlı" olarak lezyon yerini göstererek gözden kaçmaları önler.



System Bottleneck and Efficiency

Each day, 16,000 new images come from our KETEM units; the 70,000 patient images accumulated in the system are currently pushing capacity. In normal operation, if there is discordance between two readers, the case goes to a third eye; however, at this level of intensity, the process becomes locked. This is precisely where we provide artificial intelligence support to our physicians. Our aim is for physicians to be able to access the decision-support system by pressing a button whenever they wish.

This model, developed and fine-tuned within the scope of TUYZE, competes with the world's most advanced mammography software with an AUC value of 0.90 and is moving toward becoming even better.

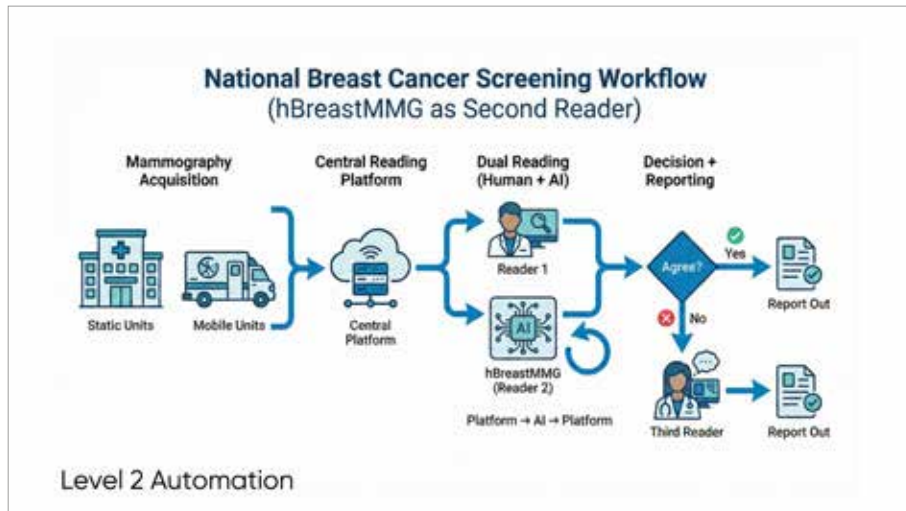


High Performance: Our model, which we developed and patented within the scope of METRA, competes with the world's most advanced software with an AUC value of 0.90. As we also demonstrated in the live demo, it takes only seconds for the image processed on the Ministry's central server to return to the doctor's screen. This high speed and processing capacity are critically important for taking that enormous burden off the physician.

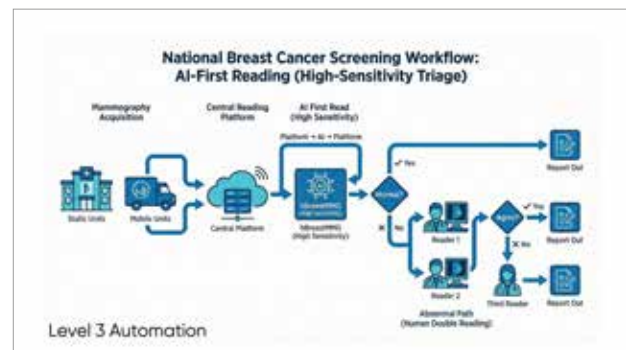
HEDEF: KARAR DESTEKTEN "İKİNCİ OKUYUCU"YA GEÇİŞ	
Mevcut Durum	Gelecek Hedef
Rol: 3. Göz / Yardımcı Karar Destek	Rol: Otonom İkinci Okuyucu
Radyologların kararlarını destekleyen, isteğe bağlı açılan bir güvenlik katmanı olarak çalışır.	İnsan okuyucunun yerini almak.
	Yılda 30 Milyon TL+ Tasarruf hedefi.
	AUC performansını 0.98+ seviyesine çıkarmak ve başarılı kanser taraması.
*Gereklikimleri: Geniş ölçekli Klinik Validasyon, CE-MDR "Diagnosis" seviyesi ve güncel risk analizleri.	

Goal: “Replacing One Reader with Artificial Intelligence”

We are focusing on a goal that has not yet been achieved in the world. In Türkiye, the number of physicians who perform professional-level mammography screening readings does not exceed 50, and the number of physicians who perform third-eye readings does not exceed 10. Our goal is to completely replace at least one of the readers with artificial intelligence.



We have the technical equipment and a massive dataset capable of doing this. However, before taking this radical step, we aim to scientifically prove the validity and reliability of our system in respected journals such as Nature or Science. Since no one has a dataset large and qualified enough to replace the reader with a computer, this will be a first in the world.



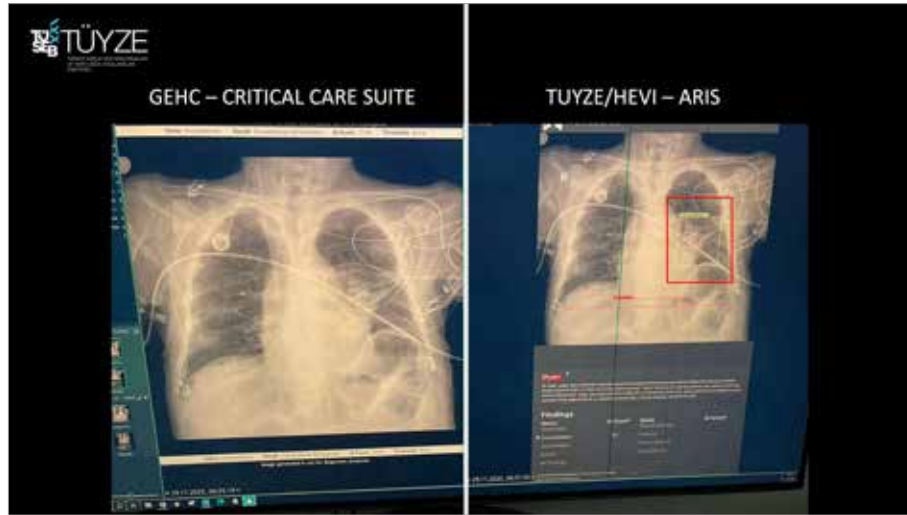
New Innovation: Intelligent Triage Model

On the road to Full Automation, we are moving to a new stage with a very valuable innovation by one of our internationally recognized radiologist professors: Why do we not have artificial intelligence read all of them first? We plan to directly eliminate the cases that artificial intelligence identifies as "Normal" and send only those it identifies as "Suspicious" to the Double Reading system. In this way, we are working to implement a project that will dramatically reduce physicians' workload: ARIS.



ARİS: Artificial Intelligence-Integrated Intelligent X-Ray and Global Vision

Another strategic project that we also presented to our President is ARİS. Let us clarify this: ARİS is not merely an X-ray device. There are more than 300 manufacturers producing mobile X-ray devices in the world, and the Chinese even produce these devices almost for free. However, ARİS has a very fundamental difference: This device not only captures images, but also provides an instant report to the patient.



In this study, which we are carrying out under the umbrella of TÜYZE, the process works as follows: The image is captured, and approximately 14-15 seconds after the relevant button is pressed, the system automatically detects critical emergency findings such as pneumothorax. There are only two examples in the world with this capability, and the intellectual originator of one of them is again us.



HEDEF: İLK ETAPTA SAHADAKİLERİN V1 DÖNÜŞÜMÜ VE SONRASINDA 330 CİHAZDA V2 YAZILIM

330

ASELSAN'ın siparişi kesinleşmiş cihaz sayısı. Bu cihazlar doğrudan hChestXR yeteneği ile teslim edilecek.



Sahada aktif çalışan mevcut ASELSAN cihazları için donanım güncelleme fizibilitesi tamamlandı. Eski cihazlar da AI yeteneğine kavuşturulacak.



Dissemination and Strategic Partnership: Within the scope of our cooperation with ASELSAN, this system was installed on 330 devices. 30 devices will be delivered to the General Directorate of Public Hospitals.

PAKET KONFIGÜRASYONU

DÜNYADA BİR İLK: SENARYO BAZLI HİBRİT PAKET MİMARİSİ

TRAVMA VE ACİL <i>Hedef: Acil Servis & Travma</i>	YOĞUN BAKIM (YBÜ) <i>Hedef: Entübe Hasta Yönetimi</i>	GENEL SERVİS <i>Hedef: Yataklı Servisler</i>
☒ Pneumothorax Y1	☒ Pneumothorax Y1	☒ Pneumothorax Y1
☒ Pleural Effusion Y1	☒ Pleural Effusion Y1	☒ Pleural Effusion Y1
☒ Consolidation Y1	☒ Consolidation Y1	☒ Consolidation Y1
☒ Kosta Kırığı Y1	☒ ETT - Kartina Y1	

"FAST-TRACK" REGÜLASYON STRATEJİSİ

FAZ 1: HIZLI GİRİŞ 0-2 AY	FAZ 2: KONSOLIDASYON 3-12 AY	TEKNİK ALTYAPI SÜREKLİ
- Mevcut durumda Cihaz ve Yazılım için CE belgeleri sağlandı. - Mevcut 30 CE'nin önümüzdeki yılın ortasına kadar tamamlanması. - Yeni cihazların teslimatı 3 ay içinde tamamlanacak.	- Kurulum için 1000+ cihazın teslimatı için CE belgeleri sağlandı. - Yeni cihazların teslimatı için CE belgeleri sağlandı. - Yeni cihazların teslimatı için CE belgeleri sağlandı.	- CPU-Only Mimari (Hasta CPU) yapıldı. 1000+ cihazın teslimatı için CE belgeleri sağlandı. 1000+ cihazın teslimatı için CE belgeleri sağlandı.

D GRUBU ARİS PROJESİ PAYDAŞLARI (18 AY, 50 MİLYON TL)

HEVİ AI 20 Milyon TL	ASELSAN ~10 Milyon TL (Kısmi)	TÜYZE 10 Milyon TL
Mevcut Trauma Cihaz ve Yazılım için CE belgeleri sağlandı.	Yeni cihazların teslimatı için CE belgeleri sağlandı.	Yeni cihazların teslimatı için CE belgeleri sağlandı.

In coordination with the General Directorate of Public Hospitals, this software will also be added to other existing devices through “retrofit,” that is, retrospective updating. Special modules for areas where seconds are critical, such as trauma, emergency departments, and intensive care, will continue to be updated continuously. We will put this into operation through a public, private sector, and ASELSAN partnership.



Intelligent Tuberculosis Screening and the Global Market

The next stage of ARİS will be the Intelligent Radiographic Tuberculosis Screening Software (ART-TB). We are advancing this project on two tracks:

- 1. Existing Systems:** A “distilled” Mini PC software to be added next to the devices in tuberculosis dispensaries.
- 2. Mobile Solutions:** An integrated structure for handheld screening devices, which are highly needed especially in regions such as Africa.

Our greatest goal here is to be included in the approved list of the World Health Organization (WHO). The WHO list will be updated in 2026, and if we can make it onto this list, we as Türkiye will be able to directly offer this product in international tenders led by the WHO. This is not only a technological achievement, but also a global health initiative.



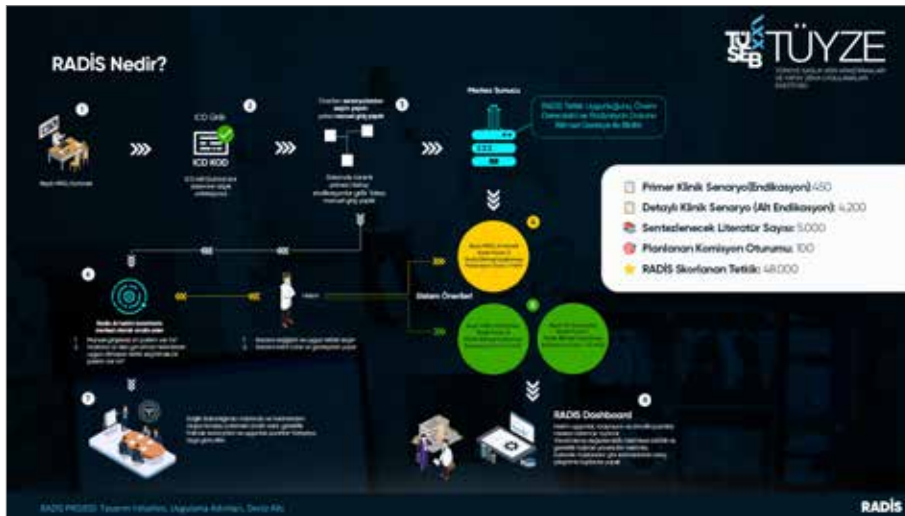


RADİS: AN INTELLIGENT DECISION-SUPPORT SYSTEM AGAINST INEFFICIENCY IN HEALTHCARE

One of the most critical projects on our agenda is the RADİS (Radiology Decision Support System) project, which was even brought to the parliamentary commission during budget discussions. The global picture is far more severe than you might imagine. Look, according to data published by the European Society of Radiology just two weeks ago, 40% of computed tomography (CT) scans in European countries are unnecessary or incorrect. The situation in Türkiye is no different; in fact, this rate approaches 50% in MRI and CT.

So, what does this lead to?

1. Economic Burden: A massive inefficiency and waste of resources.
2. Diagnostic Delay: Unnecessary examinations clog the system and delay the diagnosis of real patients.
3. Radiation Risk: Especially unnecessary CT scans impose an excessive radiation burden on our patients.



Rakamlarla RADİS

- Primer klinik senaryo (endikasyon): 450
- Detaylı klinik senaryo (alt endikasyon): 4.200
- Sentezlenecek literatür sayısı: 5.000
- Planlanan komisyon oturumu: 100
- RADİS skorlanan tetkik: 48.000

RADİS

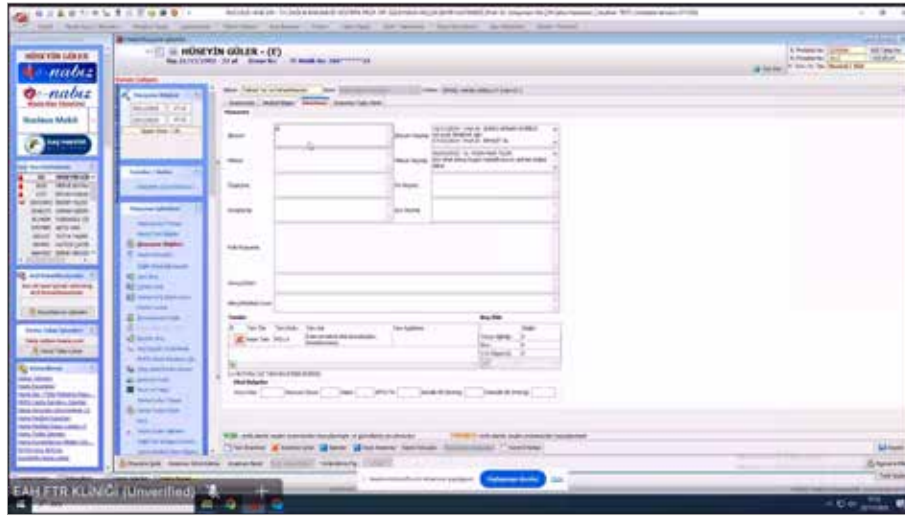
KDS klinik iş akışına entegre olacak, ayrı bir logins/aktivasyon gerektirmeyecek. KDS gerçek zamanlı ve hasta bapı olacak, poliklinik öncesi ve sonrasında bir süreç olmayacak. KDS SADECE otomatik seçim değil, hasta tavisine yönelik Literatür özeti de sunacak. KDS hekimleri radyasyon maruziyeti hakkında bilgilendirecek. KDS oyunlaştırma dayalı kalıcı davranış değişiklerine yol açacak. KDS, açılabilir, getir, hesap verebilir olacak.

Kaynak: Kawamoto, K. BMJ 2005;330:768

RADİS: Data-Proven Decision-Support Power

“The system we have implemented within the scope of the RADİS project is not merely a software program; it is the product of a massive operation based on scientific foundations. This system was developed by TÜYZE. It was built on a highly difficult and complex methodology; exactly 48,000 examinations were reviewed one by one and scored within the system.

This system, which we use live in the field at sites such as Göztepe Training and Research Hospital, consists of certain interfaces and decision screens. When a physician attempts to enter an examination request, the experience and literature synthesis derived from these 48,000 scored examinations are activated and provide the most accurate guidance within seconds.



RADİS: From the Era of “Zombie Requests” to an Intelligent Decision-Support System

“I would like to show you the system currently operating in our hospitals through a live example, on a screen at Göztepe Training and Research Hospital. Normally, the physician opens the system; enters the patient’s complaint and, if available, physical examination findings, which are sometimes not entered at all, and then marks an option from the examination panel. For example, ‘Lumbar MRI.’

This is what we call a ‘Zombie Request.’ Because the moment you press that button, the examination is automatically requested for the patient. The existing system does not ask the doctor, ‘What is wrong with this patient?’, ‘Is there really a need for an MRI?’, or ‘Could a better diagnosis be made with CT?’ Since this uncontrolled process operates this way all over the world, it causes millions of unnecessary examinations to accumulate in every country.

How Are We Changing the Process with RADİS?

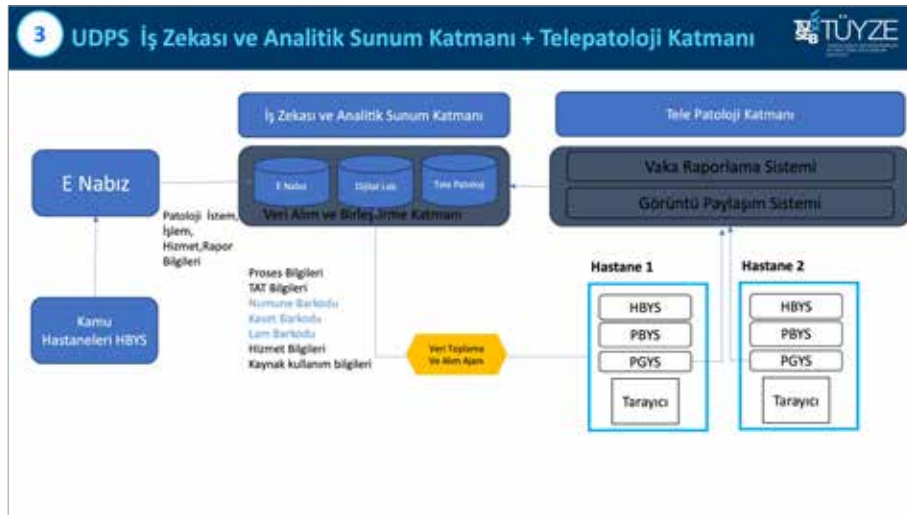
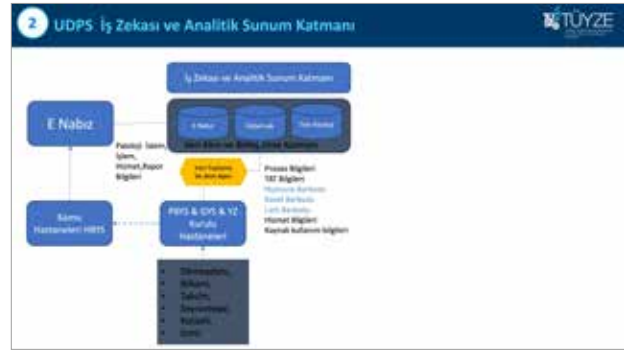
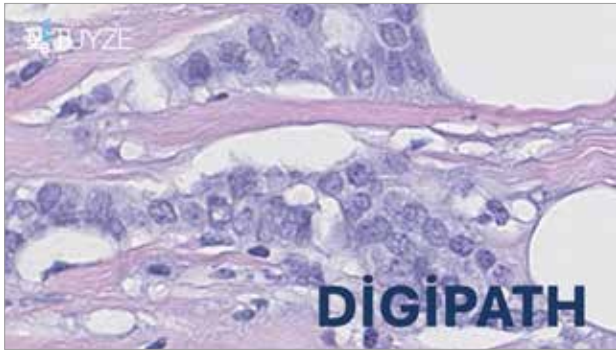
With the RADİS project, we completely eliminate this “zombie” process. Now, when the physician requests an examination, our system steps in and asks: “What is the indication for this examination?”

- **Literature Synthesis:** The moment the physician selects a reason such as “neuropathy” or “headache,” a synthesis of thousands of pages of literature scanned by Large Language Models (LLMs) runs in the background within seconds.



- **Scoring System:** The system presents the doctor with a clear comparison: “The examination you requested is worth 5 points according to the literature. But if you choose this examination instead, its clinical success will be 9 points.”
- **Gamification:** We physicians, that is, humans, are naturally inclined to achieve high scores and succeed. Here, by using game theory, we guide our physicians toward the most accurate and most efficient examination without imposing any obligation.

Our physician can read the literature summaries and technical details in the system at that moment if they wish. However, if they do not have time, the system already shows them the safest and most scientific path by scoring it. With this intelligent method, we both protect our patient from unnecessary radiation and prevent the waste of our national wealth.



Digital Transformation in Pathology: Transparency and Audit

The subject I will now discuss concerns our healthcare managers much more closely. Our Ministry of Health has decided to digitalize all pathology processes in Türkiye. In fact, the digitalization of pathology has been a topic discussed for a long time; however, due to both technological inadequacies and certain resistance within the specialty, it had not been fully implemented until today.

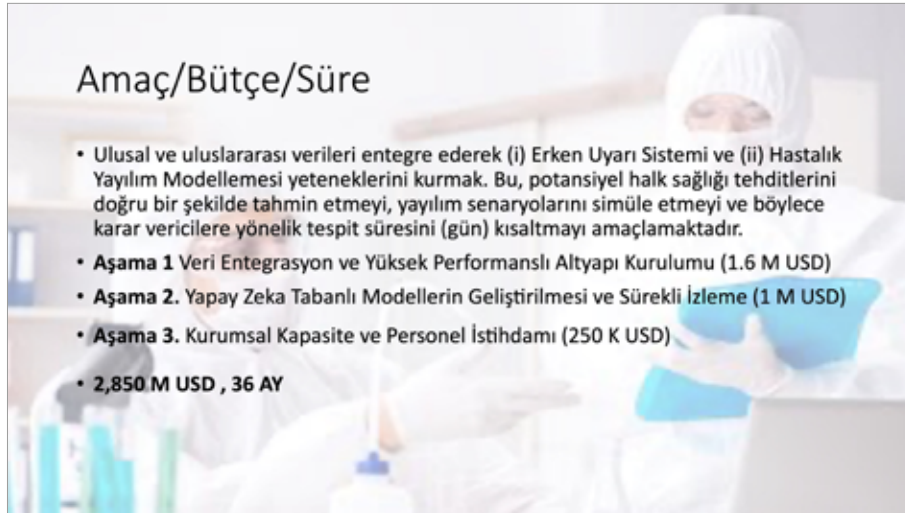
In the current situation, pathology processes unfortunately still proceed largely in an analog manner. In other words, it is almost impossible to track how many slides are read per day, which ones are waiting unread, and where the process becomes blocked. However, this situation is now changing completely.

As TÜYZE, we are establishing a two-stage structure here within 6 months:

- 1. Analytics and Business Intelligence Layer:** We are creating a presentation layer integrated with the e-Nabız system. In this way, we will be able to see instantly how many pathology requests have been made across Türkiye, how many have turned into services, and how long reports have taken to be finalized.
- 2. End-to-End Tracking:** From digitalized hospitals, we will collect every kind of digital trace centrally, from specimen barcodes to cassette barcodes, from slide barcodes to turnaround time data. Thus, the Ministry of Health will be able to take a full picture of pathology in Türkiye, whether analog or digital, and regularly audit the process.

Financial Incentive and Payment Model: A “Telemedicine” layer will also be added to this, and over time all hospitals will be connected to this system. After a while, there will be some changes in the SUT payments of hospitals that have not undergone digital transformation accordingly. Just as today hospitals cannot receive payment unless an MRI or CT image reaches our central servers from MEDULA, a similar model will be applied in the near future for pathology units that have not completed their digital transformation.

WHO – Pandemic Early Warning System



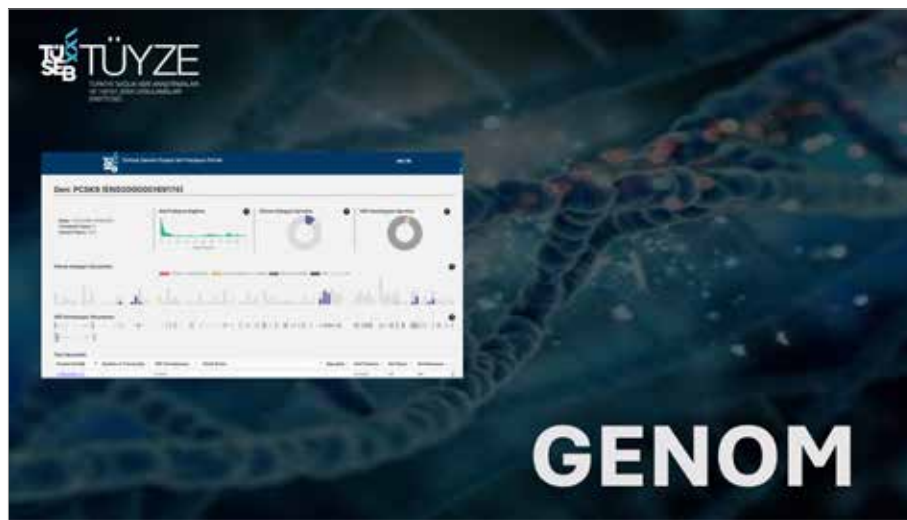
Pandemic Early Warning System and Genomic Data

As our Deputy Minister also knows closely, we are now implementing the Pandemic Early Warning System project, which has long been on our agenda. With this system, we will track the arrival and spread route of an epidemic through two main channels:



- **Internal Data:** Real-time clinical data coming from all our hospitals and healthcare institutions.
- **External Data:** Global data drawn from news sites and digital sources around the world.

This study, which we are carrying out with our operations research colleagues at Hacettepe University, will also strengthen our hand in the detection of rare diseases and variants. Remember, even the genomic analysis of a single person means a massive data load; we need very serious processing capacity to make sense of all of this.



National Genome Project and the Depth of Data

“One of TÜYZE’s most strategic and future-shaping main areas of work is undoubtedly Genome Research. Today, we are personally carrying out the National Genome Sequencing Project within the scope of our institute in order to map Türkiye’s own genetic profile, diagnose rare diseases, and implement personalized medicine practices.

The process we call genome sequencing is not merely a biological analysis; it creates one of the largest datasets the digital world can encounter. The complete genome sequence of a single human consists of approximately 3 billion base pairs, and the raw form of this data occupies hundreds of gigabytes. When you consider that we are processing the data of thousands of our citizens, the data load we face goes beyond even the concept of “Big Data.”

Within this enormous mass of data, vital tasks such as:

- **Variant Detection:** Identifying small genetic changes that cause diseases,
- **Rare Diseases:** Finding the genetic origins of undiagnosed cases,
- **Pharmacogenetics:** Predicting in advance which medicine will cause side effects in which patient,

can only be accomplished with artificial intelligence and high-performance computing power. This is why we not only collect data, but also develop our national algorithms that will make sense of this data within this scope.

Data Processing Power: İzmir High-Performance Computing Center (HPC)

So, where and how will we process such a large volume of data? Massive operations such as human genome analysis exceed the capacity of standard servers. To meet precisely this need, we are establishing Türkiye's first health-focused High-Performance Computing Center (HPC) within Ege University in İzmir, in the area allocated to us.

This center will not merely be a storage area; it will be a “supercomputer” ecosystem capable of performing trillions of operations per second. Our main objectives here are as follows:

- 1. National Data Security:** Processing our health data on our own soil and with our own processors, instead of sending it to cloud systems abroad.
- 2. Speed:** Reducing genomic analyses and medicine design processes that would take decades to the level of weeks, or even days.
- 3. Academic and Industrial Infrastructure:** Providing world-class computing power to both our researchers and our domestic technology developers.

With this center, Türkiye will become a base that produces its own energy and intelligence on the path from raw data to “knowledge.”



The Future of Data: Legal Infrastructure and Strategic Sovereignty

“No matter how powerful technology is, it is not sustainable if it does not have a set of rules to govern it and a safe harbor. For this reason, we are not limiting ourselves to establishing the computing center alone; we have also simultaneously created a solid legal infrastructure that answers the questions of how data will be stored in this center and how it will be shared across Türkiye.

As a result of the widely attended workshops we organized with the major contributions of TÜSAP (Türkiye Health Platform), we prepared a comprehensive Workshop Report that will determine the future of data. We presented this report to our Minister, and in a very short time it will become official and turn into a Regulation.



İçindekiler	
Açılış Konuşmaları	
Prof. Dr. H. Muammer Karaday / TÜSEB TÖYZE Başkanı	9
Prof. Dr. Hasan Mandal / ITU Rectorü	10
Doç. Dr. Şeyma Bitez / Sağlık Bakan Yardımcısı	12
PERSEKTİF KONUŞMALAR (Global Bakış)	
Dr. Ali Dönmez / Genel Müdür, The King's College Clinic & Hospital, İngiltere	25
Sağlık Kurumlarında Veri Güvenliği	
Dr. Jonathan Green / Direktör, IQVIA Privacy Analytics, Amerika	39
Sağlık Verilerinin Güvenli Toplanması ve Paylaşımı: İngiltere Perspektifi	
PERSEKTİF KONUŞMALAR (Ülkemizdeki Durum)	
Dr. Özgür Sener / Sağlık Bakanlığı Sağlık Bilgi Sistemleri Genel Müdüğü	61
Sağlık Bakanlığı Dijital Sistemleri	
Dr. Yücel Akpınar / Sağlık Bakanlığı Sağlık Bilgi Sistemleri Teftiş Kurulu Başkanı Say. Meman	73
Sağlık Bakanlığı Açık Veri Platformu ve Yapay Zeka Uygulamaları	
Prof. Dr. Kemal Hakan Gökmen / Akdeniz Üniversitesi, Tıp Fakültesi Biyostatistik ve Tıp Bilimleri	85
Anabilim Dalı, Sağlık Verilerinin Kalite, Güvenlik ve Kimliklerinin Sağlanması	
Yücel T. Tuncer / Türkiye Bilimsel ve Teknolojik Araştırma Kurumu (TÜBİTAK)	95
Sağlık Kurumlarında Veri Güvenliği Yaklaşımları	
ODAK GRUP TOPLANTILARI (4 grup)	
Moderatörler	
Prof. Dr. Salihattin Aydın (Yönetim Kurulu Başkanı) / Marmara Üniversitesi Öğretim Üyesi	113
Prof. Dr. Sinan Mahvan (Üniversite Kurulu Başkanı) / Başkent Üniversitesi Öğretim Üyesi	131
Prof. Dr. Hasan Serdar Çakır (Halkın Sağlığı Kurulu Başkanı) / Etiler-Kuşatma Üniversitesi Öğretim Üyesi	147
Prof. Dr. Şenol Balıkcı (Türk Telekom) / İstanbul Tıbbi Üniversitesi Öğretim Üyesi	169
ÇALIŞTAY SONUÇLARININ SUNUMU VE DEĞERLENDİRİLMESİ	197
Moderatör	
Prof. Dr. Haluk Özcan / İstanbul Üniversitesi - Cerrahpaşa Öğretim Üyesi	199
Çalıştay Grup Moderatörlerinin Özet Sunumları	205
Çalıştay Grup Toplantı Sonuçlarının Sadece Tartışmaya Açılacak Özetleri (Görüşmeler)	225
Ankara Sonuçlarının Değerlendirilmesi	
DEĞERLENDİRME VE KAPANIŞ KONUŞMALAR	229
Doç. Dr. Mustafa Mahir Üçü - Prof. Dr. Hakan Muammer Karaday	
Çalıştay Anlamı, Gerekçesi, Kurgulanması, Sağlık Verisi Güvenliğinde Dinamik	

At this point, I would like to express my gratitude to our esteemed president, TÜSEB, and TÜSAP administrators who contributed to the drafting of the regulation. Thanks to this regulation, we will have made great progress in the world not only technically, but also administratively and legally in high-performance computing (HPC) processes. We are establishing a balance that protects the privacy of data while paving the way for scientific development.

National Data Repository: Cooperation with Türk Telekom

Another important pillar of our strategic sovereignty is where our data physically resides. With the critical decision we have taken, we are ensuring that all health data belonging to the Ministry of Health, TÜSEB, and our country will now be stored on Türk Telekom servers within the scope of the protocol signed.

- **Secure Transition:** This is not merely a storage decision, but a defense of the “Digital Homeland.”
- **Planned Migration:** The data volume is so large that all necessary calculations have been made for this. Our data is currently continuing to be gradually migrated to our national servers in a planned manner.

Thus, Türkiye’s health data will both be protected on domestic servers and processed at our high-performance computing center (HPC) in İzmir, turning into national added value.

Quality and Approval: Audit and the “Gold Standard” in Artificial Intelligence

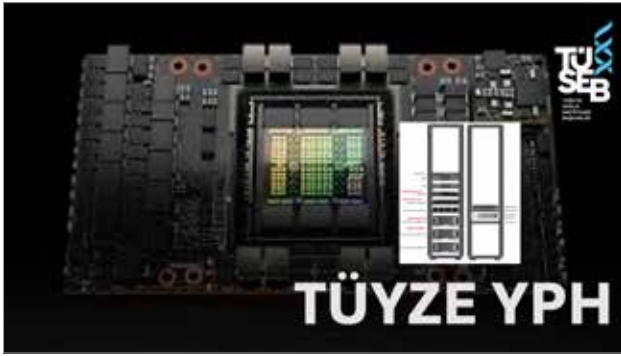
In the final part of my presentation, I would like to touch upon what is perhaps the most critical stage: productization and audit processes. Today, there are many artificial intelligence solutions on the market, but choosing which of these products is truly reliable is a problem in itself. When it comes to artificial intelligence, our Ministry of Health is developing a “pre-approval” mechanism for products and services.

The process will operate in two stages: In the first stage, an administrative preliminary assessment will be carried out, covering issues such as compliance with procedure and production standards. However, the truly critical stage is auditing whether the product delivers in the field the performance it promises on paper. This is where we, as TÜYZE, step in.

Data-Based Verification: 140 Questions and Live Testing

Within the scope of the audit methodology we have developed, we essentially take an X-ray of companies and their products:

- **Comprehensive Inquiry:** We have a detailed set of 140 questions. This set covers everything from the company's organizational structure to market analysis, from the reliability of the dataset to the training methodology of the model.
- **Technical Validation:** We do not rely only on declarations. We also test the product technically. We take the Docker image of the product and test it with our own "standard datasets," which the company has never seen before.
- **Real Performance Measurement:** If the software cannot achieve the promised success rates in our closed-loop tests, we do not allow it to be included in the system. This is a quality filter for artificial intelligence products that will enter the Turkish health system.



Future Vision and Closing

As TÜYZE, our work, our vision as TÜSEB, and my individual expectations from artificial intelligence are to build a technology ecosystem that has scientific depth, is auditable, and, most importantly, has been transformed into products.

Each of the projects I presented to you here today, such as METRA, REDiS, ARiS, and Genom-Türk, has passed beyond the idea stage and turned into concrete value. I believe that these domestic and national technology initiatives will carry the Turkish health system to a position of global leadership and a reference point.

I extend my gratitude to all my colleagues who contributed to the realization of this vision and to our state leaders who have not withheld their support. Thank you very much for listening to me patiently.



QUESTION - ANSWER SECTION

In your presentation, you stated that only 3% of health data is actively processed and used in decision-making processes; this is a very striking figure. Afterwards, you shared solution proposals such as ARİS, RADİS and UDPS. In your opinion, what will be the most critical lever in the coming years to increase this rate? Regulations, inter-institutional integration, or the standardization of data?

Prof. Dr. Hakkı Muammer Karakaş: Regulation and legislation are very critical. Let me explain with an example; the President of the United States, the President of China, and the President of France came together and said, “Let’s do artificial intelligence.” Trump said, “I have software,” the President of China said, “I have hardware,” and Macron said, “I have GDPR (General Data Protection Regulation).” In the end, they could not do anything because Europe is very strict on this issue.

The Ministry of Health does not initially support the view that health data should be locked in a safe and not shared with anyone. If data is not used, it is a buried treasure; if it is used, it becomes a treasure. What matters is by whom this treasure will be used, how it will be audited, and how it will be opened to the use of researchers. The regulation for this is being prepared. However, regulation alone is not enough; our place to store these data and our capacity to process them are also limited. Today, GPU (Graphics Processing Unit) servers are considered strategic wealth. Even their sale and export have been suspended. Researchers today cannot obtain processing power in cloud systems even with money, because all capacity has been filled by large language models. Therefore, beyond regulation, we also need high-performance computing farms where health data are stored cleanly and processed at the same time. But whether these will be in the cloud or not is another matter. We have already started doing this now. This has been accepted by everyone. Especially when we started preparing the project to present it to our President at the Turkish Medical World Congress, if TÜYZE’s high-performance archive servers had not existed, we would have been in serious trouble. Thankfully, they existed. Now Türk Telekom says, move these as well. I say, I will not give you my server. That is precious to me. It will stay here, I will keep them here. Our colleagues at İTÜ are now suffering from the same problem. We need very large processing powers.

The person known as the “godfather” of artificial intelligence and the Nobel Prize laureate (Geoffrey Hinton) is actually not a physicist, but a cognitive psychologist. He built his studies on the question “how does the human brain work?” Based on this, since artificial intelligence imitates the human brain, could it one day have consciousness? Could it completely replace a physician or psychologist?

Prof. Dr. Hakkı Muammer Karakaş: I did my doctoral studies in Germany, in the field of neuroscience. In 1995, as a student of Prof. Christian Elger, I worked on chaos and complex systems. I observed both theoretically and experimentally that the human brain is an extremely complex structure. Many scientists such as Cushing, Sherrington, and Lashley searched for answers for years to the questions “what is the brain, how does it think?”; however, we still cannot give a complete answer to these questions even today.

I find Karl Lashley's "engram" studies conducted on mice in 1954 particularly striking. Lashley showed that learning continued even though the mouse brain was gradually reduced. The mouse continued to run the maze in the same way. Lashley had difficulty explaining this situation and virtually said the following: "Under normal conditions, learning should not be possible." This example very clearly shows how complex and holistic a structure the brain is built upon.

Classical intelligence tests measure human intelligence in four or five dimensions. Today, modern approaches address intelligence in 80-90 different dimensions. With artificial intelligence, we can simulate only a limited part of this multidimensional structure. In contrast, the processing speed of artificial intelligence is extremely high; this makes it a very powerful tool in certain areas.

However, I would like to state this clearly: Artificial intelligence does not represent the entirety of human intelligence. We are currently only imitating certain functions of human intelligence.

Within my own lifetime — I am currently 60 years old — I do not think artificial intelligence can possess human consciousness, conscience, or compassion. These issues may be discussed in a much more distant future; however, for today, saying that this is possible does not seem realistic to me.

At this point, I would also particularly like to emphasize this: Some studies being conducted today aim to copy the human brain onto a chip or to produce a chip that thinks like the human brain. There are even studies based on the idea that a person's thoughts continue to live after death. However, at the point reached today, only approximately 1 mm³ of a mouse brain can be copied in an extremely limited and incomplete manner. In my opinion, copying the entire human brain is a matter for hundreds of years later.

How much the visions of futurists such as Elon Musk regarding "transferring the human brain to a chip" will come to life is directly related to how much long-term investment will be made in this field. However, in light of the current scientific data, I state this clearly: Artificial intelligence can make rational decisions and perform very rapid analysis; but I do not see it becoming a being that thinks like a human, has conscience, or is compassionate in the near future.

Since the 1950s, the use of artificial intelligence has shown a major explosion in the last three years. What triggered this explosion in the field? Was it an organization, a spontaneous development, or someone quickly launching a product to the market?

Prof. Dr. Hakki Muammer Karakaş: This was not triggered by one person. This triggering was entirely caused by human needs. In economics, it is said, "Economic improvement is imminent." This triggering is not man-made, but there is human involvement in it. This is a major technological revolution. Needs...

It had become necessary for the unsustainable economy to continue and for people to maintain their lives in these geographies. But of course, technological discoveries, for example the discovery of U-Net algorithms in radiology and the increase in processing power (GPU) since 2015, accelerated this process. In other words, both economic needs and technological discoveries combined to give birth to this major revolution.



MODERATOR

Prof. Dr. Cengizhan ÖZTÜRK
Faculty Member at Boğaziçi University

WE MUST INTEGRATE THE CHANGING PERSPECTIVE INTO OUR HEALTH SYSTEM

Today, with this survey study, we aim to evaluate current approaches regarding the use of health data and artificial intelligence applications together with field experience and expectations. I believe that the contributions of participants from different disciplines will be guiding both technically and administratively. In this session, I think that sharing views in an open and constructive manner will provide important outputs that will shed light on future policies and practices.



METHODOLOGY

At the 44th TÜSAP Vision Meeting, held under the theme of “**Data Analytics and Artificial Intelligence,**” opinion leaders representing the healthcare sector were asked questions related to the agenda. The result graphs prepared based on the responses of more than 70 senior executives representing the public sector, NGOs, the private sector, and universities were again interpreted by the participants. NGO representatives constituted 17% of the participants, while public executives accounted for 32%. Private sector executives represented 21%, and universities focused on the field of health took their place with a share of 30%.



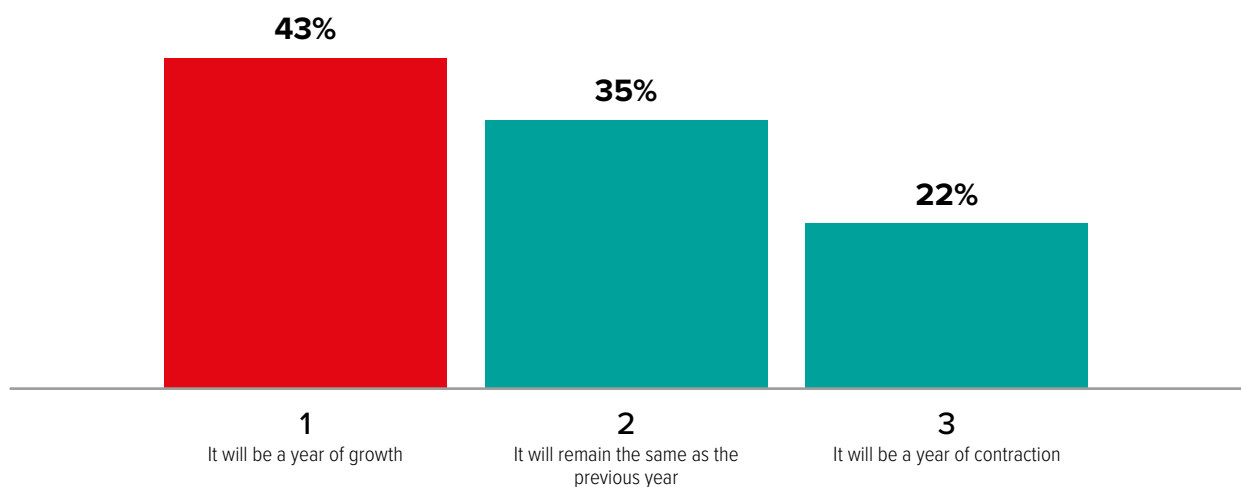
CAUTIOUS OPTIMISM IN THE HEALTHCARE SECTOR

43% of the participants stated that 2025 will be a year of growth for the healthcare sector. This rate shows that optimistic expectations for the sector are strong, but do not constitute absolute dominance. On the other hand, the fact that 35% of the participants foresee that the sector will remain at the same level as the previous year indicates that growth expectations are shaped on a cautious basis.

The 22% segment expressing an expectation of contraction reveals that economic and structural risks in the sector have not completely disappeared. When the overall distribution is evaluated, it is considered that the majority of participants point to growth potential in the healthcare sector; however, the fact that expectations of stagnation and contraction together carry significant weight shows that forecasts for 2025 are shaped within a framework of cautious optimism.

1. What is your forecast for the healthcare sector in Türkiye for 2025?

1. It will be a year of growth
2. It will remain the same as the previous year
3. It will be a year of contraction



EXPECTATION OF BALANCED MEDIUM-TERM GROWTH IN HEALTHCARE INVESTMENTS

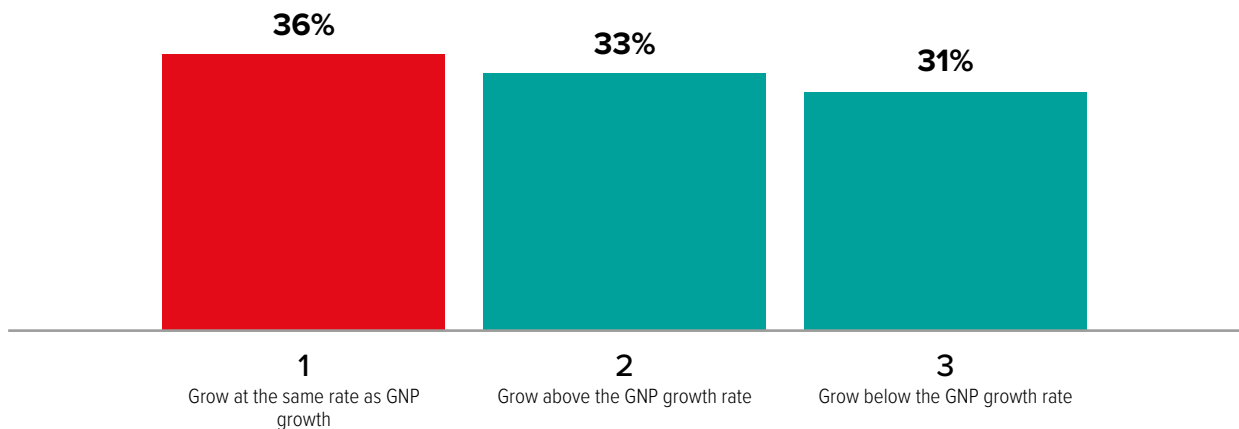
36% of the participants stated that healthcare investments will follow a course parallel to the GNP growth rate over the next five years. This distribution shows that an expectation of stable but limited growth in healthcare investments comes to the fore.

On the other hand, the 33% segment foreseeing that investments will increase above the GNP growth rate points to the existence of additional investment areas and expansion potential in the sector. Meanwhile, the 31% share of participants who think that investments will lag behind economic growth reveals that cost pressures, financing conditions, and uncertainties may affect investment decisions.

When the overall picture is evaluated, it is considered that participant views are distributed in a balanced manner among the three options; this situation points to a cautious and multi-scenario expectation structure rather than a clear direction regarding the medium-term outlook of healthcare investments.

2. For Türkiye, over the next 5 years, healthcare investments will:

1. Grow at the same rate as GNP growth
2. Grow above the GNP growth rate
3. Grow below the GNP growth rate





EXPECTATION OF PUBLIC-SECTOR-WEIGHTED EXPANSION IN HEALTHCARE INVESTMENTS

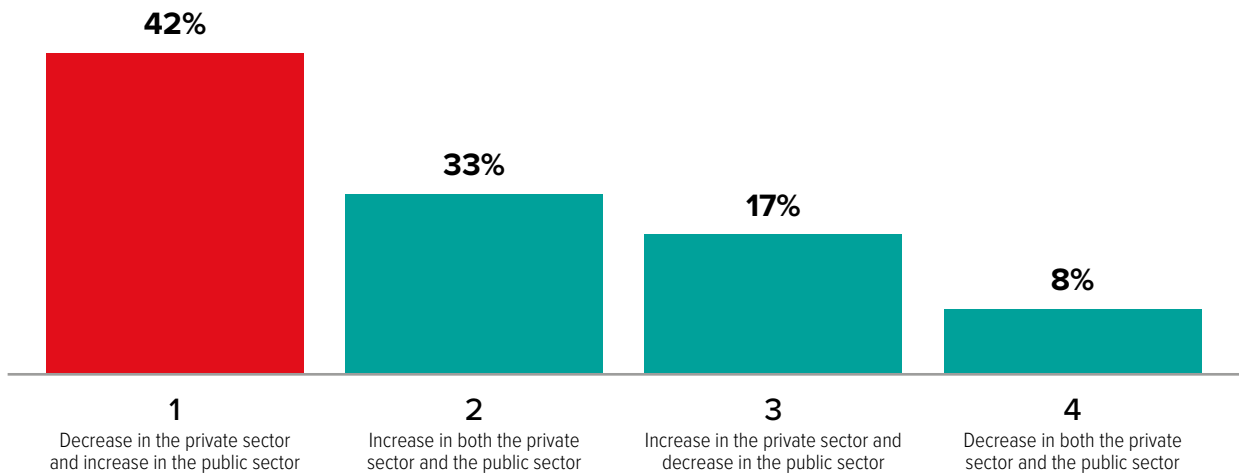
42% of the participants stated that, over the next five-year period, healthcare investments will decrease in the private sector while increasing in the public sector. This distribution shows that an expectation that the guiding and determining role of the public sector in healthcare investments will strengthen comes to the fore.

The 33% segment foreseeing an increase in both the private sector and the public sector points to a more balanced investment scenario led by the public sector but in which the private sector is not completely excluded. On the other hand, the 17% share of participants who think that investments will increase in the private sector and decrease in the public sector reveals that a limited group of participants foresees a more market-oriented structure.

The 8% segment expressing an expectation of decline in both sectors constitutes a low share within the overall picture, but shows that financing and sustainability risks are not completely ignored. In the general assessment, it is understood that healthcare investments are more likely to be shaped around a public-sector-oriented growth trend in the upcoming period.

3. For Türkiye, over the next 5 years, healthcare investments will:

1. Decrease in the private sector and increase in the public sector
2. Increase in both the private sector and the public sector
3. Increase in the private sector and decrease in the public sector
4. Decrease in both the private sector and the public sector



AGING POPULATION AND EXPECTATION OF CAPACITY INCREASE MAKE HEALTHCARE INVESTMENTS NECESSARY

It was stated that Türkiye is one of the fastest-aging countries and that this demographic transformation will create inevitable pressure on healthcare expenditures. It was emphasized that the burden of chronic diseases will increase with aging, which will affect demand for healthcare services and therefore investments upward. It was expressed that existing hospitals will largely maintain their presence, and therefore the system's need for capacity increase is clear. Within this framework, it was assessed that the healthcare sector has the potential for an increase in investments in parallel with, or slightly above, general economic growth.

STRUCTURAL TRANSFORMATION AND EMPHASIS ON CHAIN FORMATION IN THE PRIVATE SECTOR

It was stated that a qualitative transformation process, rather than quantitative growth, will come to the fore in the private healthcare sector. It was noted that the sustainability of small-scale hospitals providing general services has become more difficult under the current structure, and that healthcare institutions without a specific theme or area of specialization will lose their competitiveness. Since current planning does not allow this theme, it was stated that all hospitals under 300 beds will experience major difficulties; however, the functions of small hospitals that close will continue in large hospitals. It was emphasized that chain hospitals and large-scale structures will strengthen in the private sector, while small-scale hospitals will either be absorbed into these structures or have to narrow their fields of activity. It was also among the points expressed that the current planning and regulatory structure does not sufficiently support thematic hospitals.

EXPECTATION THAT PUBLIC-SECTOR-WEIGHTED HEALTH POLICIES WILL CONTINUE TO STRENGTHEN

It was stated that the policies followed since the entry into force of the General Health Insurance have laid the groundwork for the gradual strengthening of a more public-sector-weighted health system in Türkiye. The view was expressed that the public sector will maintain its determining role in healthcare service delivery and that this role will be further reinforced in the upcoming period. It was stated that the main axis of health policies in Türkiye will continue to strengthen with a public-sector-weighted approach, while the private sector will continue to assume a complementary function; however, the expectation of strong and widespread growth, especially in the field of direct service delivery, is limited.



DIFFERENT GROWTH DYNAMICS IN THE DISTINCTION BETWEEN SERVICE DELIVERY AND PRODUCTION

It was recalled that the public sector does not have a producer role in the fields of medical devices and pharmaceuticals, and that it is positioned more as a purchaser in these areas. This situation was assessed as Türkiye's potential to achieve growth in the fields of medical devices and pharmaceuticals by using its advantages in global supply chains and international markets. In contrast, the view was shared that in direct healthcare service delivery, the weight of the public sector will increase due to factors such as aging and chronic diseases, while the private sector will show more limited expansion in this area.

NEW GROWTH AREAS: ELDERLY CARE AND THE HEALTHY LIVING INDUSTRY

It was stated that while industry is declining in Türkiye, the service sector is growing. Regarding the private sector's growth potential in the field of health tourism, it was expressed that Türkiye's existing potential has largely been used, and that, as many countries increase their own healthcare capabilities, international patient flow is approaching saturation. For this reason, it was emphasized that elderly care tourism, health and care services for the elderly, and the healthy living industry may come to the fore as a new growth area. It was stated that new markets based on devices, software, and applications are emerging in the field of healthy living, that these areas will develop more through private sector dynamics, and that the public sector will not remain completely indifferent but will take part in a more regulatory and supportive role.

QUALITY AND INTEGRATION ISSUES COME TO THE FORE IN HEALTH DATA

33% of the participants stated that the most critical problem in the analysis and management of health data in Türkiye is the lack of data quality and standardization. This distribution reveals that the main barrier to producing meaningful and reliable outputs from health data is related to problems concerning the structural quality of the data.

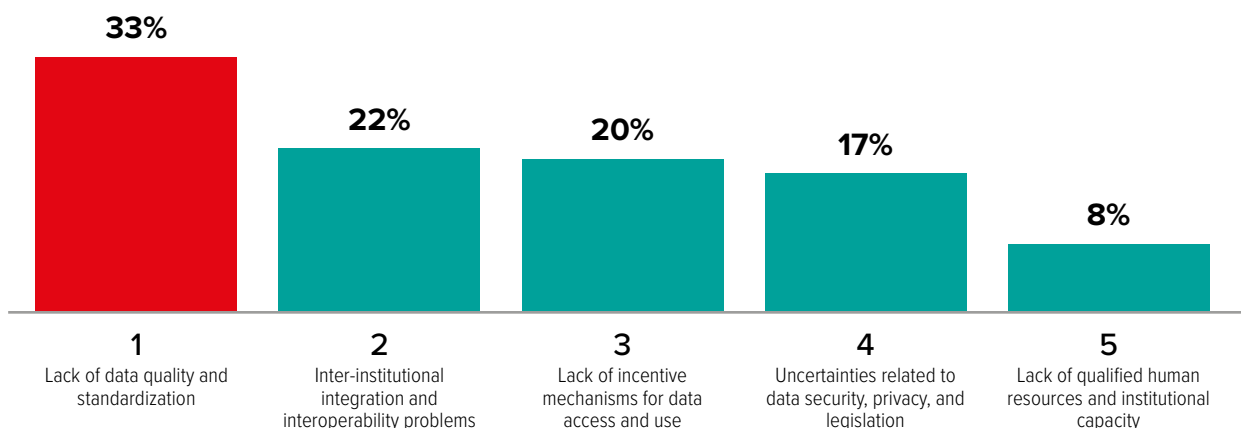
The 22% segment that sees inter-institutional integration and interoperability problems as a priority indicates that limited data flow between different systems weakens analytical capacity. The 20% share of participants who think that incentive mechanisms for data access and use are insufficient draws attention to administrative and structural deficiencies that prevent existing data from being evaluated effectively.

The 17% segment emphasizing uncertainties related to data security, privacy, and legislation highlights the importance of clarifying the legal and ethical framework of analytical processes. The 8% share that evaluates the lack of qualified human resources and institutional capacity as the main problem shows that the need to improve technical and administrative capacity is prioritized by a more limited segment.

When the overall distribution is evaluated, it is understood that participant views are concentrated more on the quality of data infrastructure and integration between systems, while security, legislation, and human resources issues are considered secondary priorities.

4. In your opinion, what is the most critical problem in the analysis and management of health data in Türkiye?

1. Lack of data quality and standardization
2. Inter-institutional integration and interoperability problems
3. Lack of incentive mechanisms for data access and use
4. Uncertainties related to data security, privacy, and legislation
5. Lack of qualified human resources and institutional capacity





LACK OF DATA QUALITY AND STANDARDIZATION WAS EVALUATED AS THE PROMINENT STRUCTURAL PROBLEM

There was consensus that the most fundamental problem in the analysis and management of health data in Türkiye is the lack of data quality and standardization. It was stated that this heading stands out statistically in a significant way compared to other problem areas. It was emphasized that data are collected from many sources, but it is not clear for what purpose, in what context, and according to which quality criteria these data are produced. It was expressed that a large volume of data is produced in the health system; however, these data cannot be made meaningful, comparable, and analyzable.

In the evaluations from the field, it was stated that coding and data collection practices developed over the years according to different needs have not achieved a holistic structure, and that this situation distances health data from producing meaningful analysis.

It was emphasized that entries that do not sufficiently reflect clinical content have become widespread, especially in diagnosis and coding processes, and that this prevents large datasets from being used effectively in scientific and policy decision-making processes. Despite the collection of large amounts of data, the failure to clarify for what purpose and which analyses these data will serve was evaluated as an important factor reducing data quality.

THE PROBLEM OF NON-STANDARD CODING AND DATA INFLATION

It was stated that many practices that are not compatible with global standards have been implemented in health informatics from past to present, and that this disrupts data integrity. Drawing attention especially to the problems experienced in ICD coding systems, it was noted that entering different clinical conditions under the same diagnosis heading renders data analysis meaningless. As an example, it was emphasized that entering general expressions such as “joint pain” as a diagnosis in orthopedic cases causes clinical detail to be completely lost. It was stated that this situation indicates that the problem is not only technical, but also related to data entry processes and user behaviors.

EMPHASIS THAT THE APPROACH OF COLLECTING ALL DATA DOES NOT PRODUCE SEMANTIC VALUE

It was stated that continuous data transfer is requested from medical devices, intensive care units, and bedside monitors; however, it is often unclear which scientific or administrative output these data will serve. It was expressed that expanding data collection independently of purpose turns the system into a “data dump.” In addition, it was noted that the requested data cannot later be used due to legal and regulatory obstacles, and that this situation creates serious uncertainty for both sector representatives and institutions.

NEWLY DEVELOPED DIAGNOSES AND TREATMENTS DO NOT HAVE EXACT EQUIVALENTS IN ICD-10

It was stated that ICD-10 (International Classification of Diseases) data are thought not to have exact equivalents for newly developed diagnoses and treatments. It was emphasized that transition to ICD-11 is a special requirement, especially for rare diseases.

DATA QUALITY OR DATA ACCESS? DISCUSSION OF PRIORITY

Some participants stated that, while data quality problems are acknowledged, the actual critical deficiency is the inadequacy of data access mechanisms. It was noted that data quality problems cannot be measured sufficiently due to restrictions on data access, and that as access increases, quality problems will become more visible and corrective steps can be taken accordingly. Within this framework, it was expressed that data quality, integration, and access are not independent headings, but areas that affect one another. It was emphasized that quality problems cannot be measured or improved without providing data access. According to this perspective, opening data access, even in a limited manner, will make it possible to see in which areas the data are strong and in which areas they are weak, and to take corrective actions accordingly. Otherwise, it was stated that the approach of “first quality should improve, then access should be opened” forces the system to remain stagnant.

INTER-INSTITUTIONAL INTEGRATION AND LEGISLATIVE BARRIERS WERE DEFINED AS A STRUCTURAL PROBLEM

It was stated that inter-institutional integration and interoperability problems include serious barriers arising not only from technical issues but also from legislation. It was conveyed that there is no clear and defined framework for data sharing among public institutions, and that serious restrictions are experienced in different institutions' access to the same data. It was expressed through examples that serious difficulties are experienced in obtaining data among the Ministry of Health, the Ministry of Treasury and Finance, and other institutions when a comprehensive inventory study on health education, human resources, and health infrastructure is desired in Türkiye. It was stated that legislation drives institutions to a point of avoiding data sharing and effectively prevents integration.

THE PROBLEM OF HUMAN RESOURCES AND INSTITUTIONAL CAPACITY WAS SEEN AS A SECONDARY HEADING

Although the lack of qualified human resources and institutional capacity was expressed at lower rates in the survey results, it was evaluated as an indirect problem area. Participants drew attention to the fact that the lack of human resources is often used as a justification that conceals fundamental problems. The view that the real problem is the systemic, legislative, and structural issues that prevent existing human resources from working effectively came to the fore.



DEMAND FOR AN AUTONOMOUS AND INSTITUTIONAL GOVERNANCE MODEL IN HEALTH DATA

45% of the participants stated that an independent and autonomous “National Health Data Institution” should be established for the processing and management of health data. This distribution shows that the need for an expertise-based and long-term governance model, independent of existing institutional structures, is strongly expressed.

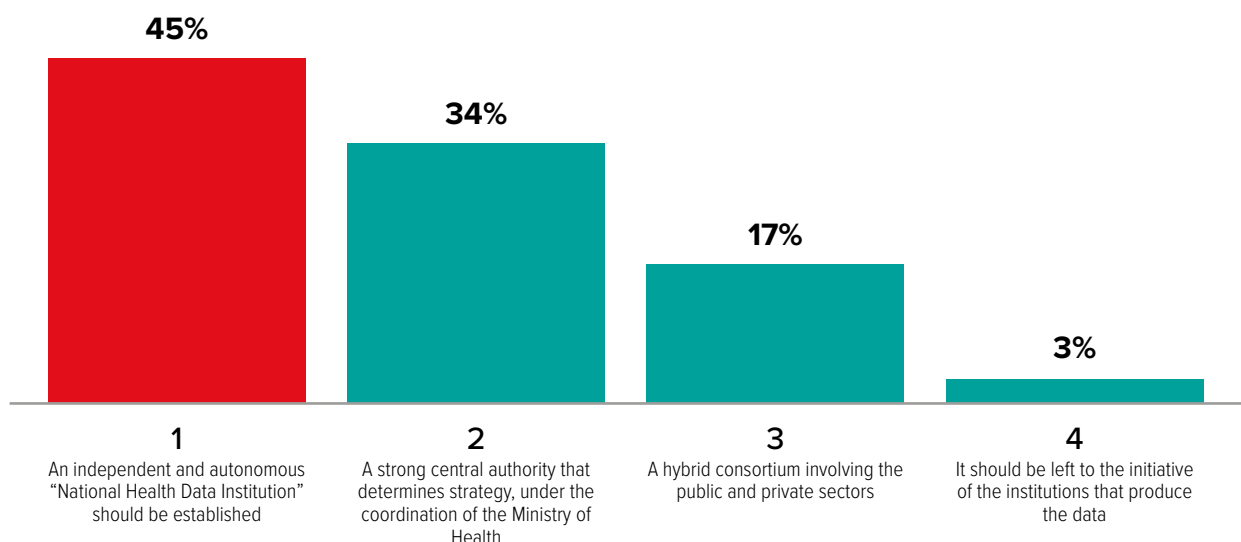
The 34% segment that prefers a strong central authority that determines strategy and operates under the coordination of the Ministry of Health indicates that health data should be managed under the umbrella of public authority, but through a more effective coordination mechanism. The high combined share of these two options reveals that the need for institutionalization and central planning is prioritized in the management of health data.

The 17% share foreseeing a hybrid consortium model involving both the public and private sectors shows that a multi-stakeholder and flexible structure receives limited support. The 3% segment that thinks data should be left entirely to the initiative of the institutions that produce it has a very low weight within the general trend.

In the general assessment, it is understood that the great majority of participants prefer a strong, institutional authority model with clear boundaries of authority in the management of health data, rather than fragmented structures.

5. What should the ideal “Authority Structure” be for the processing and management of health data?

1. An independent and autonomous “National Health Data Institution” should be established
2. A strong central authority that determines strategy, under the coordination of the Ministry of Health
3. A hybrid consortium involving the public and private sectors
4. It should be left to the initiative of the institutions that produce the data



SEARCH FOR POLITICAL INDEPENDENCE AND FUNCTIONALITY IN DISCUSSIONS ON AUTHORITY STRUCTURE

It was stated that there was a clear hesitation among participants regarding the selection of the option of a strong central authority that determines strategy, under the coordination of the Ministry of Health. It was emphasized that frequent management changes at the level of the Ministry of Health over the last 18 years have also led to a problem of continuity in the perspective on health policies, and that a critical area such as health data should not remain under the influence of periodic ministerial policies. For this reason, attention was drawn to the importance of addressing the management of health data from the perspective of national policy rather than through a single administrative structure.

While the option of establishing an independent and autonomous “National Health Data Institution” was discussed, it was questioned whether such a structure would truly be independent. Concern was expressed that an “independent” board operating through instructions from above could, in practice, turn into a more dysfunctional and problematic structure than a central authority working under the coordination of the Ministry of Health.

Within this framework, it was stated that a stance closer to the hybrid consortium model involving both the public and private sectors was adopted. However, it was also noted that in this model, due to certain disciplines or lack of discipline in the private sector, there are uncertainties as to whether data can be used in line with public benefit and at the desired standards.

In the speech, it was emphasized that the real determining factor is not the institutional model, but the institution’s operational capacity. It was stated that a well-designed institution with a strong governance structure and effective functioning could solve these problems. At this point, it was expressed that the issue is not limited only to “health data”; a strong and competent Data Institution Presidency model, in which all data produced in Türkiye are gathered under a single roof, could be more meaningful. It was stated that such a structure should not only collect data, but also have a strong institutional capacity to enable the analysis of data.

THE NEED TO SEPARATE DATA-PRODUCING AND AUDITING STRUCTURES

It was stated that the fundamental principle in the management of health data should be the separation of the structure that produces the data from the structure that audits and stores the data. Since the Ministry of Health is an actor that directly provides services and at the same time produces a large portion of health data, the view was shared that it would be more appropriate for the auditing and storage of these data to be carried out by a separate institutional structure outside the Ministry.

Within this framework, it was emphasized that the Ministry of Health is in the position of the “service-providing sector,” and therefore that the supervisory and regulatory role should be institutionally assumed by a different structure in terms of data security, neutrality, and sustainability.

CONSTITUTIONAL AND LEGAL ASSESSMENT ON TÜSEB’S AUTONOMY AND POSITION

In assessments regarding TÜSEB’s autonomous and independent structure, it was stated that comparisons made with universities should be addressed on a legally correct basis. It was recalled that universities in Türkiye constitutionally have only scientific autonomy, and do not have administrative, financial, or audit autonomy. It was stated that this situation constitutes an important example regarding the actual capacity of structures assumed to be “autonomous.”



It was conveyed that TÜSEB, on the other hand, is a structure established by Presidential Decree, has administrative, financial, and scientific autonomy, and holds the status of a related institution of the Ministry of Health. In this context, it was emphasized that no unit within the Ministry has the authority to give direct instructions to TÜSEB; and since the Chair of the Board of Directors is the Minister, decisions taken by the Board should be finalized without needing the approval of another authority.

In the speech, it was stated that an active role was taken in the establishment processes of public organizations such as TÜSEB, the University of Health Sciences, SGK, and USHAŞ, and that an important principle was highlighted within the framework of many years of experience in public organization:

It was expressed that the factor determining the real autonomy of an institution is not its legal status, but its capacity to successfully perform its work. It was stated that institutions that are successful cannot be interfered with, whereas structures that cannot fulfill their function become constantly open to external intervention.

INSTITUTIONAL STRUCTURE OR RESULT ORIENTATION?

The view was shared that creating excessive expectations around institutional structures may overshadow the actual areas of solution. Through the example of USHAŞ, it was stated that although it was established as a joint stock company and has the same legal structure as Turkish Airlines, the difference in performance demonstrated cannot be explained solely by institutional status.

At this point, it was emphasized that the issue is essentially a matter of doing what the work requires, producing results, and showing determination in implementation, rather than institutional structuring. It was stated that while excessive attention is paid to institutional structures, there is delay in touching the essence of the matter and producing concrete results.

E-NABİZ AND MEDULA EXAMPLE: THE MECHANISM THAT DETERMINES SUCCESS

A concrete example was also shared through the e-Nabız system. It was stated that e-Nabız had technically existed for a long time; however, institutions, including universities and the Ministry of Health, did not send their data to the system. It was emphasized that the system became truly functional only when sending MEDULA data to e-Nabız was made mandatory.

Through this example, it was stated that behind the success of a system lie obligation mechanisms, implementation discipline, and processes tied to outcomes, rather than institutional structure. It was noted that e-Nabız reached its current point thanks to this determination.

THE RELATIONSHIP BETWEEN SUCCESS, INSTITUTIONAL TRUST, AND CONTINUITY

The view was expressed that the autonomy, authority, and independence of institutions often strengthen together with success. It was stated that if the mission given within the framework of a

new “productive health” vision is successfully implemented, institutional trust, area of responsibility, and authority will naturally expand.

In this process, it was emphasized that institutions must have clear visions, move forward steadily in the same direction, and avoid frequent changes of direction. It was evaluated that the key element determining institutional success is the correct initial steps and consistent practices.

THE DETERMINING ROLE OF SUCCESS ON INSTITUTIONAL AUTONOMY AND TRUST

The autonomy of institutions and the historical context of their establishment processes were discussed. It was stated that the way institutions set out, the steps taken at the beginning, and “buttoning the first button correctly” determine institutional progress. It was emphasized that if the mission assigned within the newly introduced “productive health” vision is successfully implemented, institutional trust, area of responsibility, authority, and independence will naturally develop alongside this success. Within this framework, it was stated that success is the fundamental key to the process; that institutions must have clear visions, move forward steadily in the same direction, and avoid major changes of direction.

ARTIFICIAL INTELLIGENCE, BIG DATA, AND THE NECESSITY OF PUBLIC-PRIVATE SECTOR COOPERATION

Although it was stated that the financial dimension of the matter would not be directly addressed, attention was drawn to the fact that the nature of the issues discussed requires high cost, intensive labor, and advanced expertise. It was emphasized that artificial intelligence, data, and big data are areas that require not only technical capacity, but also economic and administrative capacity.

Referring to Germany’s development during the industrial revolution, it was stated that behind this success lay strong private sector cooperation shaped by public support. Through this example, the necessity of an autonomous structure in the field of health was also emphasized. It was stated that it is important for the public authority to adopt an ownership-oriented approach and guarantee everyone’s access to health services in line with the principles of the social state; however, under the conditions of a large geography and dense population, a public system that proceeds without cooperation with the private sector can reach the targeted outcomes only very late.

THE DRIVING FORCE OF DATA REGULATION AND PAYER MECHANISMS

Attention was drawn to the importance of elements such as where data regulation will be positioned, the competence of human resources, and the governance model. Referring to the assessment made through the e-Nabız example, it was recalled that the real triggering force of the system was SGK.

It was stated that if big data is made effectively usable, as in e-Nabız, it will be possible to carry data produced through artificial intelligence or existing data to more advanced levels by processing them again through artificial intelligence tools. At this point, it was expressed that the institutions that will guide the process are not limited only to the public side; in addition to SGK, private companies that manage the payer segment are also important actors in this ecosystem.

It was evaluated that especially the inclusion of insurance companies in the process as payer institutions could create a strong driving force when the correct areas of authority and use are defined. It was stated that this approach offers a new and noteworthy opening in terms of the data ecosystem and should be recorded.



ASSESSMENTS ON LEGISLATION AND INSTITUTIONAL STRUCTURE

Prof. Dr. Hakkı Muammer KARAKAŞ

In terms of my position before and after TÜSEB, I would have liked to say “I cannot accept this” or “I reject this” on this issue; however, under current conditions, it is not possible for me to say this clearly. Because there is still no legislation that clearly defines this issue. In fact, due to this deficiency, we organized a workshop with the important contributions of TÜSAP.

Actually, proceeding with the classical method would have been much easier. Everyone who works in the Ministry knows; those who have taken part in the processes of preparing circulars or regulations have experienced this difficulty. I also coordinated two regulations and had serious difficulty. The issuance of a regulation or circular often takes one and a half to two years. The regulation on the acquisition and sharing of health data constitutes the basis of most of the problems we are experiencing today.

For this reason, an instruction was given to prepare legislation in this field. In the usual method, ministry bureaucrats would first prepare a draft, and then this draft would go through a long chain of approvals. However, this time we preferred a different method. We adopted the participatory method used by international organizations such as the United Nations.

First, we organized a very broadly attended workshop and produced a comprehensive report from this workshop. Then we established four separate focus groups and addressed the issue from legal, technological, economic, and engineering dimensions. By adding good practice examples from around the world to these studies, we created a draft text.

In the next stage, we will open this draft to the general opinion of all stakeholders within the Ministry. We will submit the text for discussion article by article and vote on it. Then the text will come back again, be distributed to all institutions, and be revised again in line with the opinions received. The process will proceed in this way.

At this point, I would also like to clearly express the approach of the Ministry of Health. The Ministry wants this structure to be positioned not directly within the Ministry of Health, but under the umbrella of TÜSEB. In fact, it wants it to be within TÜYZE; however, this is an extremely large, comprehensive, and heavy responsibility. Such a structure must have a very high level of independence both in administrative terms and operationally.

Therefore, this is the current picture. Yes, as governments change, perspectives also change. Therefore, the first thing that needs to be done is to clearly define the legislation of this field. The legislator must clearly set out, independent of time, what this structure is, how it will function, and within which framework it will be positioned. I foresee that this regulation will be implemented within this year.

SEARCH FOR AN AUTHORITY IN HEALTH DATA: THE BALANCE OF INDEPENDENCE, AUTHORITY, AND CONTINUITY

Participant views on the processing and management of health data were shaped around the view that the existing fragmented structures are not sustainable and that a clear need for authority has emerged. In the discussions, attention was drawn to the fact that the Ministry of Health's position as both a data-producing and service-providing actor creates a structural tension in terms of data audit and management.

For this reason, it was stated that institutions producing data and structures regulating and auditing the use of data should be separated. However, it was emphasized that an independent structure should not remain independent only in name; it should be supported by strong legislation, clear definitions of authority, and accountability mechanisms. Otherwise, it was noted that a new structure carries the risk of reproducing existing problems.

Participants shared the view that, rather than the institutional model, a governance approach focused on success and producing results would be decisive. The experiences obtained revealed that progress in health data is possible when the right incentives and obligation mechanisms are established, and that institutional structure gains meaning to the extent that it makes this success sustainable.





PRIVACY AND ACCOUNTABILITY COME TO THE FORE IN ARTIFICIAL INTELLIGENCE APPLICATIONS

38% of the participants stated that the most critical ethical risk in health data analytics and the use of artificial intelligence is the violation of patient privacy and unauthorized use of data. This rate shows that, with the spread of digitalization and data-based applications, sensitivity toward the protection of individual rights has come strongly to the forefront.

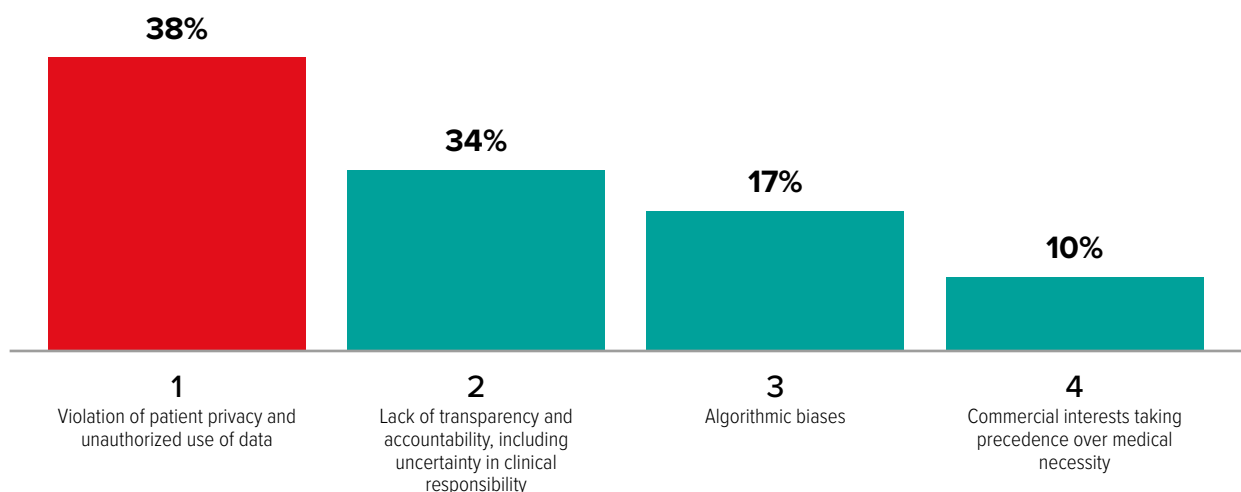
The 34% segment that evaluates the lack of transparency and accountability, particularly through uncertainties in the area of clinical responsibility, indicates that it is necessary to clarify who bears responsibility in artificial intelligence-supported decision-making processes and under which conditions. The high combined share of these two headings reveals that ethical discussions are concentrated more around governance, trust, and the legal framework.

The 17% share that sees algorithmic biases as the main risk draws attention to the fact that artificial intelligence systems may create problems of fairness and equality through training data and decision mechanisms. The 10% segment that evaluates commercial interests taking precedence over medical necessity as the most important ethical risk shows that there is limited but noteworthy sensitivity toward the potential of market dynamics to influence clinical decisions.

In the general assessment, it is understood that the perception of ethical risk in artificial intelligence applications in health is concentrated on privacy, responsibility, and governance rather than technical problems.

6. What is the most critical ethical risk in health data analytics and the use of artificial intelligence?

1. Violation of patient privacy and unauthorized use of data
2. Lack of transparency and accountability, including uncertainty in clinical responsibility
3. Algorithmic biases
4. Commercial interests taking precedence over medical necessity



ETHICAL RISK IN HEALTH DATA: TO PROTECT OR NOT TO USE?

It was stated that ethical risks in health data analytics and the use of artificial intelligence are not specific only to Türkiye, but are an issue that can be discussed under the same heading all over the world. Within this framework, it was emphasized that the most critical element is society's trust in the process. Recalling that similar agendas had also been addressed in previous workshops, it was noted that the issue of data protection can be handled not only as a matter of principle, but also through technological solutions.

It was stated that there are data protection platforms and technologies developed in this field around the world, and that examples such as the NHS ensure data security through technical methods. It was expressed that in Türkiye, too, data are protected through similar partnerships and methods, and therefore this is not an unsolvable area. It was stated that the fact that these headings are still being discussed as of 2025 points not so much to the existence of ethical risk, but rather to the issue of social perception and trust.

At this point, the source of the sensitivity toward health data in Türkiye was questioned. The question was raised as to whether there is a widespread perception in society that data are “very valuable” and that everyone is after these data, or whether negative experiences in the past have nourished this sensitivity. It was stated that this situation is a common problem not only of institutions, but also of the public.

NOT USING DATA IS ALSO AN ETHICAL VIOLATION

Bringing a different perspective to the ethical discussion, it was stated that the greatest ethical problem is the failure to apply the correct diagnosis and treatment to people. It was emphasized that this is not a theoretical risk, but a problem experienced in practice.

In the field of genetics, it was stated that directly adapting results obtained from data belonging to American society to Turkish society leads to misdiagnoses and incorrect treatments. It was expressed that the main reason for this is that genetic data analyses are not carried out sufficiently in Türkiye. It was noted that this situation reveals that the inability to analyze health data itself constitutes a major ethical risk.

It was emphasized that not using data, not analyzing it, and acting only with a reflex of “protection” actually lead to much greater harm. It was stated that excluding health data from analysis on ethical grounds eliminates the possibility of correct diagnosis and treatment; therefore, the main problem that should be focused on in ethical discussions is making data securely usable. The assessment was shared that these barriers can be overcome, and that the real risk is the data not being used at all.



“MEANINGFUL HUMAN CONTROL” AND THE RESPONSIBILITY ISSUE IN ARTIFICIAL INTELLIGENCE APPLICATIONS

It was stated that the concept of “meaningful human control” is widely discussed in the literature, and that the possibility of replacing radiologists who read mammograms with artificial intelligence, particularly in the main presentation, concretizes this discussion. In this context, it was emphasized that the concept of “meaningful” itself is highly value-laden, and that what will be accepted as meaningful human control in scenarios where artificial intelligence is used must be clearly defined.

In terms of Türkiye and specifically the systems to be established, it was expressed that how the role of artificial intelligence in decision-making processes will be positioned must be clearly determined. It was stated that the choice of whether artificial intelligence will be used as a “decision-support system” or as a more advanced substitution tool directly brings with it discussions of accountability and responsibility. For this reason, it was noted that the issue of who will bear responsibility lies at the center of this discussion.

At this point, attention was drawn through the mammography example to the mismatch between current capacity and need. It was stated that with the increase in the population over the age of 65 in Türkiye, the annual number of mammographies could reach 3-4 million, whereas it does not seem possible for the current number of radiologists to meet this burden. It was emphasized that this situation makes the use of artificial intelligence practically necessary; however, necessity does not eliminate the question of responsibility.

While it is acknowledged on the one hand that artificial intelligence must be used effectively, on the other hand it was stated that the question of “who will be responsible when this system operates?” remains unanswered. The assessment was shared that if the boundaries of meaningful human control are not drawn, the lack of accountability and ethical uncertainties will deepen. For this reason, it was expressed that in the use of artificial intelligence in the field of health, the ethical, legal, and administrative framework must be clarified as much as technical capacity.

RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE: FOUR FUNDAMENTAL DIMENSIONS OF ACCEPTABILITY

It was stated that the responsible use of artificial intelligence has four fundamental dimensions that cannot be separated from one another. The first of these is causality, which refers to the explainability of the data and processes through which the output produced by an artificial

intelligence system emerges. The second dimension is transparency, and it was emphasized that how the system works and which decision mechanisms it uses must be understandable. Legitimate authority was highlighted as the third dimension, and it was stated that the authority framework within which artificial intelligence is used and whose approval it is used with are determining factors. The fourth and final dimension is accountability, and it was expressed that the use of artificial intelligence cannot be accepted unless it is clearly defined to whom responsibility ultimately belongs.

It was stated that artificial intelligence use cannot be accepted unless these four elements come together, and that acceptability is ultimately shaped through accountability. Looking at applications, it was noted that this framework is mostly determined by the legislator, and that the conditions and scope under which artificial intelligence can be used are defined through legislation.

As an example of this situation, certain systems in the United States that include partial artificial intelligence algorithms and are reimbursed under Medicare and Medicaid were shown. It was stated that these systems are legally accepted as “medical devices” and permitted for use; and that this is an important example of artificial intelligence in health moving beyond being merely a tool and becoming a regulated application. It was emphasized that this development has the nature of a revolution, but essentially emerged from a need. Since it arose from a need, it was expressed that preventing the use of artificial intelligence is not possible, and that its use has already begun in practice.

It was also recalled that in Türkiye, the use of artificial intelligence in universities has been liberalized, but tied to certain rules. It was stated that while students were previously prohibited from using artificial intelligence, faculty members were using the same tools; and that this situation shows that artificial intelligence has inevitably become part of life. For this reason, it was emphasized that the main issue is not the question of “whether it should be used or not,” but how and under what supervision it will be used.

At this point, attention was drawn to the fact that many products offered on the market with the label of “artificial intelligence” are not actually artificial intelligence products. It was stated that the discourse of artificial intelligence in products such as air conditioners and refrigerators is used more for marketing purposes, whereas in the field of health this approach carries serious risks. It was emphasized that the main issue in health is not storing or using data, but the existence of an independent authority that will test and audit these systems.

It was expressed that such an independent authority has not yet been fully established not only in Türkiye, but also worldwide; although there are experimentally organized models within some countries, a globally accepted strategy has not yet developed. The assessment was shared that one of the reasons artificial intelligence is developing so rapidly is this administrative and ethical gap.



STRONG ORIENTATION TOWARD A CENTRALIZED STRUCTURE IN HEALTH DATA

61% of the participants stated that a centralized “national data pool” structure is the most appropriate model for the sharing and analysis of health data. This high rate reveals that, in the management of health data, a holistic, standardized, and centralized architecture is strongly adopted rather than fragmented and scattered structures.

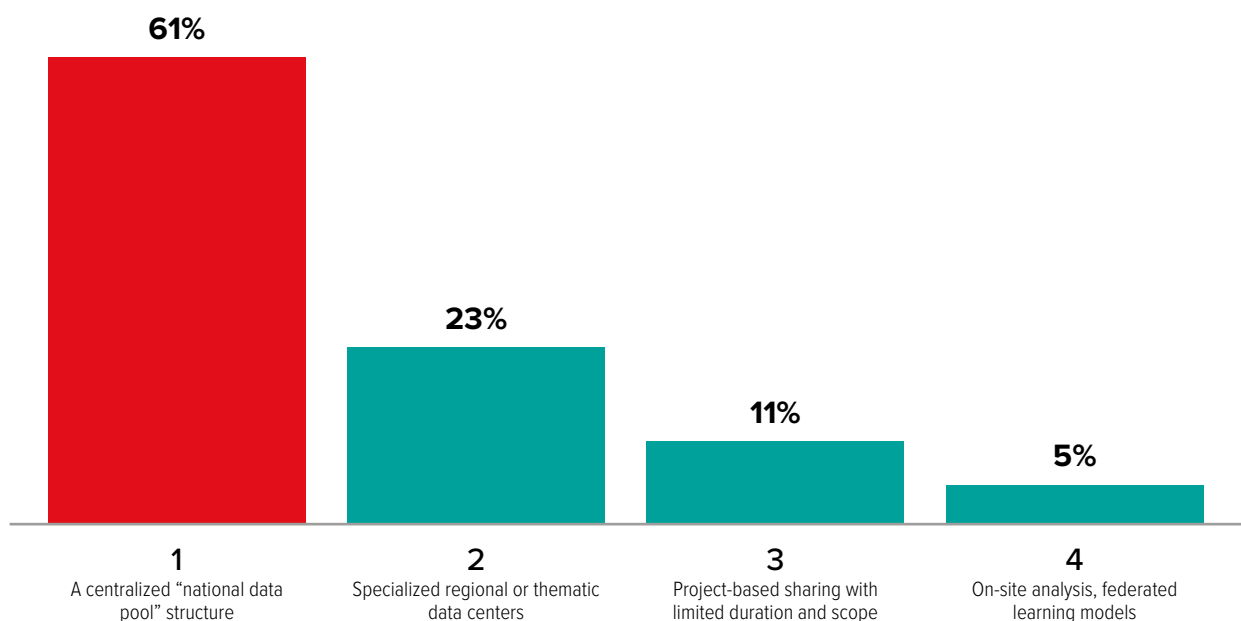
The 23% segment preferring specialized regional or thematic data centers shows that more focused and field-based models that can operate within or in harmony with the centralized structure also receive a certain level of support. On the other hand, the 11% share that finds project-based sharing with limited duration and scope appropriate indicates that more temporary and flexible structures may find a limited area of use.

The 5% segment highlighting on-site analysis, federated learning models, offers an alternative approach in terms of data security and privacy, but shows that it has not yet gained broad acceptance at the current level of perception and implementation.

In the general assessment, it is understood that the great majority of participants demonstrate a strong preference for a centralized structure in the sharing and analytics of health data, while alternative models are evaluated as complementary or secondary solutions.

7. Which structural model would be more appropriate in the sharing and analysis of health data?

1. A centralized “national data pool” structure
2. Specialized regional or thematic data centers
3. Project-based sharing with limited duration and scope
4. On-site analysis, federated learning models



DIFFERENTIATING STRUCTURAL MODELS ACCORDING TO PURPOSE IN THE SHARING AND ANALYSIS OF HEALTH DATA

It was stated that, when it comes to the sharing and analysis of health data, the correct structural model should not be determined through a single framework, but according to the purpose for which the data are shared and the purpose for which they are analyzed. For this reason, it was emphasized that addressing the concepts of data sharing and data analysis under the same structure does not always produce the right result.

In systems intended for retrospective viewing of personal health data, a centralized structural model was stated to be functional and rational. In structures similar to e-Nabız, providing access from a single center was expressed to offer important advantages in terms of being able to access the same information from different points, preserving data integrity, and user experience. It was stated that in such usage scenarios, a centralized architecture is the right choice.

However, when it comes to data analysis, it was emphasized that the structure should be layered according to the output desired. It was stated that it is not possible to propose a single-type structure before the purpose of the analysis is clarified; the question “What do we want to obtain?” is determining here. For example, in an analysis to be conducted on rare diseases, whether this analysis is carried out based on artificial intelligence or through classical statistical methods, it was stated that it is not mandatory for all data to be collected in a single center. Instead, it was expressed that transferring only the datasets required for the relevant analysis to a specific center, creating a partial and purpose-oriented national database there, and working on this limited data would be much more efficient and meaningful.

It was emphasized that this approach is both more sustainable from a technical perspective and offers a more controlled structure in terms of data security and management. For this reason, it was stated that when the question was first posed, instead of directly proposing a model, the purpose of use was first questioned.

In addition, it was stated that the need for data sharing and analysis outside existing public institutions should also be addressed as a separate heading. In this context, insurance institutions, private sector stakeholders, and academic circles conducting scientific research were identified as potential users. It was emphasized that in such sharing, datasets that have been cleared of personal data, anonymized, and secured should be used.

At this point, it was stated that making a structural preference would not be healthy without clarifying the questions of whether the data will be shared from a national center, for what purpose the analyses will be carried out, and which outputs are targeted. Therefore, attention was drawn to the need for a structure in the sharing and analysis of health data that can be flexible according to its purpose and divided into different layers, rather than a single institutional or technical model.



RISKS OF EXCESSIVE CENTRALIZATION IN HEALTH DATA MANAGEMENT AND THE IMPORTANCE OF A THEMATIC-REGIONAL APPROACH

It was stated that the extent to which health data management is centralized and enlarged directly affects the problems that may be experienced in data sharing. It was emphasized that if the structure becomes excessively centralized, serious difficulties may arise in terms of both access to data and its effective use. For this reason, it was expressed that it may be more appropriate to address health data as much as possible through a thematic approach and, to the extent conditions allow, through a regional approach.

This view was concretized especially through the example of rare diseases. It was stated that the model applied worldwide in rare diseases proceeds through certain reference centers, and that it is not possible to gather every subject in a single city or a single center. It was noted that in this field, patients are followed in certain centers, and new technologies and clinical approaches are also developed in these centers. It was expressed that the same approach should also apply to health data, and that analyzing data where it is produced and gains meaning would lead to healthier results.

At this point, reference was made to the view that what is determining is not the institutional structure itself, but the output it produces and the success it demonstrates. It was emphasized that a similar logic should be followed in health data analysis, and that before the debate on centralized or regional structures, what these structures produce and to what extent they contribute to decision-making processes are important. Within this framework, it was stated that the concept of “local” in data analysis does not mean a fragmented structure covering 81 provinces; however, centers clustered at the regional level and differentiated thematically may be more functional.

It was emphasized that the question “Why are we conducting the analysis?” is the fundamental determining factor. While discussing what the motivations of third parties for data analysis should be, it was stated that Türkiye’s priority objective should be to provide input to decision-support systems. Whether at the regional or central level, if decision-makers will actually use these analyses, it was noted that analysis processes should be designed in direct connection with decision-support mechanisms.

In this direction, attention was drawn to the importance of establishing systems that do not merely produce reports, but integrate analysis results into decision-making processes and are supported by algorithms. It was expressed that data analysis should become a tool that feeds decision-making processes at different levels of the health system, rather than merely producing an academic or technical output.

INTEGRATION BETWEEN REGIONAL DATA CENTERS AND LESSONS DRAWN FROM EXISTING NATIONAL SYSTEMS

It was stated that if regional or thematic data centers are established, the question of how

these structures will be related to one another is critical. It was emphasized that health data cannot always be reduced only to narrow areas such as singular and rare diseases; at times, it is necessary to evaluate related datasets together and produce new inferences. For this reason, it was expressed that, alongside regional structuring, an upper architecture that enables integration between centers must also be considered.

At this point, an assessment was made through two important macro examples from Türkiye. It was recalled that the Medula system and e-Nabız, together with the modules operating in parallel with it, are today the two largest data production and collection structures nationwide. However, it was stated that these two systems do not share data with each other to a sufficient extent and that there is no meaningful integration between them. It was noted that this situation does not facilitate data sharing despite the systems being centralized; on the contrary, centralized structures can at times have an effect that limits sharing.

Through this example, attention was drawn to the fact that the assumption “the more we centralize, the better we share” is not always valid. It was emphasized that overly centralized structures do not automatically ensure integration, and that in architectures that are not properly designed, sharing can become even more difficult. Within this framework, it was stated that why existing systems cannot communicate with each other and which structural problems lead to this must be analyzed correctly.

At the end of the speech, it was stated that, under Türkiye’s current conditions, the advantages and limitations of both centralized and regional structures should be addressed realistically. It was emphasized that when designing new models, progressing by learning from the strengths and weaknesses of existing practices, rather than from ideal assumptions, would produce healthier results.

DATA ACCESS AND OPERATIONAL BURDEN: THE AGILITY ADVANTAGE OF CENTRALIZED STRUCTURES

It was stated that, for structures wishing to work with data, the actual loss of time and resources occurs not in the analysis of the data, but in the processes of accessing and transferring the data. Based on their own experience, the participant stated that approximately one year was spent to obtain a dataset, whereas the analysis of the data could often be completed in a shorter period, such as six months. It was emphasized that this situation clearly reveals how determining operational processes are in the health data ecosystem.

Within this framework, it was expressed that if a centralized data structure exists, operational needs such as access, permission, transfer, and standardization would be significantly reduced, and research and analysis processes could be carried out in a much more agile and efficient manner. It was stated that centralized structures, especially in multi-stakeholder data requests, could save time by eliminating repetitive bureaucratic processes.

In a brief response to this assessment, attention was drawn to the fact that the approach was addressed more from the perspective of scientific research. It was implied that, especially in academic and R&D-oriented studies, rapid and secure access to data directly affects the quality and sustainability of research; therefore, centralized solutions could provide an important advantage in terms of scientific productivity.



PRIORITY OF PREVENTIVE HEALTH IN ARTIFICIAL INTELLIGENCE INVESTMENTS

41% of the participants shared the view that, considering limited resources, artificial intelligence investments in health should primarily be directed to the field of preventive health. This distribution shows that reducing the burden of disease through the early identification of risk groups and early warning systems is considered the area that will provide the highest benefit in terms of the effective use of resources.

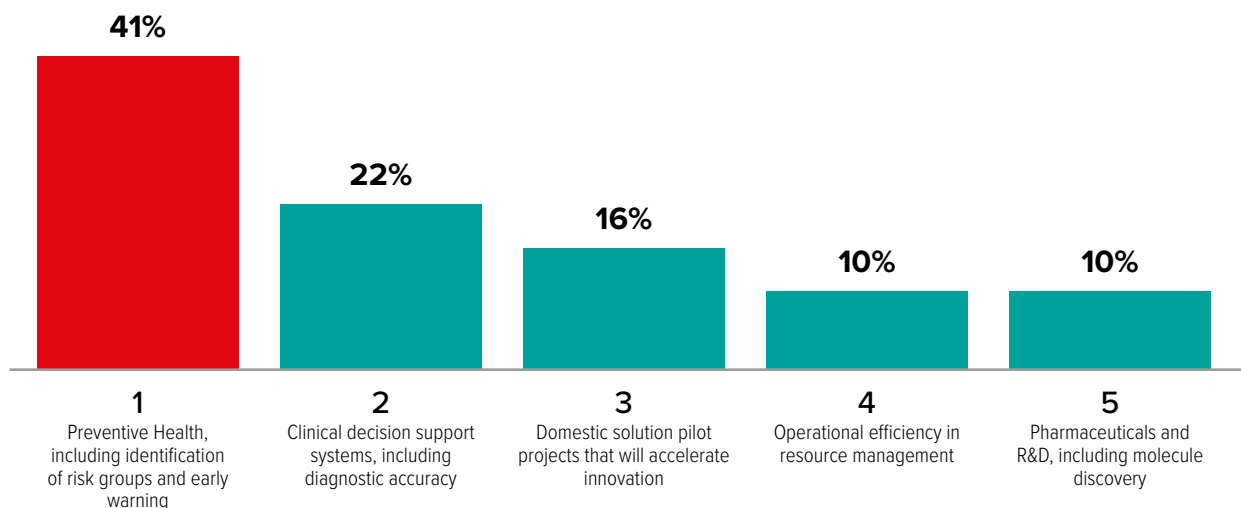
The 22% segment prioritizing clinical decision support systems indicates that increasing diagnostic accuracy and supporting clinical processes have a direct impact on the quality of healthcare services. The 16% share of participants who think that focus should be placed on domestic solution and pilot projects that will accelerate innovation reflects an expectation for the development of sustainable technological capacity in the medium and long term.

The 10% shares that prioritize operational efficiency in resource management and the fields of pharmaceuticals and R&D reveal that, although these headings are considered important to a certain extent, they are evaluated as more secondary priorities compared to preventive health and clinical applications.

In the general assessment, it is understood that participants display a common tendency that, beyond short-term clinical gains, greater emphasis should be placed on preventive and proactive approaches that affect the healthcare system as a whole in artificial intelligence investments.

8. Considering our limited resources, in which area should Türkiye primarily focus its artificial intelligence investments in health?

1. Preventive Health, including identification of risk groups and early warning
2. Clinical decision support systems, including diagnostic accuracy
3. Domestic solution pilot projects that will accelerate innovation
4. Operational efficiency in resource management
5. Pharmaceuticals and R&D, including molecule discovery



ARTIFICIAL INTELLIGENCE PRIORITIES IN HEALTH WITHIN THE FRAMEWORK OF LIMITED RESOURCES

Considering limited resources, the areas to which Türkiye should primarily direct its artificial intelligence investments in health were discussed. At this point, it was stated that the current health system is predominantly built on therapeutic medicine, while the preventive health approach is not sufficiently placed at the center at either the education or implementation level.

It was emphasized that a treatment-oriented approach is dominant in medical faculties and medical practice, and that a systematic culture aimed at protecting healthy individuals has not yet developed sufficiently. Within this framework, attention was drawn to the “Healthy Life Master Plan,” whose preparations are being carried out by the Ministry of Health. It was stated that the plan focuses on what measures can be taken before individuals become ill, and that experts assigned from academia regularly contribute to the process within this scope. It was expressed that, provided it is not interrupted by short-term agendas and daily political pressures, this approach will produce important results in the medium and long term.

THE PROBLEM OF DATA AND EFFECTIVENESS MEASUREMENT IN PREVENTIVE HEALTH

It was stated that the Ministry of Health has many digital systems in the field of preventive health, but that the extent to which these systems are effective is not measured regularly and objectively. Although there are various modules integrated into hospital information systems, it was emphasized that a holistic mechanism to evaluate the impact of these structures in the field is lacking.

It was conveyed that progress has been made through an exemplary application developed in the field of maternal and infant health, and that concrete results have been achieved especially in the midwifery segment. However, it was stated that when contact is made with the public sector, either the relevant service is desired to be developed entirely by the public sector, or a genuine integration model cannot be established with private sector initiatives.

E-NABIZ, DATA ACCESS, AND INTEGRATION BARRIERS

It was stated that integration with e-Nabız was desired in order to provide more effective and personalized services, but that no progress could be made on this issue. However, it was emphasized that e-Nabız offers an extremely valuable potential with a data volume of approximately 90 million.

It was expressed that if this data is addressed with the right architecture, both preventive health applications can be strengthened and the data can be transformed into meaningful insights. It was evaluated that especially startups could play an important role in producing innovative solutions by processing this large dataset.



PUBLIC-PRIVATE COOPERATION AND THE ROLE OF STARTUPS

It was conveyed that the most challenging part of doing data-based work is access to data and the operational transfer of data, while the analysis process takes a relatively shorter time. It was stated that while nearly one year was spent to access data, analysis processes could be completed in shorter periods such as six months.

For this reason, it was expressed that establishing a centralized and accessible data structure would reduce the operational burden and enable more agile and productive work. It was emphasized that the discussion was addressed more from the perspective of scientific research, but that the implementation and entrepreneurship dimension is at least as critical.

As a result, it was assessed that establishing an ecosystem in which the public and private sectors can meet on common ground and access to data is provided in a controlled but functional manner is critical for both preventive health policies and the sustainability of artificial intelligence applications in health.

PERCEPTION OF RESOURCE CONSTRAINTS AND SERVICE DELIVERY MODEL

It was stated that the emphasis on “limited resources” in health often does not fully reflect the actual situation, and that the real constraint arises from the current service delivery model. It was noted that rather than the limitation of resources, how the service is designed and delivered makes resource use inefficient. For this reason, it was emphasized that artificial intelligence investments should be addressed not only with a focus on technology, but also in a way that transforms service delivery models.

WEARABLE TECHNOLOGIES AND TÜRKİYE’S STRATEGIC POTENTIAL

It was assessed that wearable health technologies will become one of the fundamental building blocks of future health systems, similar to the role played by UAVs and UCAVs in the defense industry. It was stated that Türkiye has significant potential in this field, and that there is a strong foundation in terms of both technical capacity and human resources.

In order for this potential to be utilized effectively, it was emphasized that establishing focused research funds specifically for wearable technologies is critical. It was stated that encouraging R&D activities in this field through long-term and strategic support mechanisms could increase Türkiye’s competitiveness in artificial intelligence and digital health.

ECONOMIC AND DEMOGRAPHIC IMPACT OF PREVENTIVE HEALTH SERVICES

It was stated that with the effective development of preventable health services, a significant reduction can be achieved in the costs of tertiary healthcare services in countries. It was emphasized that it is possible to protect the health of a larger population at lower costs, and therefore it is important for artificial intelligence applications to primarily focus on areas that will support preventive health services.

With the gradual aging of the population, it was noted that there are relatively healthier individuals in older age groups; however, the disease profiles and risk factors of this group differ from previous periods. It was expressed that this change creates a new and important gap in terms of preventive health services. It was assessed that strengthening early risk detection, monitoring, and preventive interventions for the elderly population through artificial intelligence-supported systems is critical.

It was emphasized that there is strong consensus on the importance of preventive health services, and that the main issue to be discussed is how this approach will be implemented. In this context, it was stated that the Ministry of Health is carrying out a comprehensive study focused on preventive health and healthy living, and that this study is expected to be shared with the public.

DISCUSSION OF PRIORITY BETWEEN PREVENTIVE HEALTH AND PHARMACEUTICAL R&D INVESTMENTS

While evaluating priority areas for artificial intelligence investments in health, it was stated that a balance should be established between preventive health services and pharmaceutical and R&D studies, including molecule discovery. While it was noted that a large portion of participants identified preventive health as the priority area, it was emphasized that a different perspective comes to the fore for academic and administrative managers working in the pharmaceutical field.

It was stated that there is strong scientific evidence at the international level showing that new artificial intelligence-supported investments, especially in the pharmaceutical field, significantly shorten pharmaceutical research and development processes. It was noted that this creates extremely positive results both in terms of reducing research costs and enabling the faster development of new molecules. For this reason, it was assessed that artificial intelligence investments to be made in pharmaceuticals and R&D carry strategic value for the country.



However, when the participant distribution is considered, it was stated that, as a natural result of each stakeholder approaching the issue through their own area of expertise, the pharmaceutical and R&D heading remained at the level of 10% in the survey. It was emphasized that this rate is related to the weight of the participant profile rather than the insignificance of the field. Especially when limited resources are in question, it was stated that the effects on the national economy in the short and medium term should be taken into account; in this context, reducing external dependence in pharmaceuticals and the burden on the current account deficit is a critical objective. In the long term, it was expressed that systematically strengthening preventive health services is inevitable.

It was pointed out that if new molecule development processes remain insufficient, dependence on the side effects of medicines used in existing treatments continues, and that this creates a structural fragility in the health system. For this reason, although the number of participants is low, it was assessed that the strategic importance of the pharmaceutical and R&D heading is high.

ARTIFICIAL INTELLIGENCE AND AUDIT MECHANISMS IN HEALTH

It was stated that among the existing options, there was no heading that fully reflected the priority. It was emphasized that one of the areas where artificial intelligence can be applied at the lowest cost and in the fastest way is the audit of healthcare services. It was noted that strengthening audit mechanisms through the analysis of health data offers an important opportunity in terms of both effectiveness and sanctioning capacity.

Information was provided about the work and investments carried out in this field by the Social Security Institution, as one of the auditing institutions in the health sector. It was stated that artificial intelligence-supported audit applications are planned to be implemented within the next year. It was assessed that this approach will provide important contributions to transparency, efficiency, and financial sustainability in the health system.

The session was concluded by stating that this information would be taken into consideration by sector representatives and would contribute to the evaluations to be made in the upcoming process.

HUMAN RESOURCE PRIORITIES IN AN ARTIFICIAL INTELLIGENCE-BASED HEALTH SYSTEM

38% of the participants stated that, in the transition process to an artificial intelligence-based health system, the most prioritized area of investment in terms of human resources is hybrid roles that bring together clinical knowledge and technical competence. This need for interdisciplinary profiles such as “clinical data scientist” reveals the critical importance of human resources that will serve as an interface in effectively integrating clinical processes with data-based technologies.

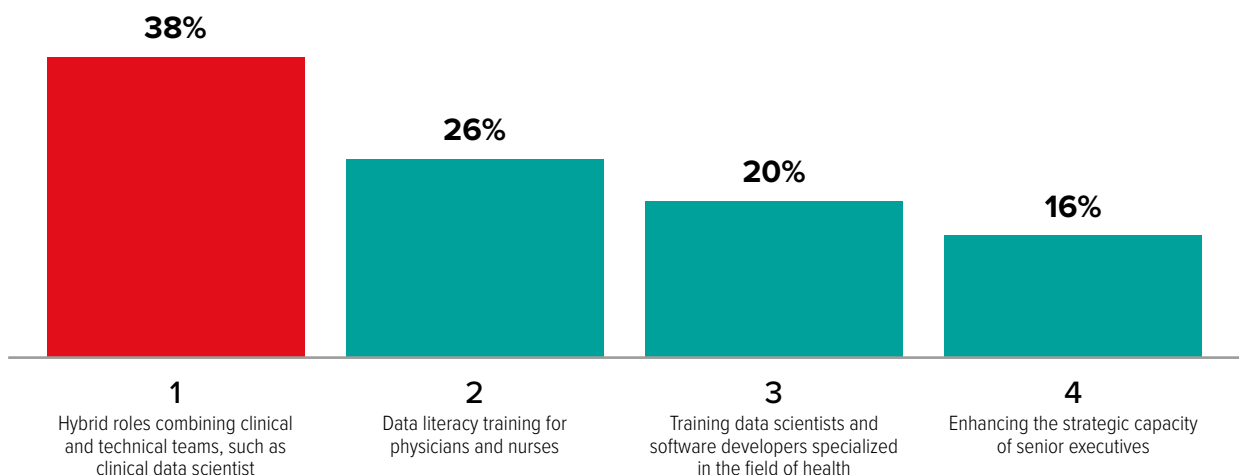
The 26% segment prioritizing data literacy training for physicians and nurses indicates that strengthening the existing clinical workforce in interpreting data analytics and artificial intelligence outputs is a fundamental requirement for the adoption of technology in the field.

The 20% share prioritizing the training of data scientists and software developers specialized in the field of health reflects an expectation for deepening technical capacity; while the 16% segment considering the enhancement of senior executives’ strategic capacity as a priority emphasizes that artificial intelligence transformation requires not only technical expertise, but also managerial and visionary leadership.

When evaluated within the general framework, participant views show that, in the transition to an artificial intelligence-based health system, neither technical expertise nor clinical experience alone is considered sufficient; human resource models that combine these two areas and holistic capacity development based on data literacy come to the fore.

9. What is the most prioritized area of investment in terms of human resources in the transition to an artificial intelligence-based health system?

1. Hybrid roles combining clinical and technical teams, such as clinical data scientist
2. Data literacy training for physicians and nurses
3. Training data scientists and software developers specialized in the field of health
4. Enhancing the strategic capacity of senior executives





THE NECESSITY OF PLACING ARTIFICIAL INTELLIGENCE IN HEALTH AT THE CORE OF THE CURRICULUM

It was emphasized that the current focus is the systematic and permanent integration of artificial intelligence into the health education curriculum.

It was stated that the future of health systems should rest on three fundamental pillars: digital technologies and artificial intelligence, innovation, and holistic/preventive health. It was expressed that unless this three-part structure is addressed together, it is not possible for health systems to progress sustainably. It was especially emphasized that preventive health is also an integral part of this holistic approach.

It was stated that the current survey results remain quite cautious and limited in this respect, and that the fact that digital health and artificial intelligence are still addressed as a secondary heading in the curriculum creates an important deficiency. It was expressed that artificial intelligence should be positioned in health education not through elective courses or limited content, but directly as the core of the curriculum.

Attention was drawn to the fact that a large portion of students studying at medical faculties are not satisfied with the current education model. It was conveyed that at Marmara University Faculty of Medicine, artificial intelligence is included only as an elective course, yet it is shown as one of the most advanced examples in this field. It was stated that in many faculties, particularly Cerrahpaşa, Çapa, and Marmara, students have established Artificial Intelligence Clubs on their own initiative, and that this situation clearly reveals students' interest in the subject and their perception of need.

It was stated that this process is supported not only at the university level, but also at the national level; and that the President of the Council of Higher Education and the Ministry of Health support the work in this direction. Despite this, attention was drawn to the fact that a sufficiently strong and binding decision has not yet been taken.

Emphasizing the importance of a concrete decision emerging from this meeting, it was stated that the education curricula of physicians, nurses, opticians, and all professional groups working in the health system should be restructured on the basis of digital health and artificial intelligence. It was noted that integrating artificial intelligence into the education process from the very beginning will enable these technologies to become established within the health system in a natural and healthy manner.

It was emphasized that this transformation cannot remain limited only to students; teaching staff must also be made competent in this field. The assessment was completed by stating that the process of training the trainers should be addressed as an integral part of curriculum transformation.

THE IMPORTANCE OF HYBRID ROLES COMBINING CLINICAL AND TECHNICAL COMPETENCIES

The reasons for selecting the strengthening of hybrid roles that bring together clinical and technical teams were addressed from a different perspective. In order to add a new dimension to the discussion, the reasons why the other options were not considered priorities were explained in detail.

It was stated that in today's environment, where artificial intelligence is being intensively discussed on a global scale, it is not possible for senior executives and decision-makers to be unaware of the strategic importance of this field. It was emphasized that a basic threshold of awareness regarding the importance of artificial intelligence in health has now been surpassed, and therefore the main discussion should focus on implementation and organizational models.

It was expressed that training data scientists or software engineers specialized in the field of health is not seen as a priority need on its own. It was stated that the basic principles of data science are independent of the sector; and that if data are collected, stored, and analyzed correctly, meaningful results can be achieved regardless of the type of data. For this reason, it was emphasized that rather than separating technical expertise by field, it is more valuable for it to work in integration with clinical knowledge.

On the other hand, it was stated that data literacy and artificial intelligence awareness training for healthcare professionals, particularly physicians and nurses, have already been integrated into education models. It was conveyed that official letters had been sent by the Council of Higher Education within the last two to three years regarding the inclusion of such content in all curricula, and that this process was closely experienced during the speaker's term as dean. It was stated that this situation shows that institutional awareness has reached a certain level.

Attention was also drawn to the international labor market, and it was noted that hybrid roles such as "clinical data scientist" are increasingly coming to the fore, especially in job postings abroad. It was emphasized that the technical analysis of clinical data alone is not sufficient; interpreting this data correctly within the clinical context requires teams performing data analysis and clinical experts to work together. The assessment was completed by stating that this integrated approach is one of the fundamental elements that enables artificial intelligence applications in health to generate real value.



ASSESSMENTS ON THE INTEGRATION OF ARTIFICIAL INTELLIGENCE INTO HEALTH CURRICULA

The Principle-Based Necessity of Widespread Integration into Curricula

It was stated that the integration of artificial intelligence into all health-related curricula, particularly medicine, nursing, and health sciences, is considered correct in principle. It was emphasized that the future of health systems is being shaped around digital technologies, artificial intelligence, innovation, and preventive health, and that the education system should therefore reflect this transformation.

However, it was noted that addressing this approach only from the perspective of “adding courses” would be insufficient, and that serious structural problems could emerge during implementation.

Trainer Capacity and the Shortage of Academic Human Resources

It was stated that if artificial intelligence is widely added to curricula, the most fundamental problem will be the lack of qualified academic staff to teach these courses. An assessment was made through the example of Marmara University Department of Computer Engineering, and it was conveyed that the number of academics working particularly in advanced artificial intelligence fields such as natural language processing and large language models is limited to three or four people.

Attention was drawn to the fact that with this limited human resource, it would not be possible to sustainably implement a comprehensive artificial intelligence curriculum spread across faculties of medicine, nursing, health sciences, and other departments. It was expressed that it would be practically impossible for the same academic staff to meet the increasing course load across different faculties.

The Problem of Access to Specialized Human Resources in the Field of Artificial Intelligence

It was stated that the discussion ultimately returns to the problem of human resources, and it was emphasized that the number of people specialized in artificial intelligence is already limited. It was expressed that as the popularity of the subject increases, finding academics in this field at universities is becoming increasingly difficult, and that even in the private sector, access to qualified artificial intelligence experts has become a serious problem.

In addition, it was noted that the observation was shared that many experts working in the field of artificial intelligence do not directly come from a computer engineering background, but have specialized in this field by transitioning from different disciplines.

The Need for Training the Trainers

In the face of this picture, it was emphasized that in order to expand artificial intelligence education, trainers must first be trained. It was stated that curriculum transformation must be planned not only for students, but also to increase the competencies of academic staff.

It was noted that rapid curriculum expansions to be carried out without increasing trainer capacity could put content quality and sustainability at risk.

Student Initiative and the Potential for Self-Directed Learning

Alongside these points, attention was also drawn to the fact that human resource insufficiency should not be used as a completely obstructive justification. It was stated that a large portion of current students have a strong quantitative foundation, and that even if they have not received engineering education, they are able to manage their own learning processes.

YÖK INITIATIVE FOR TRAINING TRAINERS IN ARTIFICIAL INTELLIGENCE EDUCATION

Institutional Response to the Need for Training the Trainers

It was stated that there is a program addressed in the recent meetings of the Council of Higher Education (YÖK), aiming to train approximately 400 academics in the field of artificial intelligence. It was emphasized that this initiative focuses on the need for “training the trainers” rather than directly on student education.

It was noted that this approach is an important step toward addressing the shortage of academic human resources, which is frequently raised in the process of integrating artificial intelligence into curricula, particularly in the field of health.

The Importance of YÖK Having Identified the Need

It was stated that the most important aspect of this program is that it shows YÖK has clearly recognized the structural need in the field of artificial intelligence. While it was assessed that curriculum transformation cannot progress in a healthy manner without strengthening the human resources that will provide the education, it was emphasized that YÖK has taken a strategic position at this point.

Within this framework, it was expressed that YÖK is moving toward a role that not only determines policy, but also develops capacity for implementation.



A Positive Ground for Curriculum Transformation

It was stated that this training program, which covers approximately 400 academics, will expand the human resources capable of teaching artificial intelligence courses at universities in the medium term, thereby creating a stronger foundation for the planned curriculum transformations in faculties of medicine, health sciences, and other disciplines.

The speaker stated that they therefore particularly wanted to share this initiative, and expressed that the program is a positive and promising development in terms of both its timing and scope.

PRIORITY HUMAN RESOURCE NEED FOR ARTIFICIAL INTELLIGENCE IN HEALTH

The Need for Data Scientists and Software Engineers Specialized in the Field of Health

It was stated that, in order to develop artificial intelligence applications in health, there is primarily a need for data scientists and software engineers specialized in the field of health. It was emphasized that determining which data will be used in the software to be developed, designing how these data will be analyzed, and building systems accordingly are critical.

For this reason, it was stated that the priority is to train experts who do not only have general software or data science knowledge, but who understand the nature of health data.

The Necessity of “Refining” Existing Health Data

While it was stated that Türkiye has a significant amount of health data, particularly e-Nabız, attention was drawn to the fact that these data are not of a quality that can be used directly in artificial intelligence applications. It was noted that existing data must be filtered, standardized, and made meaningful, in other words, “refined.”

It was expressed that this process requires not only technical but also methodological work, and that which data are useful must be clearly defined.

Defining New Data Needs and Expanding Datasets

The speaker stated that, in addition to existing data, additional types of data are also needed for artificial intelligence applications to operate effectively. In this context, it was expressed that which data are missing must be identified, the new data that need to be collected must be defined, and this process must be managed systematically.

At this stage, the need for experts who will determine data requirements and design datasets in a holistic manner was underlined.

Multidisciplinary Expertise in Analysis, Compilation, and Interpretation Processes

It was stated that data science does not consist only of analysis; there is a need for different specialized roles that collect, compile, clean, and interpret data. For this reason, it was noted that developing new-generation engineering and data science profiles to work in the field of health is essential.

It was emphasized that this human resource should be trained in a way that enables it to work in integration with the health system.

Decision Support Systems and the Use of Artificial Intelligence in Preventive Health

It was stated that the ultimate purpose of the data analysis and infrastructure-building process is to develop artificial intelligence-based decision support systems. It was noted that by using these systems especially in the field of preventive health, healthcare services can be made more effective and predictable.

As a result, it was expressed that the process requires a phased and planned roadmap that begins with data and extends to analysis, system development, and preventive health applications.





POLICY TOOLS TO DEVELOP THE DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE ECOSYSTEM IN HEALTH

Participant views show that no single policy tool is considered sufficient for the growth of the data analytics and artificial intelligence ecosystem in health in Türkiye, and that regulation, data access, and public support mechanisms should be addressed together. The 25% share evaluating the clarification of regulation and the determination of standards as the most effective policy tool indicates that eliminating uncertainties in the ecosystem and establishing a predictable legal framework are seen as priority needs.

At the same rate, 25% of participants considered opening public datasets to the ecosystem in anonymized form as a critical lever. This approach shows that accessible and secure data infrastructure is accepted as a fundamental element for accelerating data-based innovation and developing domestic artificial intelligence solutions.

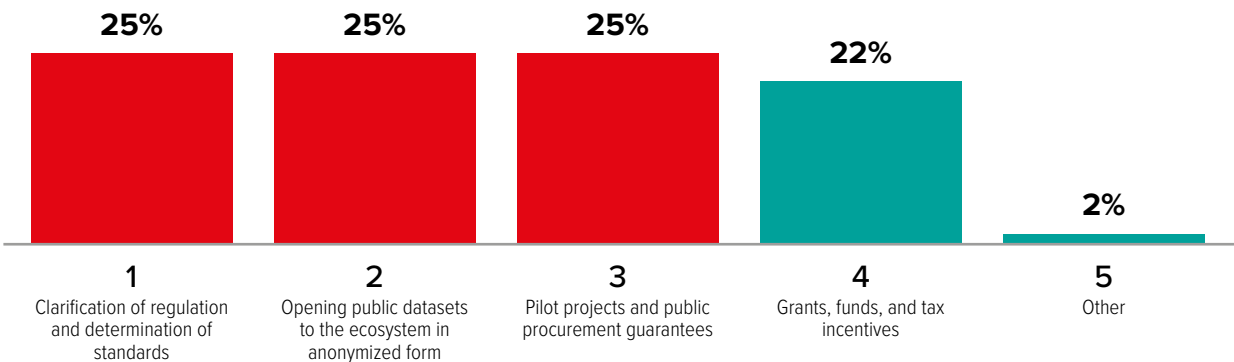
The 25% segment that sees pilot projects and public procurement guarantees as the priority policy tool reveals that publicly supported practices that will enable early-stage solutions to be tested and scaled in the field can play an important role in the sustainable growth of the ecosystem.

The 22% share prioritizing grants, funds, and tax incentives shows that financial support mechanisms, while still important, are not considered sufficient on their own; rather, they are evaluated as a complementary element together with structural and managerial tools. The low 2% share selecting the “Other” option indicates that the existing set of policy tools is generally considered comprehensive.

When evaluated overall, participant views show that a balanced policy mix is needed for the development of the data analytics and artificial intelligence ecosystem in health, and that legal clarity, secure data access, and public-led implementation opportunities stand out as complementary elements.

10. What would be the most effective policy tool to grow the data analytics and artificial intelligence ecosystem in health in Türkiye?

- 1. Clarification of regulation and determination of standards
- 2. Opening public datasets to the ecosystem in anonymized form
- 3. Pilot projects and public procurement guarantees
- 4. Grants, funds, and tax incentives
- 5. Other





Prof. Dr. Hakki Muammer KARAKAŞ
President of TÜSEB

ASSESSMENTS ON THE MANAGEMENT OF HEALTH DATA, TÜSEB'S ROLE, AND THE ARTIFICIAL INTELLIGENCE ECOSYSTEM

TÜSEB's Position and the Patronage of Health Data

First of all, I would like to underline this once again clearly: We are not a unit of the Ministry of Health; we are an autonomous institution. Therefore, it is important for me to express TÜSEB's approach on this issue correctly. There may have been points that I could not fully explain before.

Currently, the patronage of health data is not with the General Directorate of Health Information Systems. That is the structure that technically stores the data. The authority regarding how health data will be used has been granted to TÜSEB. However, this use is naturally carried out through the infrastructure of the General Directorate of Health Information Systems. Because, pursuant to the regulation, the place where the data is physically stored and the access keys are there.

There is also no single and centralized server structure within the Ministry of Health. As I stated before, with a new decision taken, the relevant data infrastructures are being moved to Telekom servers.



Data Storage, Cloud, and Misperceptions

How health data are stored, and concepts such as FDR pool or cloud, are unfortunately often misunderstood. An institution may have its own cloud infrastructure; this is possible and natural. However, I would like to state clearly that the following will absolutely not happen: there will be no situation in which all people's data are gathered in a single place and everyone can access and leave these data as they wish.

This structure will necessarily be regulated. In fact, the fundamental issue we are discussing today is the clear and explicit definition of this regulation.

The Nature of Data and the Importance of Clinical Data Scientists

I must state this clearly: A very large portion of the data we currently have is not usable data. Even very large industrial organizations have not been able to fully make sense of e-Nabiz data. Because the main issue is not the quantity of data, but producing controlled, clean, and qualified data.

At this point, the role of clinical data scientists is extremely critical. We need experts who will work on these data, make sense of them, and render them analyzable.

State Support, Scaling, and Global Expansion

I personally believe the following: No artificial intelligence initiative in health that does not have state support behind it has been successful to date. When we look at examples such as Wizz, Lunit, and Transpara, we see strong support from states such as France and Germany behind each of them.

However, this must also be stated clearly: State support alone is not sufficient to commercialize a product, scale it, and turn it into a global success. Even India's scale is not sufficient for India, and even China's scale is not sufficient for Chinese industry on its own. The real issue is being able to open these products to the world.

The problem here is not only software, but also a channel problem. In other words, the fundamental question is through which mechanisms and through which networks we will present these products to the world.

TÜSEB's Role, Funding Approach, and the Public-Private Relationship

As TÜSEB, we provide grant programs and funds. However, I would especially like to emphasize the following: TÜSEB provides funding not for R&D in the classical sense, but for product development.

At this point, conceptual confusion sometimes occurs. The Ministry of Health does not establish direct partnerships with the private sector, make purchases, or directly share data. These processes are carried out through TÜSEB. The Minister of Health is also the Chair of the TÜSEB Board of Directors and, in this capacity, has the authority to provide policy guidance. The process operates within this framework.

Our goal is very clear: We want strong health data and artificial intelligence companies that can open up to the global market to emerge from Türkiye. I believe that examples such as gamification, clinical decision support, or “insider”-like models can also emerge from Türkiye.

Priority Areas and Ongoing Projects

Of course, I mentioned only a few examples here. We are also carrying out work in the fields of genomics, drug development, and institutional decision support systems. However, the main target set for us by our Presidency is the development of decision support systems in areas that have turned into major public health problems.

We are also actively working on decision support systems for lung diseases. It is, of course, not possible for me to bring all projects here. However, I presented examples from the projects in whose execution I am personally involved.

Currently, 196 projects are being supported within the scope of TÜYZE. Of these, 116 are actively ongoing, and all of them are in the field of artificial intelligence.





REDEFINING THE ROLE OF THE PUBLIC SECTOR IN ARTIFICIAL INTELLIGENCE IN HEALTH

The Public Sector Should Be Effective, but Not Overly Controlling

The speaker stated that in innovative fields such as artificial intelligence, the public sector should not remain completely outside the process, but that assuming an overly controlling role would also slow down development. Attention was drawn to the importance of the public role being effective, guiding, and facilitating, while avoiding an audit approach that limits innovation.

Within this framework, the view was expressed that a hybrid model, in which multiple approaches are addressed together rather than the existing options being considered alone, could be more functional.

A Public Approach Developing Through the Startup Ecosystem

The speaker stated that rather than being a direct producer of products or technologies, it would be more appropriate for the public sector to nurture this field by establishing a startup ecosystem. It was expressed that many young entrepreneurs and innovative ideas are emerging in the fields of health and artificial intelligence; however, under the current structure, it is necessary to tell many of these initiatives that “there is no equivalent in the public sector” or that “there is no place for them in the market.”

It was emphasized that this situation both leads to a loss of motivation in human resources and causes ideas with potential value to be eliminated at an early stage.

Positioning the Regulatory Role of the Public Sector Within the Ecosystem

In the speech, it was stated that the role of the public sector should not be directly obstructive, but should be positioned as regulatory and guiding within the ecosystem. It was noted that when an environment is provided in which startups can develop, test, and scale, public regulations can also be shaped in parallel with this development.

It was expressed that this approach would both pave the way for innovation and enable the public sector to manage risks better.

Comparison of European and U.S. Regulatory Approaches

The speaker, as the executive of a British company, drew attention to the differences between European and U.S. regulatory approaches. It was stated that European-centered regulations such as GDPR, while important in terms of data security, can in practice have an effect that limits creativity and innovation.

It was noted that in the United Kingdom, the business world often has to follow regulations; whereas in the United States, regulations are often shaped later by following the development of business models and the market.

An Ecosystem Proposal Closer to the American Model

Based on this comparison, the speaker stated that for Türkiye, an approach closer to the American model may be more appropriate; in other words, one in which innovation and the startup ecosystem develop first, and regulations follow this development.

It was emphasized that this model could support the faster growth, testing, and acquisition of global competitiveness by initiatives in the field of artificial intelligence in health.





AREAS WHERE ARTIFICIAL INTELLIGENCE IS EXPECTED TO SHOW THE MOST CONCRETE IMPACT IN THE NEXT 5 YEARS

Half of the participants, 50%, stated that artificial intelligence will show its most concrete and measurable impact in the next five years in radiology, pathology, and other imaging fields. This result reveals that artificial intelligence applications are considered the use areas that will reach maturity most rapidly, particularly in terms of reducing workload in diagnostic processes, lowering error rates, and increasing clinical efficiency.

The 22% segment viewing early intervention in chronic disease management as the priority area of impact indicates that the main added value artificial intelligence will provide to the health system in the long term lies in supporting the transition from reactive treatment models to proactive and preventive approaches. This approach shows that data-based early warning systems are gaining importance in the face of population aging and the increasing burden of chronic diseases.

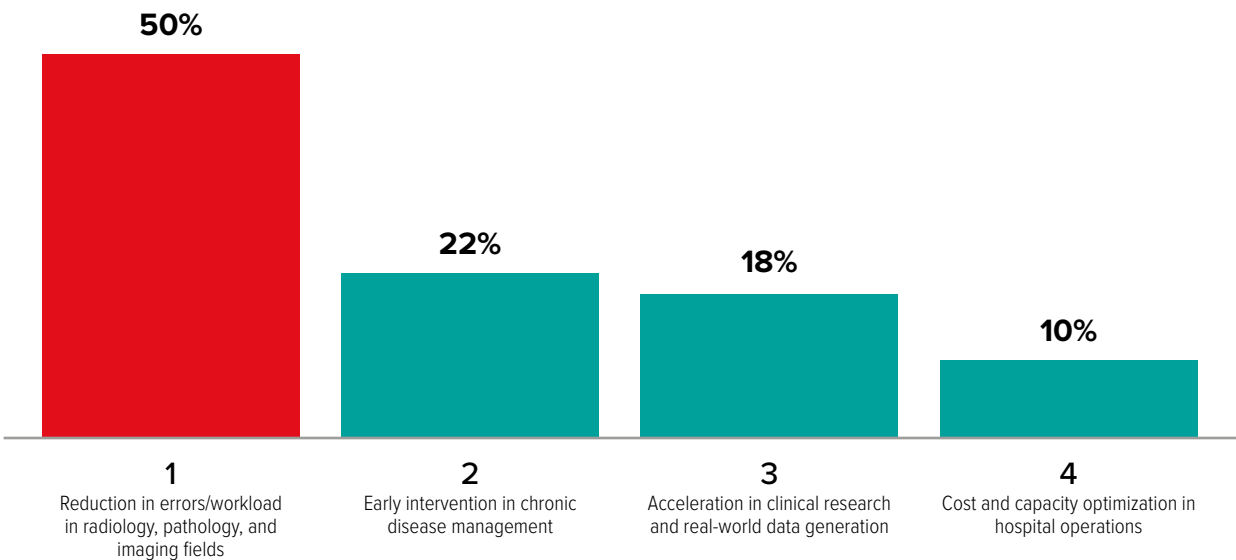
The 18% share highlighting acceleration in clinical research and real-world data generation draws attention to the transformative potential of artificial intelligence in R&D processes. This expectation reflects a projection toward shortening clinical research periods, automating data collection and analysis processes, and obtaining faster and more reliable scientific outputs.

The 10% segment evaluating cost and capacity optimization in hospital operations as the most concrete area of impact shows that the efficiency increase artificial intelligence will provide in administrative and operational processes is seen as a more limited effect compared to clinical applications and one that will emerge in the medium term.

When evaluated within the general framework, participant views reveal that artificial intelligence is expected to produce concrete results in the short term in areas with high data intensity, such as diagnosis and imaging, while its impact is expected to increase in the medium and long term in areas of more systemic transformation, such as chronic disease management and clinical research.

11. What will be the most concrete area of impact of artificial intelligence within 5 years?

- 1. Reduction in errors/workload in radiology, pathology, and imaging fields
- 2. Early intervention in chronic disease management
- 3. Acceleration in clinical research and real-world data generation
- 4. Cost and capacity optimization in hospital operations

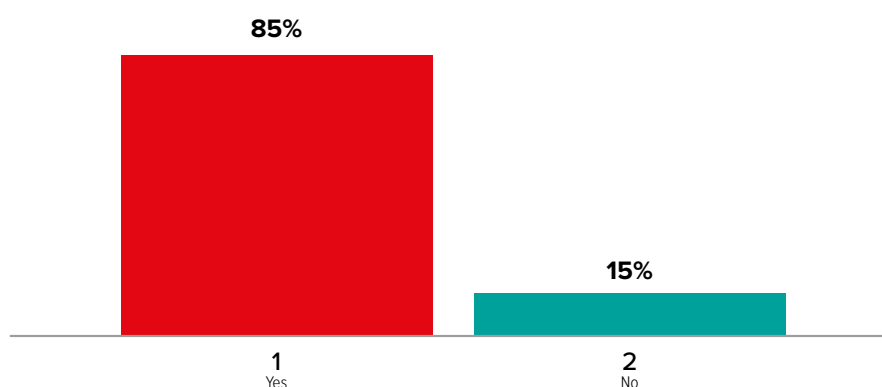


TÜSAP MEETINGS ARE USEFUL AND SUCCESSFUL

The great majority of participants stated that they found the meeting successful. While 85% expressed that this meeting was successful, 15% expressed a different opinion. When the overall benefit of TÜSAP meetings was evaluated, participants stated, at a rate of 91%, that they found these meetings useful.

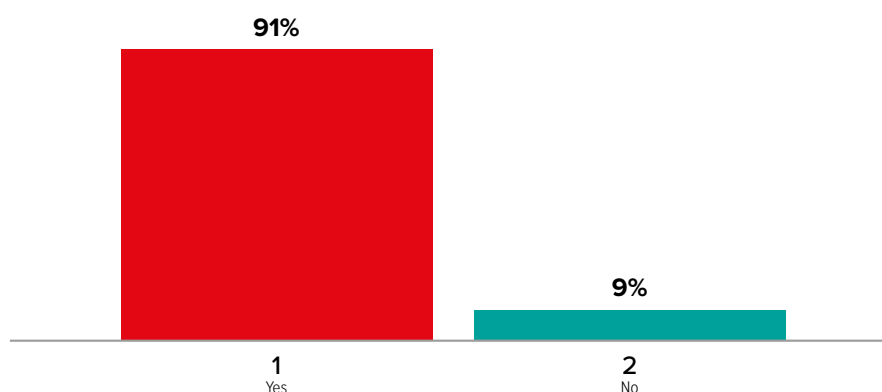
Did you find this meeting successful?

1. Yes
2. No



Do you find TÜSAP meetings useful?

1. Yes
2. No



TÜSAP MEETINGS ARE AN IMPORTANT PLATFORM IN SHAPING HEALTH POLICIES

It was assessed that artificial intelligence will continue to be one of the most critical topics in the field of health in the coming years, as it is today. Within this scope, it was stated that the meeting held was highly useful in terms of the topics addressed and the assessments made.

It was stated that TÜSAP Meetings provide an important and indispensable platform in shaping health policies; and it was emphasized that they contribute to the development of a strategic perspective by bringing together different stakeholders.



FINAL REMARKS

Prof. Dr. Haluk ÖZSARI
Member of the TÜSAP Executive Board

The meeting we held today was the 44th of the vision meetings we have carried out within the scope of TÜSAP. As in every meeting, our main objective here was to produce common wisdom by bringing together multi-stakeholder perspectives. In this meeting, particularly the point reached by data analytics and artificial intelligence in health, the opportunities they carry, and the responsibilities they bring with them were addressed with highly valuable contributions. I believe that the views shared will shed light on both policymaking processes and practices in the upcoming period.

As in all our vision meetings, the outputs of this meeting will also be reported and will form the basis of our work. This meeting was the last vision meeting of the year; following four vision meetings, we hold our summit meeting every year, as usual. This year, I hope that we will come together again at the 9th Summit, which will be the 45th TÜSAP meeting. I sincerely thank all participants who contributed and enriched the meeting with their views.

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PARTICIPANT PROFILE

The 44th TÜSAP Vision Meeting was held under the theme of “**Data Analytics and Artificial Intelligence**,” with the participation of senior executives from all components of the health sector. Of more than 100 invited participants, approximately 32% consisted of representatives of public institutions, 30% of universities, 17% of NGOs and sector associations, and 21% of representatives of private sector organizations.

TÜSAP Vision Meetings are held every year under 4 main headings: “Health Technologies,” “Healthcare Service Delivery,” “Pharmaceuticals and Pharmacy,” and “Health Financing.” Following these meetings, the meeting reports are generally evaluated through the TÜSAP Health Summit, and future projections in health are determined. The meetings are held only with the participation of invitees, and invitations are sent to relevant persons before the meeting. Corporate information about the TÜSAP Vision Meetings and the TÜSAP Summit, which are planned to be held simultaneously 4 times a year, can be accessed at www.tusap.org.

ABOUT TÜSAP

In rapidly changing conditions, sector stakeholders need to act with common wisdom in order to use limited resources efficiently and produce permanent solutions to problems for a sustainable and high-quality healthcare system.

Founded by the leading opinion leaders of the sector who came together with this idea, the TÜSAP Health Platform aims to hold vision discussions based on the current state of the sector and to produce qualified information that will affect the future of the sector.

Ensuring sustainability in healthcare service delivery, the value-based health system, increasing quality, the transition of the domestic medical and pharmaceutical industry to high value-added production, the steadily developing healthcare service delivery in our country, public health practices, and health financing are listed as important agenda items of the events that TÜSAP will regularly organize.

In these events, held under the name TÜSAP Vision Meetings in Health, mid- and senior-level executives from the public sector, civil society, and the private sector have the opportunity to directly share their views on the agenda with other participants. These views are shared with the participants themselves, the media, and the public through special reports prepared after each event.

The work carried out in these meetings, which are held four times a year, is re-evaluated with broader participation at the special event titled “Health Platform Summit” held at the end of each year, and is presented directly to representatives of the sector and other relevant institutions.

For more detailed information and participation in events, you can visit www.tusap.org.

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