MEDICAL INFORMATICS and TELEMEDICINE: 50 Years of Developments

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Summary

The applications of Medical Informatics and Telemedicine systems are growing very much in the last 50 years and they can permit a more cost-effective solutions, providing clinical outcomes as well as improving the patient's quality of life by large diffusion of electronic management of health information during the process of treatment and care (in GPs ambulatory, outpatient clinics, hospital wards, diagnostic divisions, etc.) and in diseases prevention, monitoring, rehabilitation, etc. In particular it very useful and important now during this emergency and after the dramatic Covid epidemy.
Technological innovation in health care, as the development of medical informatics and telemedicine, is necessary due to the big amount of information coming from the new and powerful digital diagnostic equipments and also to high quantity of patients, related to the ageing population, affected by several chronic diseases (diabetes; cardiologic, cognitive and neurological diseases, respiratory problems, etc) and today also to coronavirus diseases. That can support and solve relevant social, epidemiological and financial aspects in developed and developing countries. In particular now the development of telemedicine and telecare services can permit continuous monitorin of this patients even at home (telehomecare),
The use and diffusion of integrated health/hospitals information systems, electronic patients records, health smart cards, systems and services of telemedicine are a reality in the world and even in Italy. Many projects and applications on Medical Informatics, Telemedicine and e-health have been developed in the frame of Regional, National, European and international Programs. So intra/extranet tools in healthcare and integrated medical information systems (between hospital, health districts, GPs and the same patient home) are now implemented. These systems based on medical records linkage and telemedicine services have many socio-economic benefits and can generate new sources of revenues for providers and can optimize the use of availability of resources (health operators and medical devices) in order to follow a more great number of patients and citizen need of personalized care. The benefits are clear, but there may be some legal problems (security and pricacy aspects) yet to be defined and solved.

Introduction

Medical Informatics is the scientific and technological discipline relating the study, use and application of computer processing of information in the medical and health field for the automatic management and treatment of data collected in the Medical, Hospital and Health Information Systems (patient records, clinical data bases, epidemiological registries, genomic data banks, medical Knowledge bases, Decision Support Systems, etc.). So Medical Informatics involves several aspects of health activities in particular the diagnostic and therapeutic processes for the Computerization of medical data, development of HW/SW Architecture in Hospital and Health information Systrems, Data Base Management Systems in Medicine and medical oriented programming languages, clinical expert systems, etc.
Telemedicine as "medicine at distance" regards the interactive transmission of medical data, signals and biomedical images by means the use of telecommunication networks. There are several definitions of telemedicine and in particular we consider these two:
The IOM (Institute Of Medicine) of American National Academy of Science on 1996, in the "Guide to accessing telecommunications for Health Care", defined telemedicine as "the use of electronic information and communications technologies to provide and support health care when distance separates the participants".
The World Health Organization (WHO) in Geneva on 1997 asserted:

"*Telemedicine is the delivery of health-care services, where distance is a critical factor, by health-care professionals using information and communication technologies far the exchange of valid information far diagnosis, treatment and prevention of disease and injuries, and far the continuing education of health- care providers as well as research and evaluation, all in the interests of advancing the health of individuals and their communities.*"

Historically the definition and using for the first time of the term "Medical Informatics", as computer data processing in medicine, appeared at beginning of '70 years of the last century in some publications about informatics training of health personnel. Before, after the II World War, with the advent of electronic computers and their evolution (2°, 3° generations), the applications in medicine was called medical computing, biomedical engineering, etc. On the 1974 there was the first international conference of of Medical Informatics (MedInfo) and in the proceedings (ed. by Anderson & Fonsythe) some american and european researchers and professionals, as Anderson, Gremy and Pages, included the paper titled: "education requirements for medical informatics". On the years after, the diffusion of this discipline grew in many countries (UK, France, Japan, Germany, Italy, etc.) thanks to the contribute, in studying and applications, of many other professionals, academiciens, medical operators as Blum, Blois, Shortlife, Reichertz, Gabrieli, Sherrer, Van Bommel, Cimmino, Rienhoff, Gunther, Kirsten, Coiera, Mandil, Salem Badee, Celler, Hishikawa, Yagi, Ayad, Moisil, Stoicu Tivadar, Ghazal, Glinkowski and many others. Even in Italy a lot of doctors, reswarchers and IT professionals were and are involved in the beginning and development of information science and technology in medicine as (some of them besides me): Stefanelli, Casiraghi, Maceratini, Pupolin, Degli Antoni, Serio, Bracale, Andreani, Manacorda, Pinciroli, Mocarelli, Balossino, Molino, Torasso, Ricci, Rossi Mori, Quaglini, Ferri, Cristiani, Nicolosi, Ranieri Luzzana, Spaggiari, Guerra, Beltrame, Mauri, Milanesi, Azzolini, Mastronardi, Giacomini, Andreoni, Gilardi, Gerthoux, Polvani, Mazzoleni, Parati, Antonicelli and many others new and young members of scientific associations (AIIM, @ITIM, etc.) as Pellicanò, Bella, Pisanelli, Lazzèro, Dragoni, Santoro, Cannataro, Ciampi, Cabitza, Delgrossi, Orsini, Buccoliero, Randaccio, Di Tommaso, Guffanti, Murgia, Milia, Morreale, Limonta, Castelnuovo, Clemente, Magretti, Paglia, Bertaina, Papaleo, Bloisi, Giansanti, Pazzi, Orro, etc.

The communication and exchange of medical information between operators and health structures spread rapidly, after the rapid and full development of Internet and Web technology. So telemedicine systems and services for better and fast support to health diagnosis and consulting at distance, are improved in particular in the last 30 years thanks to new Information and Communication Technologies (ICT) and wide geographical networks. Before, for many years (at beginning and along several years, until the 2° period of last century) several telemedicine services had been developed on the base of analogical devices and telephony thanks the discovery on 1901 of wireless telecommunications by the Nobel Prize Guglielmo Marconi. In particular the transmission of cardiological data and signals for teleconsulting and monitoring of patient in isolated area and on the ships. In Italy these kinds of teleservices in medical field were and are delivered by the action of CIRM (International Centre of Medical Radio), of which Guglielmo Marconi was the first President. Since 1930, CIRM initially operated for medical assistance on ships and after the II World War extended the service to medical assistance on aircrafts and in small islands.

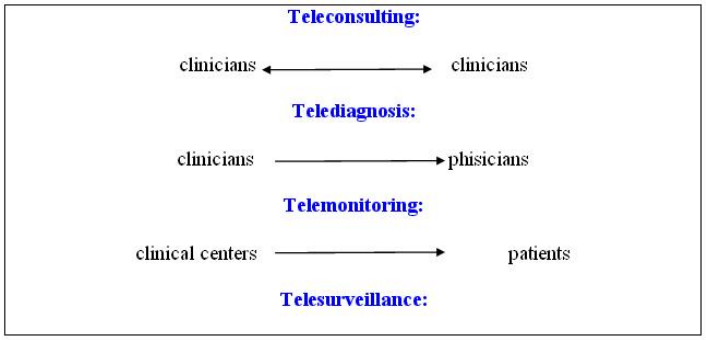
Medical Informatics, Health Records and Information Systems

The set of health information (data, text, signals, images), related to therapeutic and diagnostic processes of patient care, constitutes the medical record. It is useful to support the clinical decision and to improve even quality of care. In other words, as M.S. Blois stated around 40 years ago, "a medical record is what a physician (either in his private office or in hospital) needs in order to take care of patients". Data of medical record are collected during hospitalization, ambulatory visits of patients, etc.
For the Institute of Medicine (IOM) the "Electronic Medical Record is an essential technology for health care". With this assertion in 1991, it recommended a wide diffusion in the health care systems.
Inside the medical record we can consider some essential parts of information, as administrative data, emergency data, social security and insurance data, health care data, clinical data. When the patient

record contains different kinds of information (numerical, textual, eidetic data) it's a Multimedia Medical Records (MMR).
Recently, information and data coming from the biomolecular research (i.e. genetic data) can be part of patient clinical record in order to improve the personalized care of patient during the diagnostic processes and health practice and for diseases prevention, treatment and rehabilitation.
The medical record can represent a bridge between the user and the health structures in the different services, and it's the central element of the clinical and epidemiological databases and of Hospital/Health Information Systems (HIS). In the frame of HIS data can be exchanged and transmitted between health operators (General Practitioners – GPs, clinicians, care givers and even the patients).
Medical records travel through integrated and networked healthcare information systems (between hospital, health districts, GPs) and the main medical information subsystems are RIS (Radiological Information System), LIS (Laboratory Information System), CIS (Clinical Information System), ADT (Admission Discharge Transfer), Electronic patient Folder, etc.
But Medical Records and Clinical Data Bases are often heterogeneous and it makes difficult the sharing of information due to the difference of software platforms, data bases structures, DBMS and connection between different modalities. Then, there is the necessity of common communication and standards. So its' necessary and useful to improve and implement new standardization processes. For instance an useful standard is relating the images processing and transferring is DICOM (Digital Imaging and Communications in Medicine), which defines a standard network interface and data model for imaging devices in order to facilitate information systems integration. DICOM is a complex standard which provides detailed definitions of communication services and associated protocols. Radiological workstations acquire images from the connected modalities automatically. They can integrate RIS (Radiology Information System) and PACS (Pictures Achieving and Communication System). RIS-PACS integration is very important and, using often sophisticated compression techniques without significant loss of information, it's possible to transmit radiological images over virtually any network, according to the DICOM standard.
Another standard for communication among Health/Hospital Information Systems is HL7 (Health Level 7). This standard was created with the aim to exchange electronic data between health structures and different information systems. Particular subset of this level is CDA (Clinical Document Architecture) for standardization of clinical documents.
Diffusion of Internet also in healthcare systems and intra/extranet architectures make necessary to rewrite medical records using new tools for database in web environment. For example years ago, because HTML is not sufficient in solving the problems related to medical information transmission, by means SGML (Standardized General Markup Language - standard ISO) and XML (eXtensible Markup Language) it's possible to have a standardization of the information exchanged and not of the data format. XML can favourite diffusion of medical records into telemedicine services, using Internet infrastructure.
In the USA, ICT systems are approved by the Food and Drug Administration (FDA), Medicare organization and insurance companies. In Europe, a Technical Committee for Medical Informatics (TC 251) was established within the European Standardization Committee (CEN, Comité Européen de Normalization). The objectives of CEN TC 251 are the organization, coordination and follow-up of standards development in healthcare informatics at European level.

Telemedicine, Telecare and e-Health

In general we can say that the term telemedicine refers to a particular method of distribution of health assistance on the part of the institutions situated in the territory, which allows the supply of diagnosis and integrated medical assistance services, overcoming the restraints of territorial distribution, of fees, of the distance between experts and users. Telemedicine is the result of the convergence between telecommunication networks, medicine and health services, medical database and health information systems. Telemedicine is based on the necessity to assure a long-distance consultation, diagnosis and/or monitoring and assistance even in emergency care. Telemedicine processes regard several aspects going from teleconsulting, telediagnosis, telemonitoring, telesourvelliance, telehomecare. These activities offer the opportunity for consultation between doctors and specialists in particular for difficult clinical cases (figure 1).



(figure 1)

One telemedicine process is teleconsulting between doctors and clinical specialists. It can use real time transmission of medical data, images and signals (on-line or in videoconference) where the clinician participates in the examination of patient while diagnostic data are collected and transmitted (second opinion).
Even telediagnosis between medical specialists (cardiologists) and health care professionals (GPs) can take place in realtime but often by off line, using store and forward techniques, such as e-mail.
Telemonitoring is the activity for registration, transmission and control of data related human physio/pathological functions from a remote site. Using particular briefcase kit it regards the record of the vital signs of patient in remote areas and transmitting the data to hospitals or medical centres. In telemonitoring/telesurveillance systems part of data of medical record are directly registered on patient, using electro/biomedical tools (biodevices) and transmitting data to specialized centres for checking, diagnosing and consulting.
The main applications of telemedicine are telecardiology, teleradiology, telepathology, telediabetology, teleophthalmology and many telecare services. (There are other specialties that use telemedicine services, as teledermatology, , telesurgery, telepsychiatry, etc.).

1- Telecardiology is the oldest application, tanks to the transmission of data and signals by means of normal telephone lines (using simple modem and appropriate devices). In cardiology there is a large request of special tests, so that the integration of data and signals into medical record facilitates care treatment and the possibility to ask for a diagnosis and/or consulting in short time and with low costs. In cardiology Medical Records integrate numerical data, texts, signals of parameters as pulse, blood pressure, heart rate, EKG waveform, systolic, diastolic, values, respiration, oxygen saturation, etc. In emergency care, transmission of EKG signals can be performed in order to shorten the time between the appearance of symptoms and the beginning of appropriate treatments, improving so the coordination between the Emergence Medical Services (ambulances) and Intense Care Units (in hospital).

2-- Teleradiology is one of the fields where telemedicine recently has been more developed. Radiographs converted in digital format or digitalized images are transmitted in order to have a medical report (useful when there is lacking of local radiological expertise and it's necessary to avoid to move patients, reading the images by expert radiologists). Teleradiology refers to the transmission of radiological data and images for one location to another for diagnosis and consultation.
Different types of images produced and transferred in radiology departments include: conventional X-rays and Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), ultrasounds, images from nuclear medicine scans, and from thermography, fluoroscopy and angiography. (In neurology, oncology and orthopedy teleradiology is very diffuse).

3-- Telepathology is the practice of pathology at distance. Pathology is another medical field where images are important. It's the medical study of disease related changes in cells and tissue. Pathology covers a very broad range of diseases and medical disciplines. Hence consultations are an important part of the practice in pathology. Pathologists frequently need opinions from those who specialize in particular diseases. They see images of tissue on a monitor rather then viewing the tissue specimen directly at microscope. Telepathology can be used for obtaining a second opinion or for obtaining a primary diagnosis. A telepathology platform is constituted by base components: microscope, camera,

Computer, communication network, architecture client/server, relational DBMS, software of compression of the images (i.e. Jpeg).
There are two telepathology approaches: static and dynamic (recently, a hybrid system has been introduced which incorporates both static and dynamic imaging).

The ageing of the population poses significant economic, social and health-care challenges, due the high incidence of chronic pathologies and disabilities, such as diabetes, hypertension, heart disease, chronic respiratory failure and asthma, neurological diseases, etc. Many of these diseases can be managed away from the hospital even at home (that is true today with the advent of the Covid-19 epidemy and the patients must be isolated in particular at home). For the "continuity of care", home care and community based health services are becoming an increasingly important part of health system. Telehomecare can support the management of chronic disease by means telemonitoring process of clinical and lifestyle data collected at home and transmitted to a central healthcare facility.
In general telecare systems may easily include vital sign data and other physiological measurements, that can be tracked by the patient and transmitted while maintaining the virtual consultation with the nurse or the doctor. Interactive telecare services are mainly based on point-to-point connections between the patient's home and a hospital featured by an audio visual communication, biomedical data exchange, electronic medical record and other added value characteristics.
Systems for telecare are composed by HW/SW workstation and permit acquiring and transmission of various health data by means modem or mobile network (GSM, GPRS) directly from the home unity that allow their measurements, storage and transferring (figure 2).

(figure2)
Applications of telecare/telemonitoring services are very useful for many patients affected by different pathologies as: heart and circulatory diseases; heart failure, coronary artery disease; arrhythmias; pacemakers and implantable defibrillators; diabetes mellitus;, Diabetic Retinopathy; Aged Macular Disease; cognitive and neurological diseases, patients in pre/or postoperative monitoring; rehabilitation at distance of moviments of post-stroke patients, etc.
In order to collect and to monitor health parameters of patients, it's necessary to use some peripheral equipments (biomedical devices and sensors components of Internet of Things –IoT), as Digital electrocardiograph and cardiograph, oximeters, glucometers, tonometers, ophthalmoscops ore retinographs, devices for EEG, EMG, simple robots, etc.;
The main applications of telecare/telemonitoring for elderly and disable people are in telecardiology, telediabetology, tele-ophthalmology, teleneurology, telespirometry, telerehabilitation.

In general e-health regards electronic applications to the whole field of health sector, by means of connected data systems in different activities. So e-health includes medical information systems, public health surveillance, e-learning for health professionals, telehealth. Telemedicine can be distinguished by telehealth: this last is the provision of health administrative services (booking medical visits, health ticket payment, accessing to lab tests results, etc.) to users who are at a distance and are not necessarily ill or wounded. The common element in these different aspects is the use of telecommunications systems to deliver health-care services to persons wherever they are located (telemedicine and telehealth can be considered as part of e-health).

Internet in Medicine, Grid and Cloud Computing in Health Care

The amount of information (covering all aspects of our life and interests), today accessed through Internet network, has reached a level no one could have dreamt of just 30 years ago. The potential of

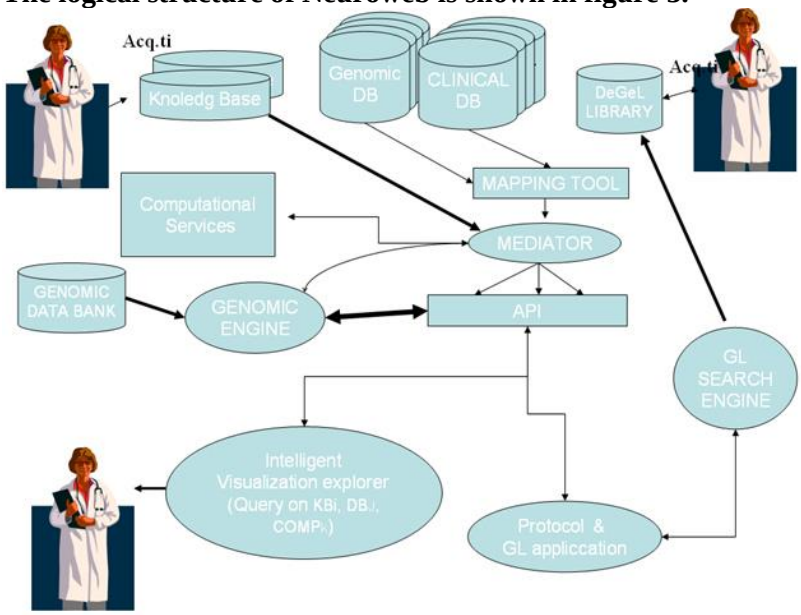
Internet technology in health care has generated enormous interest because it offers unique technical advantages in addressing health care information systems. The fact that the Internet is a widely available and popular tool of communication makes it extremely useful in transmission clinical data between doctors and health structures, providing worldwide patient support. Internet-derived technologies (worldwide web, e-mail, chat groups, social net and other forms of messaging and collaborative computing) have demonstrated to users that medical technologies can also be tied together.
In particular, Internet Web technology is revolutionising even the health care system. Web portals and web sites are present in many health care delivering services and offer today a wide range of medical news, clinical guidelines, medical directories and e-commerce applications. Sites and portals in medicine and healthcare are validated by HON (Health On Network) agency. In many medical specialties (neurology, cardiology, oncology, paediatrics, etc.) it's possible to have direct transfer of diagnostic results or findings with integration in the relevant patient information systems using this kind of communication standards. So health care systems based on Internet technology can remove some of the constraints imposed by geography, thus allowing e-health and telemedicine services to be provided in one country for another.

The term GRID (started 15-20 years ago) describes a distributed computing structure for scientific research (in particular in the field of particles physics). The concept underlying the Grid technology is coordinated resource-sharing and problem-solving in dynamic, Virtual Organisations. Grid applications are encroaching on a large spectrum of scientific fields such as meteorology, biology and also medicine. In the health domains there is an high availability of a large amount of data (clinical, genomic, epidemiological, etc.) in heterogeneous sources and formats due to the rapid progress and results in different areas such as biomedical research, clinical practices (new diagnostic/therapeutical processes), pharmaceutical developments, epidemiological studies, medical imaging, etc. This requires a growing demand for large computational power and easy accessibility to different data sources. So GRID technologies applied to health care (Health Grid) regard information processing (at molecular level as genomic data, at individual level as medical record and imaging and at population level as epidemiological registers and database), in order to establish a distributed environment providing basic common services (web portals, computing resources, etc.) to the health professionals and biomedical researches located in various hospitals, clinical and research centres. There are several projects that used GRID technology in biomedicine and health care sector at national and international level. Some of this are BioGrid, e-HeartGrid, MammoGrid, etc.
An evolution of Grid methods is now the Cloud Computing. It's the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet). Cloud computing provides computation, software applications, data access, data management and storage resources without requiring cloud users to know the location and other details of the computing infrastructure. It providers offer their services according to three fundamental models: Infrastructure as a service (IaaS); platform as a service (PaaS) and software as a service (SaaS). In particular Cloud has power at edge of network with ability to connect devices across Internet to vast computer power that come from virtualization of billion of servers to appear as one.)

Medical Informatics and Telemedicine in Italy

in Italy many, but not enough, projects and applications in Medical Informatics, Telemedicine and e-Health have been developed and improved during these 50 years.
Since 1976, after a big environmental disaster of dioxin in north Italy, where we introduced computer science and information technology for developing the first health information system for medical and epidemiological surveillance of population in a large territory. So introducing in a real project and service the concepts, methods, data bases and programming language oriented to health field (the MUMPS System created in Boston at Massachusetts general Hospital). On Year before there had been the 1 congress of Italian Association of Medical Informatics (AIIM) directed by prof. Tardini-
In the same years some projects and applications of medical informatics have been developed in the frame of Finalized Programs of National Council of Research (as SISNET, Parallel Computing and

Expert Systems and the CNR-FATMA program on Epidemiological Diseases Risk Factors where we created on 1989 the Research Operating Unit of Medical Informatics for the computerization of medical records, clinical data bases and Health smart cards). Moreover
In 1990 the Ministry of Research financed (50 million of Euros) a big program (TELEMED) that for 10 years represented a focal point for several applications in radiological teleconsulting, telecardiology, network of excellence Hospitals (oncology, neurology, etc.), teletraining, etc. The main results have been some prototypal platforms in radiological, cardiological and oncological fields and implementation of Hospital Information Systems Networking.
In the frame of Regional, National and European Health Programs (from FP3 to FP7 and to the ongoing R&D Horizon 2020), many projects have been presented and approved by Italian R&D groups. For example some projects financed at European level, have been:
*** e-CARE a project ICT based in order to improve continuity of care and healthy lifestyle. It permitted the measurement of some vital parameters, as blood pressure, health rate, oxygen saturation, position and movement of patient, in particular old people with chronic diseases as diabetes and cardiologic diseases.**
*** NeuroWeb. It is a project founded by European Commission, involving neurological clinics and hospitals in four countries (Italy, The Netherlands, Greece and Hungary). The system is based on web portal specifically oriented to neurosciences, with advanced intelligent tools to retrieve relevant information from different sources on the web. The disease considered is ischemic stroke and their risk factors, such as hypertension, hyperlipidemia and diabetes, which, in turn, have genetic and environmental risk factors of their own. Improving knowledge in stroke pathophysiology requires a large number of clinical, cellular, molecular and genomic data to be integrated and analyzed.**
The software tools developed allow to integrate clinical and genetic databases of the participating centres and to permit queries to databanks present on the web containing human polymorphism profiles in normal and pathological populations.
NeuroWeb performs tasks such as retrieving (throughout the web), integrating and delivering clinical information, medical images, as well as molecular and genomic profiles. The genetic database is based on innovative technologies such as cDNA-microarray-based methods for single nucleotide polymorphisms (SNPs) genotyping (gene-chip). So NeuroWeb generates new knowledge in order to ameliorate healthcare delivery achieving personalized health care in prevention, diagnosis and therapy: scientists with new hypotheses will be able to extract information from the database in order to evaluate the merits of their ideas.
The logical structure of Neuroweb is shown in figure 3.



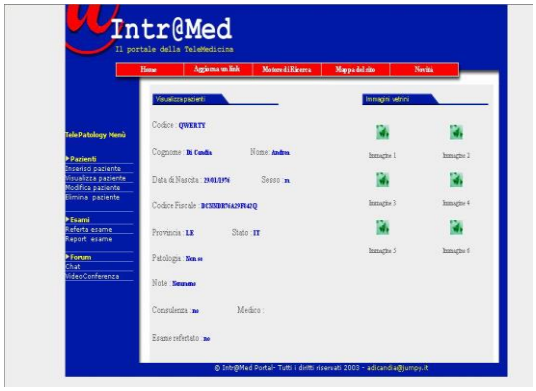
(figure 3)

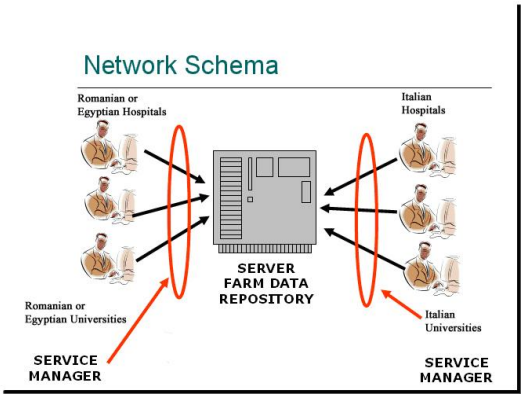
***NeuroInf. It's a project based on automated statistical analysis of bio-images. It consists on the creation of a large virtual data base merging various geographically distributed databases of PET**

images of a large number of control subjects, necessary to develop a statistical base for the detection of Alzheimer's disease (AD) at a mild state. Through a web-portal a neuroscientist can upload a PET image of a subject suspected of being affected by AD, he can run an automated statistical comparison of his image with the other control images spread on various databases and have as a return a support in the diagnosis of possible or probable AD. This web portal also provides a knowledge repository for physicians and researchers in Neuroscience. Other applications regard telematic field of Genomics.

We developed other projects in the frame of scientific and technological cooperation between Italy and many countries in the world (Canada, Australia, Argentina, Peru, Colombia, Russia, Japan, etc.) and with several European countries and of Mediterranean area (Romania, Poland, Croatia, Albania, Greece, Cyprus, Israel, Lebanon, Syria, Palestina, Egypt, Libya, Morocco).
In particular we mention these projects:
*** Intr@Med: IntraNet on Medicne in Mediterranean area. It was a project financed by Italian Ministry of Foreign Affairs on 2001 in the frame of scientific and technological cooperation between Italy and Egypt. It is based on web portal in order to improve the dissemination of information among hospitals and to support teleconsulting concerning difficult clinical cases and the telediagnosis process at specialist level (2nd opinion). The heart of the virtual network is a multifunctional medical/health web portal, which enables physicians, health operators and others researchers in biomedicine to access the whole network and share clinical information and knowledge. Intr@Med network links the Italian hospital "Umberto I" in Cairo (Egypt) and the General Hospital in Palermo (Sicily). The ICT applications regard telecardiology (telecardiosurgery in paediatrics) and telepathology (figure 4). Using the web portal the clinicians transmit and access patient medical records, in order to support processes of telediagnosis and teleconsulting in real time (conference display) or in deferred time (send of clinical and next referral of information and diagnosis). The telepathology consulting activity besides the two hospitals involved also the University Hospital of Pittsburgh.**

*** Network between Hospitals. It's another project still supported by Italian Ministry of Foreign Affairs on 2006 in the frame of bilateral scientific cooperation between Italy and Romania. For this telemedicine project the hospitals of Florence and Brescia (Italy) and the Regional Hospital of Timisoara (Romania) have been involved, together University of Milano Bicocca, Technological University of Timisoara and the @ITIM association. The aim of the project was to increase the quality of medical services, provided by the Emergency Clinical Hospital Timisoara, Romania, in collaboration with some departments (cardiology, radiology, pathology) of the Italian hospitals involved (figure 5). The project opened new perspectives regarding the development of the existing local infrastructures and support for telemedicine activities in Euro-regions. The software developed has permitted to generate a huge database, recording images and video files.**

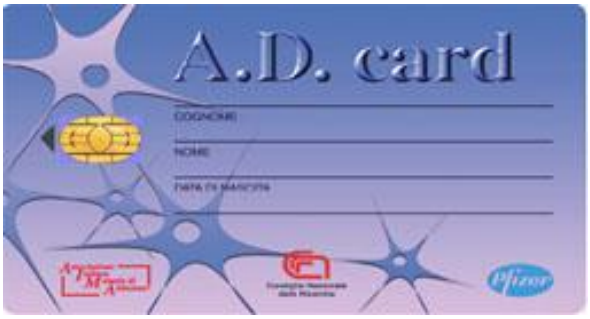




(figure4) **(figure 5)**

Moreover in Italy, many hospitals and regional health authorities have developed integrated information systems, the electronic patients records (Fascicolo Sanitario Elettronico), health smart cards and telemedicine/telecare for different diseases, mainly chronic (telediabetology, telecardiology, teleophthalmology, etc.). In particular:

*** the Hospital Information System of National Neurologivc Institute C. Besta of Milan, that we created and developed for many years, in order to integrate and manage data bases for the activities of healthcare to the patient with neurological diseases and to support the researches in neurosciences**
***Alzheimer Disease Card (A.D: Card). It's a project developed together Italian Alzheimer patients Association (AIMA) to guarantee a flow of secure and precise information for the Geriatrics Rehabilitation Institutes and Alzheimer centres in Lombardia Region. So doctors and caregivers can have a complete history of the illness, the therapies and tests already carried out. The smart card technology (figure 6)has reading/writing capabilities, good level of security and data processing capability. Furthermore, smart cards can exchange information through given protocols, sending and receiving data. The security for these sensible data is very high because it is almost impossible to copy the microprocessor and the card can be equipped with ID codes without which it is not possible to copy it. The security is guaranteed by CPU allowing the execution of algorithms of logical protection of data such as DES (Data Encryption Standard) or RSA.**



(figure 6)
The Smart card collects: ID and administrative data, Emergency data according to the Health Care European passport, data of AD diagnosis, therapies, follow-up, tests and co-morbidities

*** DIABESITY 2.0 is a m-Health (or based on mobile smartphone) project for self management care. Obesity and physical inactivity increase the risk of many health complications such as type 2 diabetes. The prevalence of diabetes for all age-groups worldwide is estimated to rise around 400 million in 2030.**
The system will provide real-time services for empowering diabetic and obese citizens in self-monitoring and self-management through the use of mobile devices-based monitoring and treatment protocols. The System is based on collecting/integrating critical information on the metabolic profile, diet, physical activity, psychological and social features in order to create successful monitoring protocols and treatments for diabesity at the very early stage. This platform wants to increase quality-of-life and help doctors i remote monitoring of patients

Since 40 years the Italian Health System (mainly public) is entirely decentralized (21 different authorities) and the health policy and management are now under the government of regions. This has been and is a very big limitation for continuity of care devoted to patients in particular elderly people with chronic diseases and now to the many patients involved by the Covid19 epidemy with very serious respiratory, cardiac, etc. diseases.
The development of health informatics and telemedicine systems in Italy needs to have effective regional and national information system and to build a network backbone with high band width, in order to get more speed and high quality of data, signals and images during teleconsulting/telediagnosis applications. ICT for Medical Informatics, Telemedicine and e-Health (from regional level to national level now a new Italian Health Information System is developed). Our Italian Association on Telemedicine and Medical Informatics (@ITIM) in these 20 years has had a proposing role in order to improve the cooperation and the diffusion of medical informatics and telemedicine culture and applications, in the whole Italian Health System.
Even and soprattutto with the explosion of covid pandemy @itim push and push to improve and diffuse telemedicine and teleehealth services very easy to use for screening and monitoring patients in particular SpO2 in order to maintain the patients at home and avoid, if it's possible, their not necessary admission in hospital or Intensive Unit Care. (Just in these months, as @ITIM and IITM

(International Institute of Tele-Medicine) with Institute of Biomedical Technologies (ITB-CNR), we proposed and developed a specific Covid19 telemonitoring system.

Covid-19 Telemedicine

The COVID-19 epidemic has put the healthcare system, and in particular the emergency rooms and intensive care units in hospitals, in serious difficulty. In addition, the hospital facilities themselves have in many cases become outbreaks of the virus.
Nowadays, the main strategy to reduce the COVID-19 spread is the limitation of social contacts and a significant number of infections may result from contacts with persons even not symptomatic. So, it is mandatory to reduce the number of people going to Hospitals and to avoid crowding in hospital emergency rooms, where positive people can easily infect people with symptoms of a "normal" flu.
In the majority of cases, COVID-19 infection results in mild symptoms, and only in some cases it progresses to severe pneumonia. This progression could be in many cases avoided if patients with early health signs are recognized, without unnecessarily crowding hospitals, and treated as soon as possible.
In order to guarantee the correct selection of patients that require treatment, it's necessary to have a home-based screening procedure by means a very easy to use ICT platform for tele-homecare and related APP with an essential medical data set and a number of questions, including heart rate, exact temperature, SpO2 and symptoms. Doctors such as General Practitioners (GPs), pneumologists and/or cardiologists, after evaluation of patient data collected and stored in the health database, can identify the risk of pneumonia and suggest the better treatment and therapy in that stage of the disease.
Patients with early signs of COVID-19 disease should be treated as soon as possible. By means of home telemonitoring, it's possible to guarantee the correct selection of patients requiring treatment for incipient pneumonia probably due to COVID-19 infection with minimal contact with clinical workers.
This Covid19 telemedicine system is based on medical records and some simple apps that provide a home-based risk estimation. The people suspected of Covid19 diseases should be monitored by health operators and the data of patients at high risk will be submitted to an expert pulmonologist for a diagnosis and drug treatment and/or oxygen support after diagnosis confirmation.

Conclusion

Medical Informatics, Telemedicine and e-Health systems, by comparison with conventional health services, introduce added value and have a positive impact at social, economic and cultural levels. e-Health and Telemedicine have many socio-economic benefits and can generate new sources of revenues for service providers and equipment suppliers, and can optimize the use of available of human and capital resources.
In general, benefit regard improved quality of treatment and patient care, more readily available information, greater accessibility, more timely information, faster and more accurate decision-making, savings in time and costs for staff and specialists.
So there are benefits for patients (cutting down on journeys to major health centres or for specialist consultations, reducing the length of stay in hospital and the cost of hospitalization, since the patient can be monitored at a distance) and also for the providers of health services (reduction in operating costs through centralization and optimization of resources -. expertise, laboratories, equipment; reduction in travel costs and time for specialists visiting other hospitals for consulting, reduction in costs of training and updating and improvement of specialists qualifications through distance, teaching and access to medical databases).
In general, the benefits associated with the introduction of e-health and telemedicine can be:
Health education of professionals operators and even of people and users;
Employment opportunities for health operators at a peripheral level;
Diffusion of medical knowledge;
Availability of normal (or on demand) health treatments, in distant areas to prevent the population from moving away;
Improvement of health indicators used by international and national government agencies
But some problems in e-health and telemedicine activities remain. These problems are related to organizational aspects and not to technological.

The problem in Italy is to remove these kinds of obstacles and to involve the large world that stays around the health sector (biomedical research centres, hospitals, ICT companies, health authorities at local, regional and national level) in order to achieve the best conditions for moving from experimental projects and prototypes to real medical ICT products, as systems and services for the citizen.

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