E-HEALTH

Redesigning a new healthcare for cure, care and prevention.

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WHAT ARE WE DISCUSSING?

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TRENDS, CHALLENGES AND OPPORTUNITIES

In recent decades, the evolution of medicine has opened up once unthinkable opportunities that now make it possible to respond more and more efficiently to the health requirements of individual citizens and society at large. Scientific development, together with economic and social development, has been so significant that they now cater for "growing needs" as well as "growing expectations" with regard to health.

These health expectations already require **today approaches totally different for healthcare**, which will increasingly have to be built around the specific needs of the individual and go beyond single "response" services downstream of the single event or need, but able to provide the individual with constant and preventive healthcare throughout their life. This new approach that will be spread using different methods, strategies and timing, will have the objective of intersecting the latest and most incisive requirements that challenge the health expectations of the population and the capability of Health Systems to respond.

It is well-known that in most western Countries, the "agenda" of priorities and the relative macro-interventions is basically consistent, as it is guided by the same social, economic, epidemiological and demographic changes. The OECD's report titled *Health at a Glance 2019* shows that the average amount spent on public and private health for these Countries is equivalent to 8.8% of the GDP (in Italy the figure corresponds exactly to this value), with an increase of 10.2% forecast for 2030. The drivers of this continuous and significant increase are manifold and with varying emphases in the different Countries, but among these, the most relevant and common aspects that the Health Systems are faced with include **the progressive ageing of the population and the close connection with the incidence of chronic diseases**. In Europe, these pathologies are responsible for 86% of all deaths, and account for an estimated 700 billion Euros of the annual healthcare expenditure; the estimate of these costs is ever more indicative on a global scale, according to which the management of chronic diseases absorbs as much as 70-80% of the world health resource
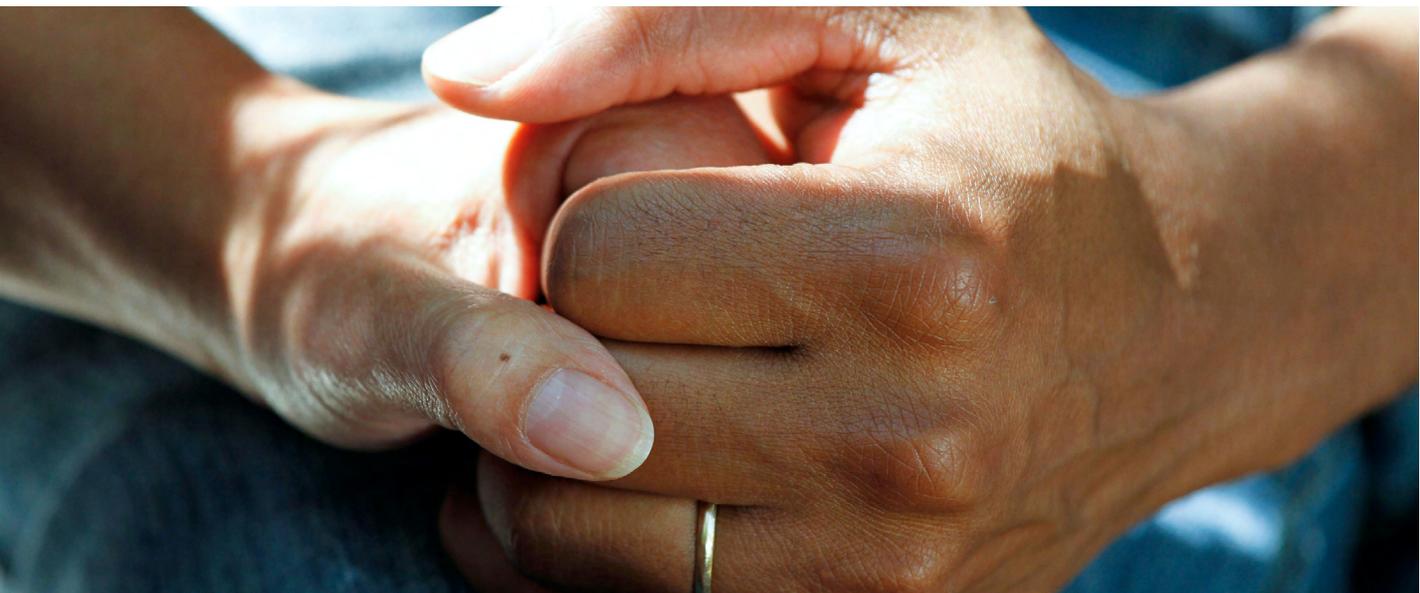
As a result of these commitments and increases in expenditure, **the topic of efficiency in the allocation of resources in multiple forms has become of crucial importance**, on a par with strictly clinical and sanitary aspects. In this sense, the most recent estimate of the OECD, which indicates that around 20% of the amount spent on health makes only a minor contribution to improving or protecting health, or none at all, is also approximate; this figure unquestionably proves the need for a quick and thorough response.

The historic event caused by the Covid-19 pandemic will have long-term impacts on healthcare (and not only), and today these are only partly predictable. What is certain, is the factor regarding changes and acceleration that has inevitably affected all Health Systems. This event amplifies the topics and challenges that are already known, such as those cited above, and brings new or renewed attention to further aspects such as **prevention, planning and organisation, speed and collaboration**.

For this reason, it is now essential in all Countries and at all levels of healthcare, a quick and thorough reconsideration of the strategies, models and instruments of the Health System.

We at Engineering have worked for healthcare for over twenty-five years, dealing with the top decision-makers and supporting individual professionals with the service they offer to patients on a daily basis; this means we are part of the system. We are thus very familiar with these tough challenges, delicate balances and the central role played by Digital Transformation in dealing with them, shaping healthcare towards a future that is already happening.

The role of Digital

Any change made in healthcare, irrespective of the level of organisation or the range of topics involved, will have to sustain models and processes that will increasingly become more information-intensive and real-time. **It will be equally inevitable for these to merge to create true healthcare ecosystems focused on individuals, governed by means of data** (in particular, clinical data), and able to network all the resources (especially professional resources) available to the Health Systems; all of this can only be made possible and sustained using digital technologies.

The strategic and central importance of digital technology is now acknowledged by all clinical professionals and decision-makers in healthcare, as well as health institutions, and the crisis derived from Covid-19, as we explain in the Appendix dedicated to healthcare of our White Paper Engineering The New Normal, has in this sense eliminated any doubt also for non-specialists: **only with the full use of digital technologies is it possible to make rapid and quality decisions for the health of citizens**.

In terms of organisation, one of the most representative examples includes the new models of assistance and care that are redesigning and supplementing the "roles" of the hospitals and the territorial (proximity) services, in which the health outcomes of the individual citizen-patient reflect the resources used by the system, whether they refer to a single operation or an entire series of health assistance treatments (Value Based Healthcare). **These models can only be enabled and sustained using digital technology**, which can provide those involved in the system with a complete catalogue of information regarding the patients (clinical history, treatments they have taken, ongoing therapies, etc.). They also provide advanced healthcare IT tools, in other words true digital assistants that work alongside professionals in the diagnosis and decisions on treatment.

[1] Health Care: Creating Value-Based Competition on Results, Michael E. Porter and Elizabeth Olmsted Teisberg, 2006
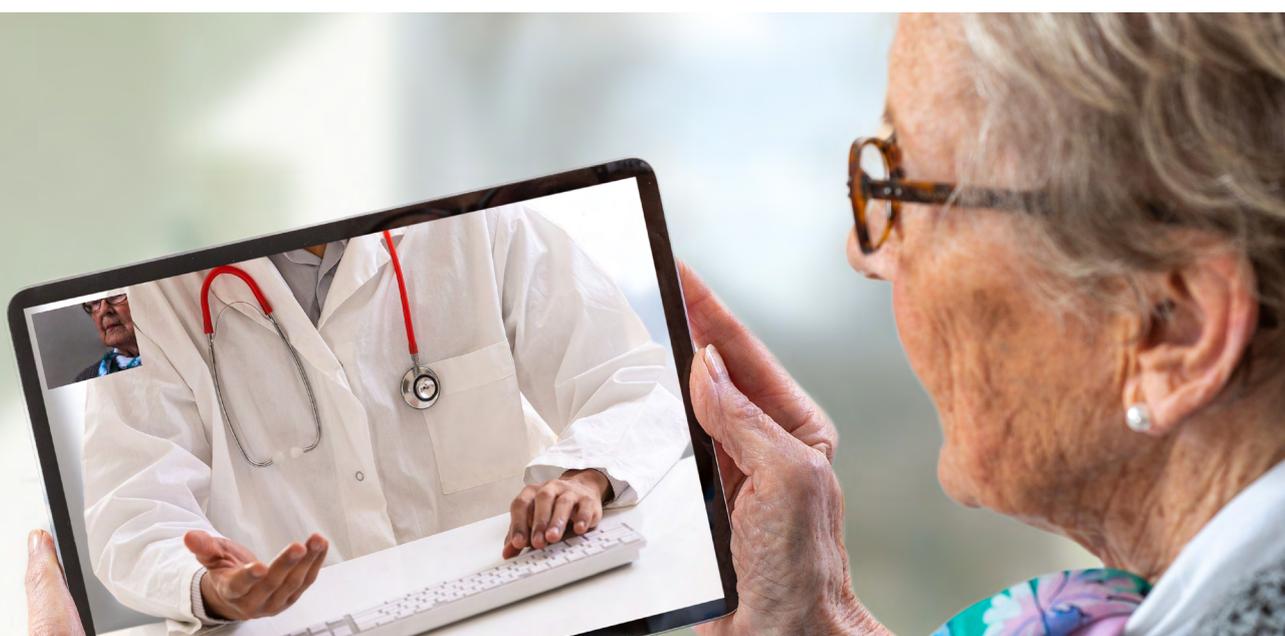
E-HEALTH

A further example from the organisational viewpoint, but not only, regards biosurveillance. Our biosurveillance platform, Eng- De4Bios, is an essential instrument for keeping check of the Covid-19 epidemic, as it maps and geolocalises any infected persons, identifying in advance the presence of clusters that require a high amount of attention; it is thus a virtuous example of how the new digital technologies can develop strategies, models and instruments of cure and care, even in just a few weeks.

The catalogue of enabling technologies and the potential fields of application in healthcare are growing day by day, and we have already been active in these domains for quite some time both in projects and actual applications:

- **AI & Advanced Analytics, Big Data** for clinical decisions, biosurveillance, healthcare governance and research

- **Telehealth** for remote assistance and health treatments

- **Internet of Things** for the acquisition of the clinical data of the patients and behavioural data at social level

- **Cybersecurity** and **Privacy Management** for the protection and also the use of personal data

- **Digital Collaboration** for teamwork between professionals and specialisations

- **Mobile Health** for the inclusion of patients and caregivers in prevention, assistance and cure

- **Risk Management Tools** for reducing clinical and biological risks

- **Real-Time Analytics** for measuring clinical outcomes, resources used, etc.

In this White Paper, we explain how we are assisting health organisations in the process of Digital Transformation, to ensure that the potential of these (and future) technologies can evolve E-Health to the next level, promoting more and more the competence of health professionals and staying increasingly close to the needs of citizens.
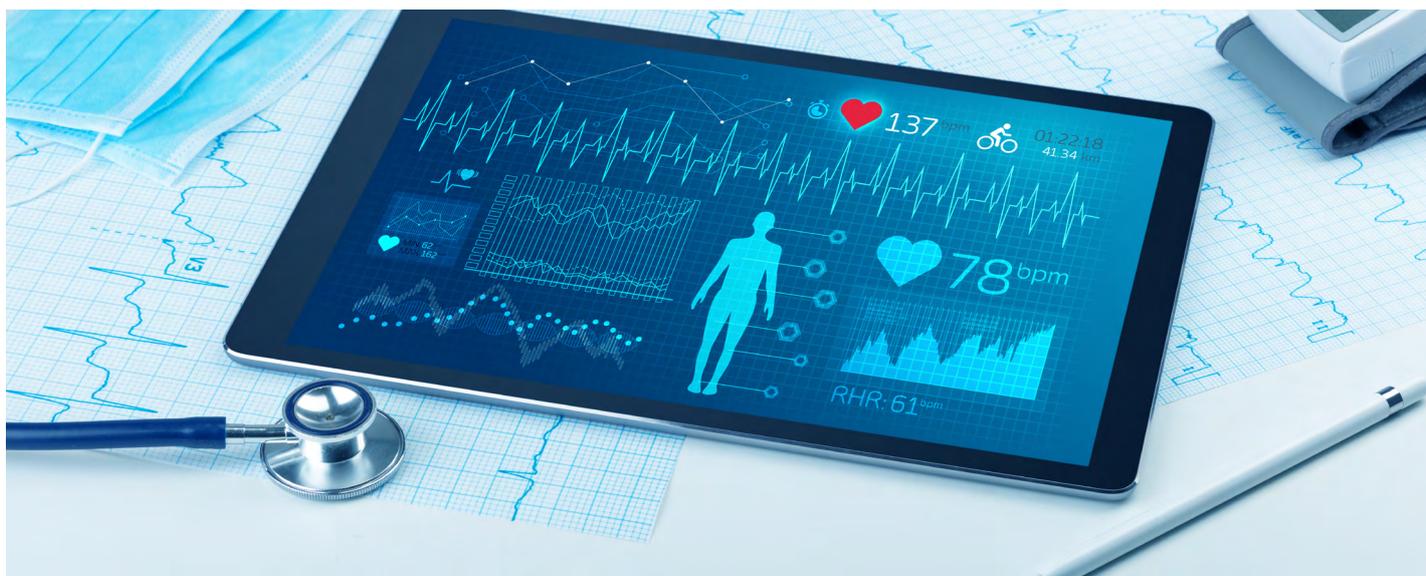
2

ALLERGOLOGY
STOMATOLOGY
PATHOLOGY
OPHTHALMOLOGY

ENGINEERING IN E-HEALTH

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Digital Transformation in healthcare is not a choice for future challenges, but a requirement of today. The digitalisation of the Health System must be total and specialistic, able to merge with other digital ecosystems that embrace the life of citizens and thus synergically expand the value of the reciprocal data. This data, directly inserted in the processes, will guide actions and strategies that are increasingly geared towards "taking care" rather than treating.

Dario Buttitta
Public Administration & Healthcare General Department, Engineering

E-HEALTH

Competence, strong territorial presence, ability to innovate. It is by relying on these three pillars that Engineering has succeeded, in the past twenty-five years, in becoming a reliable and essential point of reference in E-Health. Our expert knowledge of the organisational contexts, clinical and management processes, and the technologies used enable us to assist all organisational levels of the Health System, from national and regional bodies to the single local healthcare structures. This assures our presence – but above all responsibility – along the entire supply chain of the Health System, from prevention to cure, from access to the services to constant assistance and liaison, increasingly focusing on the management of resources and enhancing the use of available data.

This role and this presence have strengthened our awareness that today Digital Transformation is no longer an option but the only road possible to respond to the challenges posed by health, not in the future but in the present. We are an essential part of this transformation, which is a true paradigm shift with respect to the role of digital technologies, and must take us towards **an ecosystem that always focuses realistically on patients and their right to health**. For this reason, we believe that introducing digital culture into Italian Healthcare, which is increasingly open to technological innovation and opportunities, means accompanying it along a path of co-design in the broadest sense of the word. Along this path, the solutions reached are not the result of experiments and developments of our team confined to their "closed" laboratory, but of collaboration and active sharing with the our stakeholder and the citizens-patients, whose needs and objectives we are familiar with and often anticipate.

In recent years, our ability to interpret current trends and to go one step further than the market developments has led us to bring about a radical change of perspective in Italian Healthcare: overcoming the technological lock-in and an offering that is strongly focused on the product, allowing the digital technologies to be transformed into a commodity to offer services that are already – and must increasingly be – based on the ability to manage and take advantage of data to make quality decisions, above all with a real-time approach. This data is not only (or not at all) administrative, but above all clinical. The same approach is followed by ellipse, our new ecosystem platform, specialised in the field of clinical assistance and all areas of care, and is innately focused on this phase of transition towards increasingly advanced technologies: the potential of AI & Advanced Analytics and the algorithms of Machine Learning, the possibility of acquiring and exchanging data thanks to the Internet of Things, an increasingly real-time Data Analysis capacity and a cloud-native structure.

Through the capacity to manage information, which is developed by leveraging the know-how of the entire company matured in decades of projects and research on data of all types and origins, we provide support, for example, to the Regional authorities in their health planning and activities, by linking clinical data with administrative and local data, or any that relates to any other field in the life of citizens. Our capability to manage data thus opens up opportunities in areas of the healthcare market that are new for us, such as other countries or private providers. As the services offered by the company are more and more geared to data management, we are able to overcome with increasing ease specific organisational and legislative difficulties that characterise these markets in different ways, allowing us to be partners with a wealth of domain-specific know-how and innovative technologies.

Therefore, extracting value from information and data is the factor that enables us **to meet the "intensity of data" required by the new models and instruments of cure and care**, and to ensure that in each area, all those involved in the Health System have easy access to all the information that is useful for "taking care" of patients, in addition to treating them. Systems where patients have an increasingly active role as well as central (Patient Empowerment).

In our vision, digital technology in E-Health must be total and specialised. It is only through "total digitalisation", i.e. across all areas and processes of healthcare, that is possible to activate and free the true potential of digitalisation in healthcare, without any data loopholes or "compulsory paperwork". Only through highly specialised digital solutions for each single area of treatment and organisational model is it possible to improve the quality of treatments, actively supporting the decisions and activities of the clinics.

Our ability to innovate, also based on the experience gained from dozens of national and international E-Health research projects, our specialist expertise and all the technological assets of the Group, make us an ideal partner **for redesigning healthcare in the present and the future** – with the essential ethical sense and responsibility necessary in this field; this means improving the treatment given to patients, the quality of the work of professionals, and the overall sustainability of the Health Systems.

3

RESEARCH

Redesigning a new healthcare for cure, care and prevention.
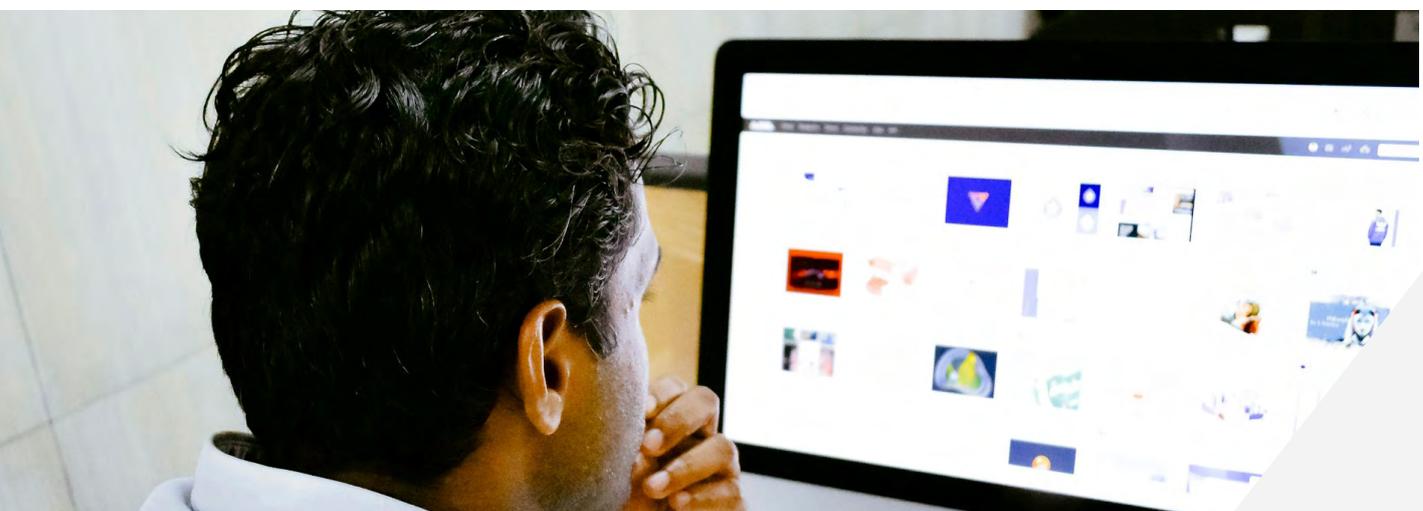
With the same impetus needed by E-Health to tackle the new challenges in healthcare, research must explore, equally intensely, the opportunities offered by the most advanced information technologies. In this way they can be inserted in the virtuous mechanism that transforms them into "instruments" for professionals and citizens through the "industrialisation" process.

In this context, **European and national research today continues to explore and expand the possibilities in multiple fields**, including:

- telemedicine applications

- a greater exploitation of the genomic data and real world data in daily clinical practice

- the widespread application of Artificial Intelligence in prevention, diagnosis, treatment and in healthcare governance

- the creation of smart hospitals

- the use of 5G networks to amplify the possibilities of remote surgery

- the conception of new organisational models and healthcare processes

- the design of security systems aimed at guaranteeing the respect of privacy and the growing level of control on personal data on the part of citizens.

Engineering has been committed for some time to research activities in the above fields, in particularly for the prevention and management of chronic diseases (diabetes and solid tumours), through the monitoring and remote coaching of patients, new data models based on the future standard HL7 FHIR, which supplement clinical and genomic data and data provided by sensors, including data relating to everyday events, so that they can be used in clinical practice for the purpose of medical research and health policies.

We currently have 50 researchers involved in over 10 international and national research projects. Among these, in relation to the particular characteristics of overall innovation, we can list the following fields:

- **Home Care and Telehealth:** for some time we have been involved in projects that exploit the increasing potential of sensors, actuators and wearable devices, allowing chronically ill patients to carry out rehabilitation activities in the comfort of their own home, which were previously only possible in hospital, with continuous remote monitoring on the part of healthcare personnel. Projects: AMICO, ReHome, 4Frailty, KIWAME, GATEKEEPER, etc.

- **Pathway and Care Continuity:** the InteropEHRate project aims to actively involve the citizen in the exchange of data between healthcare workers of different nations in order to guarantee the best treatments to patients who are being treated in Countries other than their homeland. The project defines new open protocols that will allow the citizen to safely collect, by means of a smartphone, their own clinical data produced by a European healthcare worker, to provide them to other European workers (even without using internet or cloud systems), translated into the language of the recipient, guaranteeing the authenticity and origin of the information.

- **Clinical Decision Support Systems:** the EMORFORAD system aims to create advanced diagnostic instruments to be used for new protocols of personalised medicine, based on the medicine system and on radiomics, in order to speed up the diagnosis of specific forms of tumour, their monitoring, individual prognosis, the expected response to traditional therapies etc. In this same field, the SATIN project has the objective of creating a platform for the storage and sharing of images that are useful for medical/genetic research in oncology by means of voice recognition, image analysis and image tagging techniques.

- **Holistic Healthcare Dossier and Holistic Folder (clinical-omic):** in the research projects CMP3VdA and SHE, the genomic data of patients affected by various types of pathologies (cancer, neurodegenerative and rare diseases). The holistic healthcare dossier will be a 'data as a service' platform, which enables the creation of an innovative database, which will be filled with: clinical data and medical history in the Regional Electronic Healthcare Dossier; data from the clinical files and data relating to the genomics produced by CMP3vda. Furthermore, by means of IoT and mobile application, it will be possible to enrich this platform also with increasingly relevant contextual information in order to understand the dynamics of certain pathologies (Real World Data). The clinical-omic folder will include advanced info-analytics functions for a greater support to the diagnosis process, identification of the therapy and therapy management, with the objective of providing medicine that is more and more accurate.

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THE PORTFOLIO OF ENGINEERING E-HEALTH

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Our offering is the constantly evolving result of a highly productive workshop, which yesterday allowed us to be the first to design a H-ERP for the Health System and has today allowed us to create a cutting-edge clinical suite, specialised in the Digital Transformation of every field of Care.

Our strong passion, our constant watch over the latest trends in the healthcare, and the expertise of our professionals, mould solutions that progressively push E-Health towards the future where – true to our own style – we will draw closer to other frontiers and make them real."

Antonio Delli Gatti
Director Healthcare, Engineering

For the E-Health sector, for over twenty-five years we have been providing application solutions, running projects and providing services for all organisational levels of the health system: from national and regional governance bodies to single local health structures. The services offered by the Group focus on the technological, methodological and domain expertise of over 900 professionals who are dedicated exclusively to E-Health. **A network of healthcare professionals distributed among the software development centres and the individual customers**, including over 400 developers and technology specialists, over 450 functional experts in the multiple health fields and project managers, supported by dozens of organisational consultants and researchers, for the improvement and innovation of healthcare. These professionals constantly update and certify their expertise (e.g. PMP, Prince, ITIL with regard to project management), and in certain fields they reach levels that allow them to become "observers", who are able to intercept ongoing developments in the sector (e.g. national and international legislation) and to insert them in advance in solutions and projects. Very often, this domain know-how is also provided directly by customers through educational and training activities that go beyond the purely technical aspects.

Every day, these professionals transform and innovate the processes of **over 150 customers. Local, Regional and Provincial health authorities, Hospitals and University Polyclinics, Research Institutes, and most of the Regional authorities in Italy**. For these organisations, we have been reference partners for many years, firstly due to the acknowledged closeness to them in all project phases, and to our sound expertise in the field of the multiple and complex healthcare processes.

366
Software Analysts & Developers

389
Domain & Solution Specialists

25
Technology Specialists

50
Researchers

10
Business & Innovation Developers

30
Process Consultants

88
Project Managers

22
Account Managers

980
Total

The "digital demand" that characterises this market is very much focused on the request of "products", in other words pre-defined application solutions that then have to be vertically integrated into individual specificities. The Group responds to this approach with dozens of innovative and specialised solutions that belong to two proprietary application platforms, which over the years have marked a technological turnaround for the entire sector: AREAS and ellipse. For over ten years, AREAS has been the benchmark application for the market, which has recorded a need for widespread integrated digitalisation of all healthcare processes, from clinical-diagnostics to administrative and accounting. The recent platform, ellipse, takes E-Health solution to the next level, current and specialistic focused on the clinical aspects.

The applications of these platforms, in the different technologies and functions that distinguish them, are similar, among other things, for the fact that they meet the international standards of the sector with numerous certifications relating to the most common production and management processes (e.g. ISO 9000, ISO 2700, CMMI L3), as well as those specific to the healthcare domain, such as the CE certifications for software that can be classified as a medical device, the GAMP with regard to diagnostics, or the IHE profiles for the interoperability of the E-Health applications.

AREAS

Is the platform that we developed specifically to meet the needs of healthcare, exploiting our long and transversal experience in this sector alongside the finest technologies. In over 10 years, AREAS changed electronic healthcare in Italy, allowing hospitals, local and regional health authorities to digitalise and supplement all the areas: governance, access, diagnosis, hospitals, local health authorities, human resources, administration and control. AREAS, based on its history, its 150 customers and over 100,000 users, represents the reliability and constant developments that we put into our solutions.

ellipse

Is our new ecosystem of applications devised specifically for clinical and welfare activities, activities in hospitals and health authorities, and for the relative activities involving the patients. ellipse fully digitalises the Health System as it allows:

- **health organisations** to activate and sustain the new models of assistance and cure, and those of dealing with patients

- **healthcare professionals** – in particular clinics – to have advanced IT solutions that support them actively and in real time in their everyday diagnosis and treatment activities

- **patients** to be included and to take part in the management of their own health: in the information, decisions and therapies

- **health systems** to implement practices and instruments for assistance that is always based on value (Value Based Healthcare).

Many of these applications also form the core of numerous E-Health projects at regional level, serving millions of citizens, for which Engineering is a partner not only for technological aspects. The most relevant projects are those relating to the infrastructure, as in the case of the centralised registers or electronic health record (EHR), those for the access to the services, as in the case of emergency medical services (EMS) and for booking services, or clinical and care services such as Telehealth or the diagnostic and prevention networks; it also includes projects that fully embrace and supplement all areas of healthcare and administration of an entire region.

In particular, **these projects see an increasing focus on people, in terms of citizens' rights to services, and on the right of patients to be actively involved in their treatments**, and the involvement of health workers in the design of solutions, objectives that we succeed in reaching also thanks to our expertise and projects in the field of Smart Government. Our contribution to the healthcare sector in its entirety also involves our presence in the pharmaceutical sector, for which we implement the paradigms of Industry 4.0 along the entire development, production and distribution chain. Last, but not least, there is Cybersecurity, which in this sector sees a growing number of attacks and threats, to which we respond on behalf of some of our healthcare customers, gathering the expertise of the company in the group dedicated to this field, Cybertech, with the vertical competences in the healthcare sector.

150+
healthcare facilities and providers

1.000
product installations

100.000
users

55
million bookings for services managed

1,8
million emergency requests managed

6
million hospital access managed

57
million laboratory tests supported

3,5
million paychecks processed

40
billion euros of accounting managed

The specific portfolio of services offered by the Group is characterised by the fact that it covers all the phases and fields of hospital and local processes with regard to their clinical, administrative and governance aspects. The competence of Engineering supports and promotes the Digital Transformation of scheduled or emergency access to healthcare services, of the multiple fields of diagnosis and cure, and of all care and prevention activities. The governance, support and transversal orchestration of these macro-fields have become increasingly relevant over the years and are also a key part of our E-Health offering: a governance that ranges from the more recent "instruments and paradigms" of health service management to the new vertically integrated technologies in the health sector, including the economic and financial field, logistics and HR, essential for sustaining the "core" processes of healthcare. A vast range of complete and ancillary services in which the governance and exploitation of of data plays an increasingly central role, for operational and especially decision-making processes.

PORTFOLIO MAP

E-Health

CLINICAL & PERSONAL DATA MANAGEMENT

Access
- Booking Management
- Medical Emergency Services Management
- Patient Administration

Diagnosis
- Laboratory Management
- Pathological Anathomy Management
- Blood Management

Cure
- Clinical & Surgical Management
- Nursing Management
- Drugs Management

Care
- Prevention & Chronic Care Management
- Home Care Management
- District Services Management

- Accounting Management
- Logistic Management
- Human Resources Management

Innovation & Governance
- Population Health Management
- Pathway & Care Continuity Management
- Telehealth Management
- Patient Relationship & Digital Services Management
- Clinical Decision Support Management
- Big Data Management
- Risk Management
- Privacy Management

ECOSYSTEM PLATFORM

- Technology & Cloud Services
- Business & User Services
- IT Consulting
- Mobile Applications
- UX & Service Design
- Digital Communication & Strategy

iIES
- AI & Advanced Analytics
- Cloud
- Cybersecurity
- IOT
- Robotic Process Automation
- AR-MR-VR
- Blockchain
- Digital Twin

Access

There are set access paths within the Healthcare services, for emergencies and otherwise. These have undergone major changes in recent years due to the shift in citizen relationship paradigms as well as to the local governments' strategy when it comes to to the range of services offered.

The centrality of the citizen and patient in the access phase must result in a range of services in favour of the citizen and not vice-versa, and must be offered before the citizen requests them. This access, therefore, is more and more pro-active, personalised and simplified, guided by the wealth of information generated by the clinical history of the patient, of the paths of assistance and treatment in which he/she may be involved, by the resources present in the territory (service networks, structures, specialisations, etc.), and not lastly by his/her preferences and individual characteristics, such as age or the level "of trust" with the various communication channels.

The modes of access must thus take on more and more importance to ensure the quality of the care and the experience of the citizen on the whole, from the "triggering" of the appropriate path to the ongoing rapport, which must go well **beyond the traditional interpretation of a merely operational and administrative nature of the management of requests**. This regards not only the planned accesses by or trought appointment booking system, but also for emergency-urgency accesses by dialling the emergency numbers, which must be increasingly equipped with integrated digital instruments that can immediately direct the call to the most suitable structure according to the area of specialisation (e.g. stroke unit or poison centre), and availability of assistance, without wasting vital time in communications and "analogic" activities.

Our Offering

With regard to the management of scheduled or emergency accesses, Engineering with over twenty years' experience can boast volumes and complexity of projects like few other players: **55 million bookings for services, 6 million hospital scheduled accesses, 1.8 emergency intervention request, 3 regional emergency networks (for the regions of Emilia-Romagna, Campania and the Marches) and 17 operational centres.** This is a role we have always interpreted with the responsibility of someone who is called to guarantee a key citizen's right: that of access to treatment and health.

Particularly in recent years we have developed our services in alignment with the above mentioned paths of innovation. Today, through AREAS, we offer standard booking procedures via multichannel services (call centres, portals, Apps) or from several locations in the territory (e.g. family GP or chemists), which allow the citizen to choose the most suitable combination within the local offering (structure, day, time, etc.); these booking services are specially designed to guarantee the best overall experience for the user. With view to simplifying access, we are also exploring and introducing innovative technologies such as chatbot to help users, as well as an Augmented Reality system to guide the citizen through any "physical" paths within the healthcare structures. Above all, however, in more strategic terms, in our solutions for booking management (and not only), we are introducing logics and components of **Patient Relationship Management (PRM)** to provide ongoing, integrated and pro-active assistance with the access processes of each single patient; as those for optimising "network" resources more and more, especially on the delicate question of waiting times.

With regard to the emergency medical services, our competence and **AREAS EMS** solution are totally reliable: we were among the first to support the new multi-central models, to introduce the GIS and SAT-NAV systems, to supplement the different fixed and mobile communication technologies, to use Business Intelligence for the governance and analysis of the service. We were also among the first to assist voluntary organisations with an App that makes it possible to identify the first responder and the nearest automated external defibrillator (AED) in the case of a call for cardiac arrest.

Also during the Covid-19 emergency, our solutions have proven their reliability by "withstanding" the huge increase in the requests for assistance. With the objective of developing this service, we are fitting out ambulances with mobile devices (e.g. tablets and glasses for Augmented Reality), to allow the workers on the vehicle to interact with specialists remotely (e.g. neurologists), or creating quick and precious remote Telediagnoses and Teleconsultations.

We are furthermore developing all the other application components that complete and supplement the hospital access processes, supplementing the administrative and logistic management of the Patient Journey with the clinical workflow and with the administrative and accounting systems. Also in this case, the intervention aims to improve the experience of the user-operator, by means of systems that make the interaction with the applications "easy", allowing him/her to concentrate on the activities with greater added value. With regard to a Data Governance that is closer to this field, we have created a new transversal module for the management of all the flows of information that simplies and unifies all operations for extracting data and the consequent reporting to the requesting bodies.
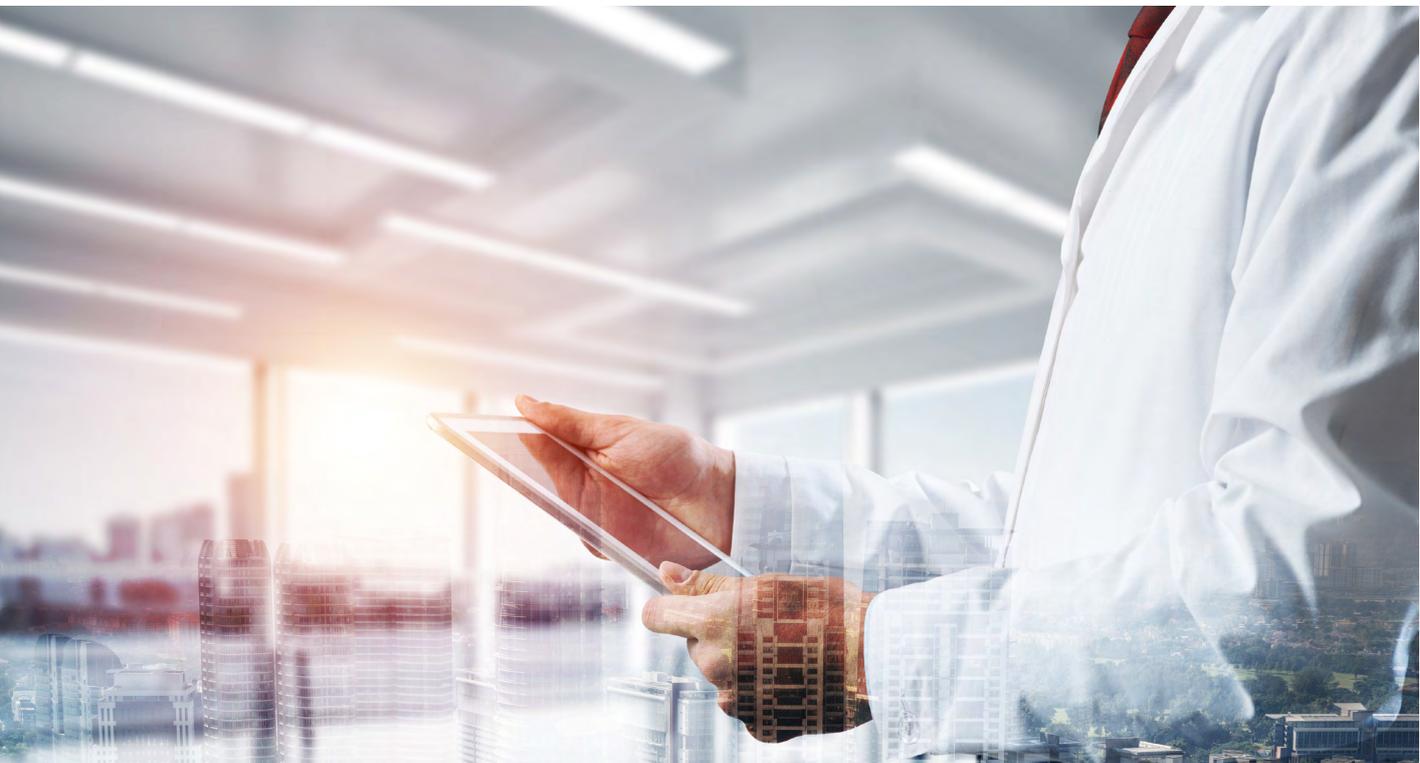
Diagnosis

The continuous and growing request for evidence in the diagnosis and treatment processes is making the activity of diagnosis more and more important. It is estimated, in fact, that around 70% of medical diagnoses depends on laboratory tests. This responsibility has led to deep changes, in this specific sector, which are linked only to the opportunities offered by the continuous scientific progresses, but also to the organisational and operational models used.

In addition to the **prime objective to guarantee maximum reliability of the diagnostic result, the protection of the patient** (both clinically and in terms of personal data), and also the activity carried out by medical and technical personnel has acquired more and more importance; this is all within an increasingly wider and stricter guarantee of quality in line with legislation and practices at international level. Parallel to this, the need to optimise the precious resources (professional and instrumental) and the relevant overall costs in this sector has grown, as instrumental diagnostic and laboratory tests are among the most costly items in healthcare expense. The automation of operational processes, the adoption of new logics for identifying the most appropriate tests (known as diagnostic appropriateness), the introduction of new organisational models, either as a network or based on centralised laboratories, are the aspects on which we have concentrated to reach greater and uniform levels of quality, security in processing and economic efficiency deriving from the massive volumes managed.

Our Offering

Engineering has an in-depth knowledge of the blood transfusion centres, the analysis and pathological anatomy laboratories, a commitment that leads to the management of **over 57 million tests per year**. In recent years, the entire offering for this segment AREAS Diagnostics has been structurally and organically renewed, primarily with the introduction of the specific compliance for the new organisational models, new pro-active instruments and the relative user experience at the disposal of professionals. On a par with this, all the instruments and functions have been introduced for the widespread automation and punctual monitoring throughout all phases in the processing of samples, from reception to reporting, achieved with the integration with the other software systems and with sample management instruments that are increasingly automated and complex: pre-analytical chains, scales and separators, apheresis separators, automated cabinets, etc. All these innovations have proved to be indispensable during the Covid-19 emergency, enabling our customers to sustain and quickly re-organise the massive volume of tests required, on which they could also insert the most advanced analytics components by means of a specific "Covid-19 dashboard", used to monitor the test results and the laboratory activities (volumes, times, etc.).

Safety has always been a fundamental element of all the diagnostic systems of Engineering, and is fully implemented in particular with regard to transfusion medicine. The legislation in this field imposes very strict rules and structures are applying more and more often for accreditation and certification (GAMPS, JACIE, FACT) In this context, Engineering offers specific advisory services for obtaining the Gamp certification, drawing from its expertise matured in the pharmaceutical sector in which it has been present for decades.

The Group's competence in the field of diagnostics now benefits dozens of structures and numerous projects at local level, some of which are centres of excellence of national importance. With regard to analysis laboratories, Engineering's long-standing collaboration with the AUSL (local health authority) of Modena has been one of the fundamental elements that allows the Baggiovara's Central Lab to carry out over 10 million analyses every year, to bring together dozens of blood sampling centres and analysis centres throughout the territory, to send medical reports to doctors and citizens in real time, and to apply Advanced Analytics instruments to the enormous quantity of data available.

The network of blood transfusion services of the Region of Campania and that of the Metropolitan City of Turin, both of which are assisted by the expertise of Engineering, are characterised by high volumes: the first has over 20 blood transfusion centres while the second processes around 500,000 blood components every year. Finally, the network of **Pathological Anatomy of the Region of Tuscany** is a project that increases the standardisation and security of the process (traceability, identification and transport of the samples, etc.) with an immediate effect on the quality and speed of the diagnostic services.

Cure

Medical treatment is probably the field that offers the greatest potential and carries the greatest expectations when it comes to digital technologies: the power of data in identifying a pathology, in the choice of therapy and the guiding of operations on the patient, up to recovery.
These opportunities are already available with the present technologies but with certain "conditions regarding the method", deriving from the growing intensity and specific nature of treatments:

- **digitalisation must focus on the patient** and be able to "read" his/her problems and needs transversely, forecasting the most likely specifications and personal developments

- **digitalisation must be total**, in other words complete and transversal throughout all phases of treatment and competence involved, without any "analog backups" that generate loopholes in information that invalidate the completeness of the clinical picture

- **the data must be central**, not an auxiliary data but the fulcrum around which the decision-making processes and activities on the patient are guided.

In the Cure processes, digital technologies must thus rapresent an ecosystem of instruments that are used proactively alongside the competence of health professionals in the acquisition and presentation of the information "in exactly the right way and moment", guiding decisions by applying scientific knowledge "on the individual characteristics of the patient at that specific moment", in supporting active collaboration in the healthcare team that is increasingly multidisciplinary and specialised.

Our Offering

Engineering has identified these topics as fundamental values of the development of its offering for healthcare, in particular in treatment processes as these represent E-Health at its maximum potential to the maximum extent. This is a commitment that we have effectively achieved with our new platform, ellipse.

Focusing on clinical and surgical activities, the first solutions of ellipse we released – because hospitals are and must increasingly be a place for intense treatment – were those for Intensive Care and First Aid. In **our approach, Electronic Medical Records (EMR) are a "dynamic and intelligent" instrument**, which is vertically integrated based on the intensity of the treatment and geared towards the problems of the patient, and is used constantly and proactively alongside the work of the clinicians. It is dynamic as it is fed in real time with vital parameters (captured by the medical devices through our component MDI), with all other evidence (objective examination, laboratory tests, etc.) and any transversal treatments. It is an intelligent instrument as it forms a solid base of information in which to insert knowledge (e.g. protocols, guidelines, databases on drugs, etc.) through different systems of Artificial Intelligence, first and foremost Machine Learning. In this way, **the clinician has a real "digital assistant" actively belonging to a healthcare team**: it advises on examinations, proposes the diagnosis and possible treatments depending on the specific aspects of each person, constantly monitors the conditions, sending alerts or forecasting possible critical routes, and plans the operational management of the activities on the ward. In this way, we make it effectively possible for the data to improve the cure.

With ellipse, we take even the activities of nurses to a more advanced level from an operational and organisational viewpoint. The functions that we have introduced in this field allow the activities to be geared to the individual needs of the patient, defined by the multiple models of care implemented and which can be personalised within our Nursing Record. In line with the philosophy of the Clinical Record, this records system has also been re-designed to allow the operators to focus on the nursing records, also by means of special dashboards that focus on and monitor the activities carried out on the patient (therapies, procedures, etc.).

In the processes relating to drugs management, we have united our various competences involved in this field: logistics, automation, expenditure control and above all the management of clinical risk. An overall view of the entire pharmaceutical supply chain, from the request of supplies to traceability of drug administration that we make efficient and safe by implementing the specific workflows and relative control logics, databases and best practices, systems for the secure identification of the drug and patient (e.g. RFID) or for its distribution (e.g. trolleys and robotised drug cabinets).

With AREAS we have introduced and made popular the digitalisation of cure processes, providing support to dozens of healthcare structures (and even entire Regions) among the most important in Italy, including: **The Sant' Andrea and San Giovanni Addolorata hospitals of Rome, the AUSL of Bologna, the Region of Sardinia**. Today, the new platform ellipse has inherited this experience, transforming the cure processes with the "new" digital technology, and already assists professionals at the healthcare centre ULSS 6 Euganea, Orthopaedic Institute Rizzoli and the Central Area of Emilia-Romagna.

**ellipse for the digital transformation of the ICU
at the Sant'Andrea hospital of Roma**

The University Hospital Sant' Andrea of Rome is one of the most important healthcare structures in Italy in terms of the volume of services provided and the level of specialisation, territorial and scientific importance. For over ten years, Engineering has supported this hospital in its digitalisation process of all areas, from the clinical area to healthcare management, from administrative and accounting to its HR management. This led to a further development in 2020: the introduction of ICU-Medical Record, the specific component for the high intensity of treatments dealt with by the platform ellipse. ICU-Medical Record will assist health professionals in their activities of diagnosis, programming and execution of the therapies. Thanks to the direct interconnection with the medical devices fitted to the hospital beds and the other sources of information, the system processes in real time all the data required, suggesting the most appropriate information for treatment and giving off an alarm immediately in the event of ongoing or possible critical events. The project is one of the first experiences in Italy involving the introduction of cutting edge digital instruments, real "digital assistants" working alongside doctors and nurses in the most difficult areas of treatment for the health of patients.

Care

For several years already, chronic diseases have already been the major influence on the organisation of healthcare services, and in particular on local healthcare assistance. It will also continue to have an effect due to epidemiological trends. Frequently, especially in the elderly population, the presence of a chronic disease is not the only condition that chracterises the clinical picture: a combination of conditions, lack of self-sufficiency, fragility and needs that involve also the social sphere, are just some of the possible additional factors that affect the health and the quality of life of this increasingly wide sector of the population.

In a similar context, **the treatment does not require singles interventions, but a series of health and prevention actions that are planned and long-term**, aimed and maintaining the person's health condition stable, and avoiding any worsening that could lead to excessive use of the hospital structures (e.g. repeated stays in hospital, accesses to the A&E unit).

Furthermore, in addition to pursuing a health "objective", such interventions become necessary to optimise the resources available to the health organisations, which have been strongly diminished in recent years. This means that the hospital is not the appropriate place for health interventions: these are not, in fact, aimed at patients with acute needs but to patients who neede to be treated over time.

For these reasons, **the health organisations have adopted new organisational models** to take care of such patients (with chronic diseases, fragile, etc.), characterised by common features and aimed primarily at privileging local assistance, favouring the continuity and supplementation of treatments with the hospital and with the other healthcare and social-welfare services typically involved, adopting a multidisciplinary approach to the cure and define a personalised care pathway for the patient. All this is necessary to ensure that the patient and his/her needs are effectively placed in the "centre" of the network of care services.

Our Offering

Engineering innovates and amplifies its offering through specific application solutions that fully meet the principles underlying the organisational models of modern local healthcare assistance. To implement such principles, the digitalisation we promote is aimed at:

- **the colleciton of information relating to the patient** and sharing this with all players in the healthcare services involved (local health authorities, hospitals and social services), to ensure that they can have an organic vision of the conditions of the patient and of the assistance and treatment activities provided to the patient, with the purpose of intervening in the most "appropriate", "coordinated" and "timely" manner.

- **the management of the personalised care pathways**, allowing the definition and monitoring on the part of all the professionals involved in the treatment of the patient. This pathway must be coherent with the indications of the medical and scientific guidelines and best practices that are implemented within the specific integrated patways (diagnosis-treatment-care). The digitalisation of these thus increases their value even further. Engineering has approached the digitalisation of the personalised pathways with the aim of increasing their value, by developing a specialised solution of Digital Patways in line with the platform ellipse.

- **enabling forms of Home Care**, providing solutions dedicated to the acquisition of vital parameters collected by means of medical devices (MDI) and processing these to be able to feed appropriate information into the healthcare organisation's IT system, supporting the decisions of professionals who have the task of "monitoring" them remotely (Teleassistance and Telemonitoring)

- **creating solutions that support the inclusion of the patient** and his/her caregiver in the care patways. In particular, through these solutions (e.g. Apps), the patient can be informed and warned about the planned activities in his/her patway (e.g. scheduled check-ups, medical examinations, drugs to take) and interact with it – in such a way that he/she takes a truly central role – and directly provides information that is useful to the healthcare professionals to evaluate the progress of the treatment over time (e.g. the value of vital parameters).

These new objectives for the digitalisation of local healthcare services correspond perfectly to the services that Engineering has traditionally dedicated to this field, with particular reference to the individual services offered: Home Assistance, Single Access Point, Residential Care, Prosthetic and Rehabilitation Assistance, General Practitioners and Paediatrics, Metal Health and Addictions, Environmental and Workplace Controls, etc.

In this field, our application solutions are used by dozens of Local Health Authorities serving millions of citizens, and form the basis of numerous regional projects, including: SIAT – IT System for Local Assistance of the Region of Lazio, SISaR – Integrated IT Healthcare System for the Region of Sardinia, Regional Medical Record for General Practitioners of the Region of Emilia-Romagna, Regional Medical Record for Mental Health and Addictions of the Region of Emilia-Romagna.

Telemedicine for the ASL of Foggia: from the chronicity management to the monitoring of Covid.

As for the other health structures, the ASL of Foggia was called on to respond to the parallel commitment to deal with the health emergency and to guarantee healthcare for other illnesses. The project aimed at digitalising the process of initiating cure and care for certain specific chronic diseases (e.g. cardiac insufficiency, diabetes, hypertension), was expanded and reconfigured very rapidly also to meet the need for telemonitoring the new Covid patients.

The contribution of Engineering – with specific methods, domain expertise and proprietary technological solutions – made it possible to create the telemonitoring platform to connect the Local Operational Centre and Covid patients in their own home, from where they transmitted their own vital parameters via Apps and electro-medical devices (e.g. body temperature, oxygen levels, blood pressure) and received remote clinical advice and assistance.

This experience is effectively unleashing the potential of Telemedicine, in particular with regard to the continuity of treatment, extending it to scenarios like the current one in which the multiple types of service (Televisit, Teleconsulting, Telemonitoring, etc.) have proven to be a strategic asset to truly guarantee the right to health.

Accounting, Logistic, HR

The evolution of health requests is generating increasing attention to the management of available resources and how they can be balanced to maximise health results, at individual and at collective level, above all in a context in which the organisational models of healthcare being re-designed. From this viewpoint, there are many fields of governance that need to guarantee and "support" processes that are strictly healthcare-related, in particular:

- **Economic and financial governance**, to guarantee the sustainability of the Healthcare Systems model and the investments necessary for its development

- **Governance of procedures**, to guarantee that the processes run smoothly and focus the attention of human and intellectual capital more and more on the "core" activities of healthcare

- **Governance of compliance with legislation**, to guarantee the protection of the correct use of public resources and safety in the activities carried out.

This governance action, as for any treatment processes, is tending more and more to go beyond the boundaries of the individual healthcare organisation to adopt models and planning and control criteria that aim at a vision that goes beyond the specific organisation, region and nation. In this light, many Italian regional authorities have placed even greater importance on harmonising the processes by unifying their administration, control and financial systems, and integration with the Centralised Health **Management system in accordance with the holiding-subsidiaries model, with view to creating a "system" between the functions of the local health authorities and the regional authorities**. Therefore, the management systems that are able to read, correlate and interpret the data generated by the management systems, which need to be flexible in order to adapt the objectives of analysis to the needs for information of the various level of governance in the Health System, are becoming increasingly strategic. One example of this is the Covid-19 pandemic which, in addition to stressing the emergency assistance processes, has put the administrative and accounting control models to the test: it has in fact been necessary to adapt promptly to the new organisational dimensions, to intercept accounting and process data correlated to the management of Covid (purchasing and goods logistics, work shifts and presence of personnel, etc.), in order to make them available in real time for supporting the decisions to be made.

In such a scenario, the element of interconnection that enables the function of governance is the circulation of data and digital documents.

Our Offering

Engineering has an in-depth knowledge of the organisation and methods of governance in the field of accounting and finance, logistics and human resources, thanks to the many years in which it has supported healhtcare structures in the creation of solutions for the digitalisation of processes and specific advisory services provided in various sectors, including programming and directional control, management control and the consolidation of annual accounts. Through our solutions and competences, we manage 35% of Italy's National Health Fund (around 40 billion Euros) and 40% of the paychecks of the personnel of the National Health Service (3.5 million paychecks each year).

This presence and responsibility mean that we also play a key role in advising on the main innovation initiatives in these fields:

- **dematerialisation by design**, as a paradigm for the creation of the solutions necessary for the complete digitalisation of processes and the correct management of documents, and the relative re-design of the administrative procedures and the control levels (e.g. operational and approval workflows)

- **Robotic Process Automation**, as a further accelerator for the re-articulation of the organisational models and the redistribution of the resources available, in particular with regard to human capital

- **the digitalisation and automation of HR management**, which allows us to guarantee the automated and integrated performance of processes. Through our advisory activities, it also allows us to harmonise the models for controlling staffing expenses to protect the Body's strategic objectives.

Thanks to this strong quest for innovation, with its specific sub-systems for accounting, logistics and HR, our AREAS platform has been used as the sole administrative and accounting system at regional level by the regional authorities of Sardinia, Liguria, the Marches, Abruzzo and Apulia. **To these customers we do not provide only the technological solutions, but also share a path that starts with the development of the directional control model and the re-definition of the sole model for processes and master data**, and leads up to the configuration of each application system.

All the initiatives undertaken are conducted according to a methodological approach inspired by the principles of:

- **integration of the different areas of expertise** in technology and application and organisation and procedures, in order to intercept the full potential of the digitalisation of processes

- **exploitation of the available information**, by means of data-driven analysis and process mining, to objectively and quickly identify all evidence essential for the governance of resources.

This approach has allowed us to successfully deal with important moments of development of the processes and systems used in **over 70 health authorities**, such as the introduction of electronic invoices, the management of online collection and payment orders, the generation and management of electronic orders, etc., always in compliance with the strict times set by law and with a minimum impact on the operational activities of the health authorities.

During the Covid-19 emergency, together with an increasingly data-driven approach and the dematerialisation by design of our modules in the adminsitrative area, this method has allowed all our customers to activiate smart working without the need to made any adjustments to the applications or infrastructure and without any discontinuity of operations. Above all, it has been possible to quickly configure the new management processes, guaranteeing the sharing of information within the organisation, the planning of activities and the monitoring of resources of evey kind.
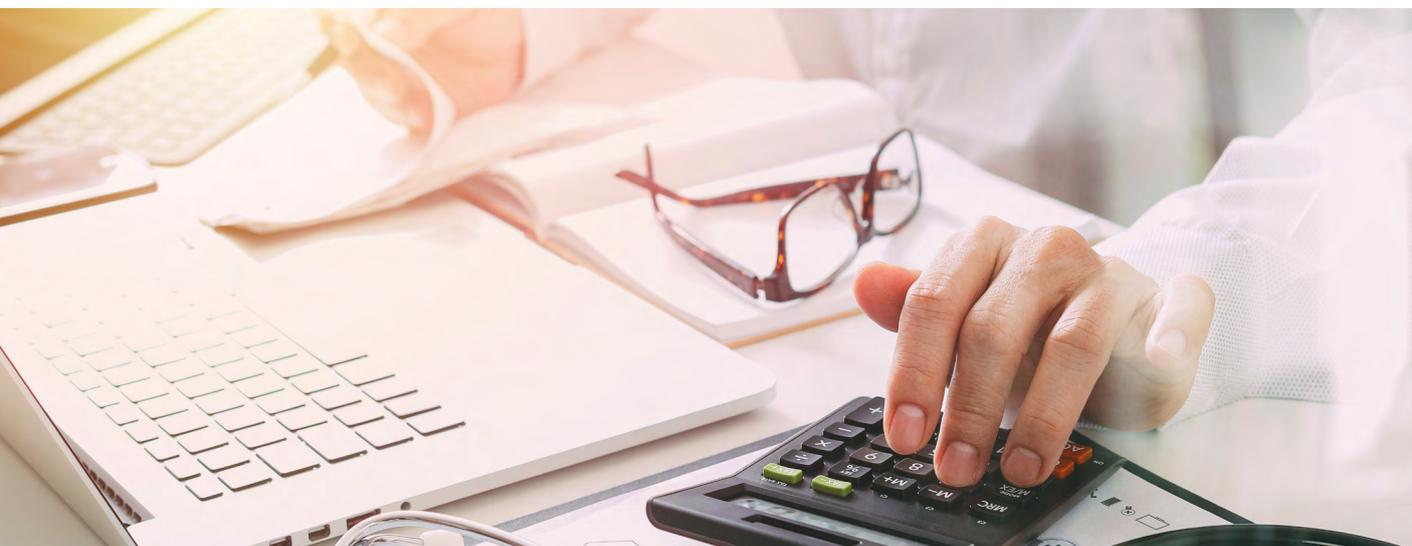
Innovation & Governance

Innovation must be governed, and governance requires innovation. In E-Health, these two topics go hand-in-hand and are indispensable to enable a data strategy that is now a current need, as the Covid-19 emergency has shown in different areas. To properly achieve this governance strategy, **it will be necessary to stably introduce "ecosystem" platforms that are able to supplement large**, diverse and transversal data sources, that can be used to create complex Data Lakes thanks to the architectures of Big Data and systems of Data Cloud Analysis. That enable the possibility to, putting together very different sources of information for. These instruments, that will maximise the value extracted from this enormous amount of increasingly "liquid" data (**Data Liquidity**), will become essential in the governance of health in all its aspects: healthcare, social aspects, organisational and economic.

This new capacity of governance guided by the data finds its greatest potential not only at local level (in a country or region), but also in the single structure. As in Industry 4.0, the governance of data, together with the automation of processes, can make it possible to create control centres in real time, even within hospitals, that are able to reduce waiting times and make the patient's experience simpler, quicker and more efficient. **These control centres will have the objective to transform the way in which the healthcare services are provided and organised**. Above all, however – thanks to artificial intelligence and advanced data analysis – they will make it possible to provide healthcare workers with information in real time, which is indispensable for coordinating the treatment paths of each single user, in particular those deriving from the integration of the hospital in its specific area, as they are based on the intensity and quality of the information provided.

This change puts us before a first large "obstacle", that regarding the management of the privacy of clinical and healthcare data. Through the GDPR in Europe, and in Italy in its national embodiment of such law, have regulated the possibility to use also healthcare data for secondary purposes of governance and research, one of the next objectives is that of effectively implementing these regulations, creating services that guarantee data privacy with advanced data anonymisation systems, but at the same time exploiting the great value for healthcare, among other things.

Our Offering

Engineering is making these "transversal trajectories" of governance and innovation tangible, and both are based on the central importance of the data. In the governance of care and cure pathways, based on the expertise gained from a research project, we were the first to develop the specific solution **Digital Pathways** belonging to the platform ellipse, which "orchestrates" the various healthcare processes, drawing on the multiple hospital and local applications that intersect the treatment and the patient. With the "ICU-Medical Record", still within ellipse, we are introducing Machine Learning in one of the most demanding fields in terms of the intensity of treatment. The multiple branches of Telehealth interpret this – for the purpose of extracting its real organisational and informative potential – organically, with respect to the IT system of the health authority, in other words its "natural and homogeneous" extension for applications and projects, which is built up from the initial phases involving the users: patients, care-givers, doctors and nurses. This latter method of co-design is the one we use in all our projects and components of Digital Services aimed at the direct contact with the citizens, thus based on the real needs and preferential ways of communicating with the healthcare services and social and welfare services that will be more and more a "mixture" between direct and remote contact. The biosurveillance platform Eng-DE4Bios that we created for the Covid-19 emergency – at lightning speed and with acknowledged success – demonstrates our ability of aggregation and advanced analysis of Big Data from diverse sources for the governance of public health and the management of particular types of risks. We develop the governance of risk management and privacy by a systemic approach, in which we unite technologies, domain expertise and advisory services. One example is our "Privacy Manager", a solution created specifically for healthcare for a privacy "by- design & by-default" to protect citizens and organisations.

Data Governance of Engineering for the biomonitoring of Covid-19 in the Region of Veneto

Limiting the Covid-19 emergency using data: to monitor the development of the epidemic, to direct healthcare and organisation interventions and to forecast its evolution. Based on this vision, the Regional authorities of Veneto have chosen the technology and the data governance capacity of Engineering to make this result tangible.

Eng-DE4Bios is the biosourveillance platform that has allowed the Regional authorities to keep watch over the evolution of the epidemic. By mapping and geolocalising infected persons, creating heterogenous databases and applying advanced algorithms, it has been possible to determine the density of the phenomenon in the areas of the region, the relations between the people infected and the likely evolution over time and within the area. Thanks to this capacity to understand and predict, all the persons involved (task-forces, healthcare personnel, general practitioners, etc.) have been "pointed" towards the most appropriate actions and decisions: strategies regarding testing, organisation of medical devices, restrictive measures, surveillance of clusters at greater risk, etc. This experience, which is a benchmark in Italy and beyond, has demonstrated that the capacity of data governance, enabled by instruments for extracting and combining data on which to perform the "intelligence" of Advanced Analytics, is already essential in order to guarantee health objectives in emergency situations and otherwise.

CASE STUDY

5

WHAT IS THE FUTURE OF E-HEALTH?

The future of E-Health is beyond E-Health. Encompassed inside a holistic vision able to implement it in a completely widespread and specialised manner, hand in hand with a Digital Citizenship, where the Health System and the Public Administration unite and interact to take care of citizens. Anticipating their needs instead of responding to their healthcare requests.

We live in a world in which life expectancy is becoming increasingly longer. At the same time, however, populations are ageing, often with lifestyles that are harmful and that exacerbate problems linked to heart problems or diabetes, which affect more and more people every year. **This results in Health Systems being unable to limit themselves to intervene when a patient needs hospital treatment that is costly in terms of assistance and economic resources**. The challenge thus lies in anticipating such needs in order not to reach that breaking points in which all the health assets (structures and professionals) become insufficient to deal with a population that needs increasing assistance.

The most acute phase of the pandemic caused by Covid-19 has made it very clear that, when faced with sudden peaks in a health emergency, the systems are placed under stress, and unable to respond adequately to a dramatic increase in the request for treatment. At the same time, however, some virtuous situations have shown that where capillary monitoring is carried out on the population and the area, it has not only been possible to limit the epidemic, but to anticipate the flaring up of new hotbeds, by re-organising resources and structures that are close to saturation. The results obtained by us at Engineering in the Region of Veneto, thanks to our platform Eng-DE4Bios, can certainly be considered a best practice.

However, that experience was also a laboratory where the benefits of a system that is able to unite and georeference data coming from the health structures (hospitalisations, test results, etc.), were tested with those of the local area and its inhabitants (members of a same household / family, workplace colleagues, etc.), in order to prevent, for example, all the critical aspects linked to the nursing homes. Forward-looking Health Systems must thus use the liquidy and transversal nature of data to ensure that active and central citizen, are no longer just a patient that needs treatment and thus access to hospital, but a person within a digital ecosystem that guarantees the right to health before this becomes a duty that is impossible to satisfy. An ecosystem in which, in respect of the privacy laws, the new technologies (AI & Advanced Analytics, Digital Twin, Augmented, Mixed and Virtual Reality) become instruments for interfacing, for example, purely clinical/health data with data deriving from other fields of life (e.g. family, education, work, environment) making it possible to anticipate individual health needs and to define the preventive governance strategies for particular clusters of the population (e.g. for a certain age group or certain pathologies), improving treatment and the sustainability at social and economic level. Alternatively, it must be one where the enabling technologies (for instance 5G) are able to ease the pressure off the health structures, guaranteeing the same assistance to the citizens by enabling and increasing Telemedicine systems which – by no coincidence – after the crisis generated by Covid, registered an increased use of over 50%, accorfding to the latest data provided by leading market analysts.

Still with view to the future, **the revolutionary opportunities that are opening with precision and predictive medicine**, can only be achieved by an inseparable connection between digital technology and other sciences (genomics, pharmacology, etc.), as their implementation is based on the availability of enormous quantities fo data and in the ability to use these for increasingly fast and advanced analyses and simulations.

All this knowledge generated by the data provided by the applications, must not remain separated from such applications. On the contrary, it must be fed back into them to ensure that the applications themselves become the transmission chain – shorter than ever – that allows knowledge to be transformed into decisions and, therefore, into actions.

That's how we imagine E-Health of the future: applications embedded in vast and diverse digital ecosystems, that are able to "feed themselves in real time" with knowledge generated from data, able to reconfigure themselves and, therefore, **to remodel the processes and paths of healthcare and treatment**, to pump life into a resilient healthcare system and to give value to people's lives.

If Italy's countrywide ecosystem (public and private) believes in Digital Transformation it will know how to push forward policies for health and care that can deliver "action and prevention" through the transversal use of data and its inherent power. Only in this way will it succeed in anticipating the problem instead of reacting to the problem. Preventing it from become a social issue rather than a health issue.

Redesigning a new healthcare for cure, care and prevention.
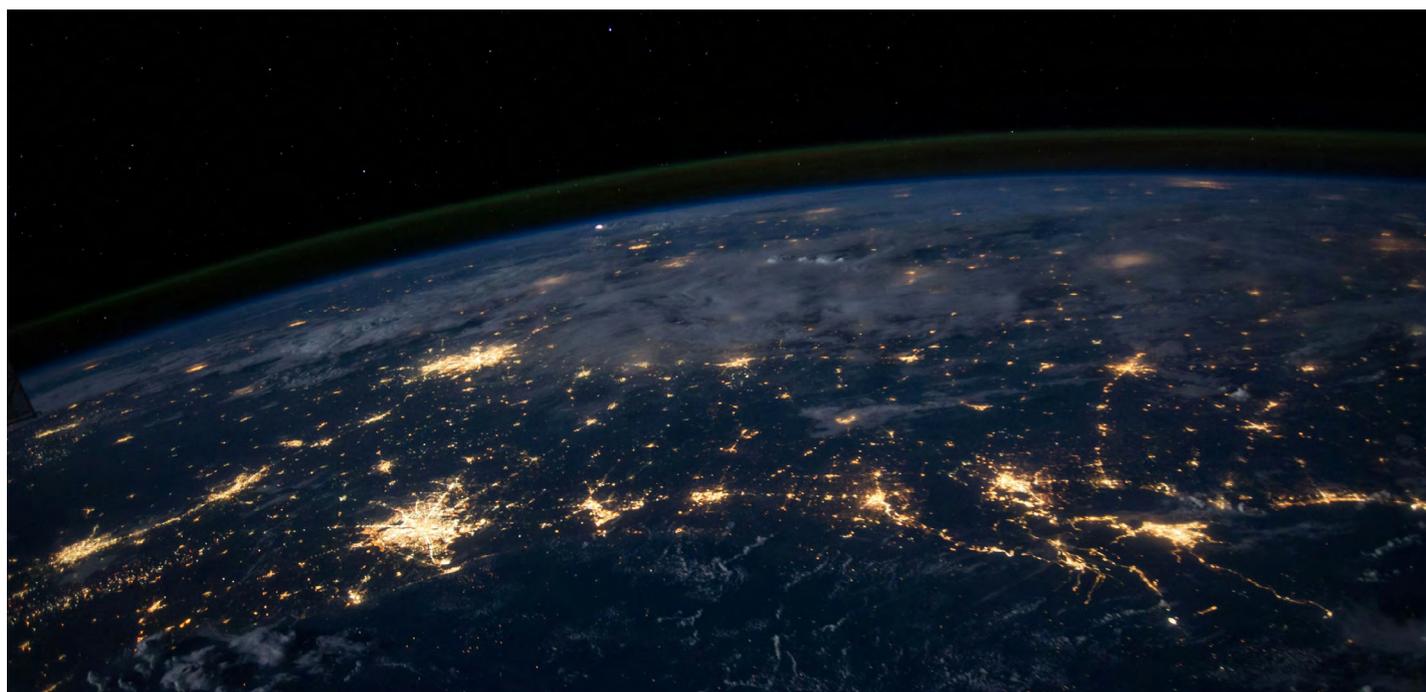
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