Hospital Architecture and the Digital Revolution

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Abstract:

The frenetic development in the fields of telematics technology and automation sees constant changes in the modality of giving the health care, in the managing organization of the hospital services nonetheless in the architecture of the same hospital building. The project of a hospital building nowadays cannot leave aside the knowledge of the potential expressed by digital revolution in terms of new distribution, spatial proximity and quantification of the functional areas. The speed of the changes induced by the importation of the diagnostic and telematics technology, keeps on growing and with it the strength of the attrition between technology of the health care and the spatial organization of the hospital, and also, between the “container” – the hospital – and its contained - the technologies.

A primary importance has to be directed from the planner to the potential expressed by the new diagnostic and therapy integrated equipment with the telematics systems for data, information and images transfer. This paper intends to face the impact of the digital revolution in the re-organization of the spaces dedicated to health care e to the diagnostic in the hospital building not current any survey respect to the past.

1. Introduction

The frenetic development in the fields of telematics technology and automation sees constant changes in the modality of giving the health care, in the managing organization of the hospital services nonetheless in the architecture of the same hospital building. The project of a hospital building nowadays cannot leave aside the knowledge of the potential expressed by digital revolution in terms of new distribution, spatial proximity and quantification of the functional areas. The speed of the changes induced by the importation of the diagnostic and telematics technology, keeps on growing and with it the strength of the attrition between technology of the health care and the spatial organization of the
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by the new diagnostic and therapy integrated equipment with the telematics systems for
data, information and images transfer. This paper intends to face the impact of the digital
revolution in the re-organization of the spaces dedicated to health care e to the diagnostic
in the hospital building.

2. The innovation in data transmission and in the virtual reality

In the next future the technologies of data transmission and of the virtual reality will
assume a determinant role and will be integrated in the hospital building. The analysis has
been headed to the comprehension of the potential effects induced by the introduction of
said technologies, in the reorganization of the activities, of the spaces and their inner
relations inside the hospital building. The possibility to put the information in real time on
the information technology net, the possibility to operate through robots brings to a new
vision of the hospital building. Diagnostics area is drastically reduced in terms of
functional operative unities, but the offer is broaden in numerosity to the end of reducing
the times of survey and hospitalization.

The operating theater, given the introduction of equipment for the production of bio–
images, augmented its dimensions. The adoption of the robotic surgery brings to the
hypothesis of a new vision of the “operating theater”. The concept of tele–medicine is
integrated with that of tele–health, including so also the technologies for the management
of the hospital implants “delegated to comfort and safety”.

The hospital becomes clever, a smart building, integrated in all its functions. Until
today the essential condition for the adoption of said technologies is the project of a
structured wiring system, that “born” with the hospital building, equals to the other
implants technologies.

3. Data transmission technologies: hospital information system and healthcare
communication network

In the future hospital communication strategies will assume a determinant role. The
development of the communication (and of the telecommunication technologies) will
constitute «the characterizing element of the great reorganizing process that has as a target
the new hospital: a hospital that hospitalize a lesser number of patients, that puts its
equipment, its medical competence, the needs of specialized healthcare assistance in the
healthcare network» [1] and that is connected in a network with the other healthcare
structures in the territory.

The telecommunication technologies, in a quick evolution from several years on,
provides instruments that drastically modifies the means with which the information could
be collected, manipulated and trans-missed from different emplacements, both inside the
hospital structure and between this and the remote emplacements through the creation of
the so called health care network.

The digital clinical record of each hospitalized person will be consulted by any
medical operator and from any point into the hospital. «Optical fibre and high–speed
telephone lines will transmit data, words, sounds and images indispensable for the
diagnosis. Therapies will be more precise and quicker» [2].
As for other kind of technologies, even in this case is necessary to speak of an initial technological transfer [4], to which has followed the development of a wide market segment dedicated to medical data transmission technologies.

Though is necessary to make a distinction between the systems that guarantee an internal communication between the different areas of the hospital and those that guarantee the communication between the hospital and the other parts of the system located outside; in fact from the technical point of view to the quick evolution of the systems that guarantee the internal communication – workstations becomes more powerful every day, microprocessors becomes faster both with an increase in the data transmission velocity and in the memory wideness – doesn’t correspond a quick development of the transmission networks[3].

Notwithstanding, though, the market availability of sufficiently consolidated technologies and the potentiality offered also in terms of a greater productivity and costs reduction both of the entire hospital organisation and of the whole healthcare system [5], the latter, differently from commercial and industrial sectors, is still at the beginning of a hard process of adjustment [6].

The causes of such delay could be traced back on one side in the peculiar characteristics of the same healthcare system characterized by a limited financial resources [7] and for which the re-organizing process couldn’t be induced by the simple technological availability, but it must be necessarily supported by a series of planned

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[*] The first applications of the data transmission technologies go back to the beginning of the ‘60 in the american aerospace sector managed by National Aeronautics and Space Administration (NASA). For further insights on first applications see Telemedicine Research Center, “History of Telemedicine”, http://tie.telemed.org/, (downloaded on 15/04/98)

[**] Many are the studies that confirms the strategical importance of the adoption of the data transmission technologies to the end of increasing the productivity and the efficiency of the entire organization in front of a convenient reduction of the costs, a problem this latter that join all the industrialized countries (see chap.4). Of particular interest is the previsional analysis conduced by the major U.S. experts aimed at the individuation of the technologies and the related policies of development oriented towards costs reduction in the healthcare sector. The analysis has been sponsored by different organizations among whom: US Army Medical Research & Materiel Command; Defence Advanced Research Projects Agency (Darpa); Pennsylvania State University Research Laboratory; Massaschusettes General Hospital. AA.VV., The role of technology in reducing Health care cost, Sandia National Laboratories, Usa, novembre1996

[***] In the United States the experts of the sector preview that «Within the next 10 years, health care operations face the same technological transition that many businesses and industries made during the 1980s and the early ‘90’s». But it is necessary to consider that in 1992 in the United States has been launched the Telecommunication Reform Act, that has opened the market to competition between the telephone companies, with a consequent drastic reduction of the costs of the high-band-width services that allows the different connections. See Shearer S., Miller T., “Designing for the future: the impact of technology in health care design”, in AIA, The medical equipment and technology workshop, AIA, Waschington D.C., 1999, p.108.

[****] Historically the high cost of the equipment has been individuated as the greatest barrier for the diffusion of the tele-health technologies on a large scale.

[*****] «The efficacy of those interventions is nonetheless substancially subordinated to three conditions: 1. that the innovative project anticipate the technological project: the clarity of the targets of the first is the condition for an effective use of the technological innovations; 2. that the innovative interventions (organized - technological) are substitutive and not additional respect to the old system; 3. that the introduction in the healthcare paths of the data transmission technologies could be supported by an adequate organized net: the tele-communication innovation could be "supported" on a organizational innovation level». See, Moruzzi M., “Comunicazione e reti informatiche”, Nuove tendenze, n.4/99, p.65

[******] The debate around the organized strategies to be adopted for the introduction and/of the implementation of the data transmission technologies in the healthcare system concerns the opportunities to adopt a strategy of incremental or of radical kind
actions that proceed the insertion and the adoption of the technologies. In other words the technological innovation, the computers adoption, must be implemented in parallel to the innovation of political–organizational character of the entire system. continuous organization and training are key–words of the same process of computers adoption. On the other side between the causes of the fore–mentioned delay must be numbered the limitations related to the spatial configuration of the hospital buildings previously realised in the '90, not conceived to allot easily the required infrastructures to the support of the new technologies. Actually what is defined as “mixed bag” of available technologies generates in many hospitals an inefficient use of the economical and human resources.

The first applications of computerized global systems inside the hospital, that goes back to the second half of the '80, were inspired by an improper approach that saw the creation of closed nets, to which was denied the possibility of expansion and of flexibility, of terminals defined “stupid” as usable only for the insertion of the data. Nowadays the creation of a network is based upon the principle of the flexibility and of the opening of personal computer capable of communicating between themselves and perform their own elaborations.

Upon these premises the analysis that follows is finalized to the comprehension of the potential effects induced by the principal data transmission technologies available nowadays, in the re–organization of the activities and in particular of the spaces and their relations of the hospital building. This latter is considered in its meaning of location specialised for the high–intensity assistance for pathologies in acute phases, that required a brief hospitalization and of a service capable of “delegate” the assistance at low and medium intensity to more economical and lighter structures available on the territory.

In the sphere of the medical data transmission technologies, with the deed of defining further on the field of survey, are subject of analysis the so–called systems of communication, that is the systems of data bases and the systems of filing and communication of sounds and images. The use of data transmission technologies in the sphere of the medical assistance, in its wider meanings, is defined tele–health. Different have been the definitions attributed to this term surveyed during the work – and this aspect brought a reflection on the necessity of a clear and unambiguous language to be partaken by all its operators –; the most appropriate, to which will be made reference hereafter, [ in 1990 inside the National Tele–health Program has been previewed a School aimed to special purposes in Computerized Medical activities and Medical data transmission, with the target of preparing new professional figures of Technician in Computerized Medical activities and Medical data transmission capable of managing the techniques of treatment, elaboration and distance transmission of the biomedical informations (data, signals, knowledge) through data transmission technologies. The training of the medical and paramedical personnel is an essential condition for the insertion of the data transmission technologies. See Timed, 2° Mostra Convegno Nazionale: Telemedicina informatica e telecomunicazione in sanità, Genova 20–21 maggio, 1999, http://www.it.net/timed/ (downloaded on 24/06/99).
[∗] The systems of medical data transmission could be classified in: systems of communication, afore–mentioned and systems of counselling, that is systems of consultation, systems of control and systems of critics. these latter made referment to particular programs (software) that offers the possibility to the medical personnel of consulting specific data bases, controlling the action plans on specific clinical problems and apply the informations stored to the solution of the problem. To exemplify «the medician describes a clinical problem and the action plan that is proposed to execute and the software will give a critical analysis of that plan. The central target of the system is to allow access not only to data that are available in the archives but also to the meaning that the data assumes in light of experience». See Rennel D.G., Shortliffe E.H., “Elaborazione avanzata in medicina”, Le scienze, n.75 dicembre 1993, pp.39–45. It is deemed that these technologies have an impact on training and on the medical practise but not on the physical entity of the hospital spaces. ]
defines the tele–health as «the trans-ferment of all the medical information – imaging, sounds, medical records and data of the patient – from one emplacement to the other»[*].

Interesting is the integration of the concept of tele–medicine with that of tele-health as «a set of the hospital technologies that provides to the patients information, to the diagnostics, to the imaging, to the implementation of the comfort and safety» [*]. This definition, comprehensive of the tele–health technologies (fig.1), includes also the technologies for the management of the hospital implants dedicated to comfort and safety, introducing a unique and integrated vision of the application of the data transmission technologies to the hospital building: the concept of a smart building, integrated in all its functions.

Fig.(1): Hypothesis of an exemplifying scheme of a set of medical data–transmission technologies

During the analysis that brought to the individuation of the tele–health technologies, has been noticed a repeated imprecision that sees the tele–surgery being numbered between one of these. It is deemed necessary to emphasize that: the tele–surgery, whom first application is the mininvasive surgery, must not be considered such inasmuch uses the technologies of the virtual reality [5] that constitutes, as will be analysed hereafter (see par. 7.3), a research sector on its own [**].

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[*] Telehealth: The technologies of healthcare that provide patient information, diagnostics, imaging, environmental comfort, and security. Integrated to improve the patient care environment and patient outcomes while improving the efficiency of the medical system and lowering costs». See Severns M., “What is Telehealth?”, report presented in ASHE’s 36th annual conference & technical exhibition, Philadelphia, 21-25 june 1999. The material related to the report, integrated by further notes, has been sent by the author who has been contacted in the course of the present work to answer to an questionnaire on the thematic object of this survey.

[**] «Telemedicine is the real-time or near time two-way transfer of medical information between places of greater and lesser medical capability and expertise»… «Telemedicine does not use virtual environments. Telepresence systems which use a full virtual environments for the users interface and telemedicine are often confused». See Moline J., Virtual Environments in Health Care, National Institute of Standards and Technology, http://nii.nist.gov/pubs/VIRT_ENV_doc/abstract.html, (downloaded on 21/08/97)
Entering the specific of the analysis has been tempted to:

• individuate the principal tele–health technologies applied, considering that some are of managing character and others are of a prevailing medical–healthcare character, and that these latter are fastly evolving respect to the different clinical specialty and integrating with the same medical equipment [∗∗∗];

• Describe through examples the applications and identify the eventual induced modifications.

• The principal technologies individuated of the tele–health, listed hereafter, are:

  • Systems of internal communication – patients, nurse personnel, medical personnel, technologies, that allows the different forms of communication through mobile equipments, as for example the cellulares studied appropriately for the hospitals or microcomputers to record prescriptions;

  • Electronic Medical Records – E.M.R. – for the electronical registration of the patients data, including the information collected by the monitorizing systems on the patient’s bed, medical notes, information related to the cure path and the achieved results;

  • Systems of vocal report, that allows the dictation of the record, the information and whatever directly on the computer;

  • Centralized data storage, on the patient’s images and information, for the centralized storage of all the information of the patient;

  • Digital imaging, for the advanced elaboration of the images;

  • Picture Archiving Communication System – P.A.C.S. – for the storage and communication of the images produced by the equipment for the production of bio–images;

  • Home Health Medical Monitoring Networks, that allows the patient to “auto–monitoring” at home and transmit the data to the hospital;

  • Technologies that allows the control at distance of the patients in intensive therapy;

  • Clinical tele–conference and tele–consult, that allows several specialized medicians of geographically distant centres to discuss a clinical case partaking the different images, as radiograms, histological potions, video-endoscopical relics, etc..

[∗∗∗] The application fields of the tele-health are becoming always wider and sees the participation of a growing number of operators from european and extra-european countries: this great interest is creating numerous problems not only of inter-connection and of crowding of the communication lines but also of judicial nature for the presence of different laws in the countries for what concerns the privacy or the codifying of the pathologies. See Timed, 2a Mostra Convegno Nazionale: Telemedicina informatica e telecomunicazione in sanità, Genova 20-21 maggio, 1999, http://www.it.net/timed/, (downloaded on 24/06/99)

[∗] In the sphere of the application of the tele-pathology two approaches could be distinguished: the "static" tele-pathology, in the case in which only single images coming from the histological potion are transmitted and the "dynamic" tele-pathology, in the case in which the pathologist observes images of the potion with the possibility to move the latter. Those two techniques implies different resources, in fact to transmit images moving in real time is necessary a quickness of transmission far greater respect to that that could be used for the transmission of static images sequences, because of this the dynamic tele-pathology is not an extension of the static tele-pathology, as it comprehends decidedly different problems and modalities of use. The use of the dynamic tele-pathology is limited to the intra-operating diagnosis that necessitates of a dynamic approach, because it has to be performed in few minutes on part of the pathologist operating from a remote site, to whom has to be left the greater liberty of autonomously selectanate the fields of the microscope slide. All the other application allows instead to use the more economical static approach. See Timed, 2a Mostra Convegno Nazionale: Telemedicina informatica e telecomunicazione in sanità, Genova 20-21 maggio, 1999, http://www.it.net/timed/, (downloaded on 24/06/99)
The tele-consult represents a multidisciplinary form of the tele-medicine, while the technologies that follow represent iper-specialized forms of tele-medicine:

- Tele-radiology, represent a specialised technical form that allows the transmission of radiological high-quality images for a tele-consultation at distance
- Tele-pathology [*], the L.I.S. (laboratory information systems) represents a specialized technical form that allows the pathological diagnostics at distance, through the visualization on a monitor of images coming from a microscope located in a remote location;
- Tele-endoscopy, for the storage and the transmission of endoscopical images [*].
- Tele-psychiatry, that allows to an expert, with audio and video connection, the controls of psychiatrical tests and exams at distance;
- Tele-cardiology, for the monitoring at distance of the cardiac activities with the enter of electro-cardiografical or ultrasoundgrafical outlines to the specialized medician located at distance.

The recent definition of a standard for the medical images – the Digital Image and Communications in Medicine format – D.I.CO.M. – is rendering even more possible the application of the tele-healthcare to the most varied specialization, other than those that have been already cited, like rheumatology, orthopedia, dermatology and so on.

With the terms Hospital Information Systems (H.I.S.), moreover, is defined the whole of the technologies that allows the internal communication between all the hospital areas and with the terms Healthcare Communication Network (H.C.N.) the possibilities of communication with the other structures or remote emplacement.

The first question to which it will try to give an answer through the analysis of examples is the following: “What changes inside the same hospital in terms of spatial proximity ties, of areas that shrinks or are enlarged from the dimensional point of view?”.

In other words: “What are the effects induced by the application of the data transmission technologies from the distributional and spatial dimensioning point of view?”

The possibilities of insert the information in real time on the data transmission network from any point of the structure – the patient’s room, the analysis laboratory, the operating theatres, the diagnostics department, the pharmacy, etc. – even through the use of wireless technologies, in fact, not only contribute to the evolution of the same structure towards a paperless system [**], but also notably affects the re-organization of the internal paths and of the spaces. As an example, let’s look at the possibility of inserting the data in the patient’s digitalized clinical record and having them disposable in any emplacement of

[*] In the structures that uses the video-endoscopy, those instruments film the images with micro-television cameras and transforms into analogical signals, so the computer, with appropriate high performance analogical-digital converting cards, could store the images or transmit to other computers that use the same program. See Timed, 2° Mostra Convegno Nazionale: Telemedicina informatica e telecomunicazione in sanità, Genova 20-21 maggio, 1999, http://www.it.net/timed/, (downloaded on 24/06/99)

[**] An essential condition for the complete transition towards a paperless system is the recognition of the digital signature, that is the possibility of recognize and accept as legally valid the documents transmitted through data transmission. In Italy the juridical validity of the electronical document has been introduced by the Law 57/97, Bassanini law, that at the article n.15 establish that: “the acts, data and documents created by public administration and by private enterprises with data transmission instruments, are valid and relevant according to the law”. On the 10/11/97, published on march of 1998, has been introduced the regulation to attenuate the d.p.r. 513/97 and on the 19 of october of 1998 the authority for the data transmission in the Public Administration has completed the predisposition of the referring scheme for the formation, the transmission, the filing, the storage, the duplication and the validation of the data transmission documents. See BNL Multiservizi, “multicertify, rassegna stampa”, marzo 1998, where are collected the articles related to this matter connected with the health-care sector.
the hospital or at the use of minicomputers that allows the medician to identify the patient at his bedside, to have direct access to the data of his clinical record, to order during the visit the necessary deepening and send in real time the instructions to the nurses and to the laboratory, etc.; all the above is a glimpse to the deep transformation of the dynamics that until now have governed the organization inside the hospital with an effective saving of times and costs and a greater efficiency of the service and impose the necessity of a new logic for the design of the same hospital building.

Hereinafter are reported some examples finalized to the comprehension of some of the dynamics into effect induced by the application of the data transmission technologies.

In the Ipswich Trust Hospital in the Suffolk county, United Kingdom, the first English hospital that have adopted the wireless information technology and that have taken advantage of the potentialities offered by the techniques of radio transmission of digital impulse, has been launched the process of total conversion of the clinical record on paper, into totally computerized records [\*].

In the Sarasota Memorial Hospital, in Florida, United States, that has adopted the wireless information technology, has been eliminated the admission department: the patient at the moment of the recovery is directly conducted in the hospitalization room waiting for the visit of a responsible of the admission that, equipped only with a minicomputer carry out all the admission procedures [2].

In the Donauspital of Vienna, Austria, considered between the examples of most advanced structures in Europe from the point of view of the communication technology, all the radiological exams are digitalized, the archive contains three million radiographies memorized on a computer that necessary occupy about five squared meters localized in the basement. «A traditional archive of radiological images would have requested at least 650 cubic meters, without counting that almost 30% of the archive researches is without result, because the radiological images that are needed often aren’t found» [6].

In the hospital of the University of Maryland, in the pharmacy is utilized Rxobot, “the chemist robot” that is based on the principle of the bar code [**] and on the robotics: «the system is composed of a central computer to which arrives the prescriptions with the patients codes and the necessary clinical information; of a video-camera apt to read the bar codes of the medicines and the information furnished by the manufacturer; finally of a bundling machine that seals every dose into an envelope completed with the label. It has been adopted Rxobot because elaborates in a few seconds information that would request hours or even days. The computer could absolutely confront the medicines assumed by the same patient to verify if there are side–effects, or putting heads–up against a possible allergy reaction »[7].

Rxobot, employed in 25 United States hospitals, in a period of five years has distributed 30 millions doses without an error.

[ \* ] The digital transmission technologies, of military origin, are «systems that consists of "entry stations" installed in strategical points, apt to receive data via radio in a span of 250 meters from wireless mini-computer, the so-called pocket "notebook" and so to download informations in the department pc. This technology is a lot safer and reliable of the analogical data transmission systems utilized by cellular phones, because it changes frequencies every two or three seconds. So the flexibility of access to the data transmission network becomes total, given the fact that the mini-calculators could be transported everywhere by medicians and nurses in visit to the patients». See Trenti Paroli E., “L’ospedale funziona meglio se cablato”, Telematica n.9/97, http://www.fub.it/telematica/TELEMA9/Tparoli.htm (downloaded on 01/06/98)

[**] The application of the bar code is diffused initially for the management of the supplying, in the store-room and in the warehouses and subsequently in the analysis laboratories and in the pharmacies.
Actually in the most advanced hospital structures – that in the greater part of the cases corresponds to those recently realized or rebuilt – the transition towards the “data transmission” hospital is already in effect. Hereinafter will be synthesized its principal aspects [4]:

- many or all the information on the patient, as his vital statistics, are disposable on-line, although under various formats and some specific for single structures;
- many laboratories systems are on-line and the results are disposable in all the structure and could be printed from different points and departments of the hospital;
- many pharmacies offered an access on-line to the forms, to the interactions with other medicines, etc.;
- some surgical and radiological planning are computerized, but tends to be always kept inside the department, so though external people could see the planning only the department could plan a new procedure or bring some changes;
- some hospital have at disposal a modem connection that allows to the doctors the access to the information of the patient, as for example to the results of the laboratories analysis, even from home;
- the tele–radiology is rather diffused, but its use is still limited to the request of reading of the reports;
- many systems of transcription are on-line for a remote access
- some departments of radiology utilize the Picture Archiving Communication System, principally for elaborating, transporting and seeing the images inside the department [5], at times the system includes a remote station in the key–department, as the intensive therapy and the emergency department, but still only a limited number of images modalities are connected;
- few hospitals have nowadays the monitoring stations connected for the visualization and the remote monitoring; many structures are organizing themselves for the electronical recording of the medical data (E.M.R.); the operators are moving towards the patient’s bed to capture the information and see them through the use of portable instruments. Ultimately many hospitals have already introduced some technologies of the hospital information systems (H.I.S.), but still the transition is not complete. The principal motive that will guide the transition to the completion, according to the sector experts, will be the possibility offered by the data transmission technologies to contain the costs through the reduction of the inefficiencies.

[5] The Mayo Clinic Foundation, in Phoenix, Arizona, United States has been cabled through optical fibres for the complete use of the P.a.c.s.. To install the work emplacements and design the infra-structure for the P.a.c.s. has requested a correct knowledge of the work organization. see Shearer S., Miller T., Gillen S., “Picture Archiving Communication System Implementation: the practical consideration of adapting the technology to the real world of health care operations”, in AIA, The medical equipment and technology workshop, AIA, Waschington D.C., 1999, pp.135 -137

It is previewed in fact that in the next future [4]:

- the cost of the technologies will diminish (see chap.1) in front of the increase of the technological potentialities;
- will be at disposal standardized formats of data and protocol that will allow the total sharing of the informations;
- the recording of the copies on paper support or film will disappear definitively; in as much as the high cost of the spaces for the storage of the material and the cost of the labour to manage and have access to the information will render the old system prohibitive;
- the doctors and the other professionals could see and update the data in real time, from whatever emplacement, using the portable equipment that will potentiate their capability and will rapidly spread;
- the technology will bring the information and the services where are necessary, so the operators and the patients will spent less time and efforts to move inside the hospital;
- the personnel could see a patient in the department of emergency or follow his progressions in the monitoring from remote emplacements;
- the planning of the patients will be centralized and will be more friendly;
- work charges will change and in parts will be virtually eliminated the necessity to leave the primary area of work.

All the above strengthen the thesis according to which the adoption of said technologies induces substantial modifications to the managing organization and to the spatial organization of the hospital.

Respect to the possibility to slim the entire bureaucratic system, in fact, reducing the waiting lists for the patients and lighten the job of the doctors in the making of the diagnosis [4], to the new modalities of data transmission is associated the possibility to

[ * ] It is to be considered that from the analysis carried out by the Andersen Consulting related to the daily time expended for the different activities by a doctor in a traditional hospital of 700 bed places, comes out that 30% is dedicated to the patient cure; 29% to the communication; 22% to the registering of the clinical record, 7% to the movement and 12% is under the entry “other”. See Centro Studi Economia e Sanità, Quale Sanità per l’Italia del 2000, Roma 1996, p.86
improve the relationship benefit/costs in connection with the eventual transfer from a department to another of the same hospital or from a hospital to another for a specialized consultation of patients with serious pathologies, in particular, this is made possible through the creation of the healthcare communication network with which is exemplified the access to specialized cures eliminating the geographical separation between the patient and the “cure dispenser”.

The possibility to send immediately the principal medical data of the patient – electrocardiogram, blood pressure, etc. – to the hospital, already from the ambulance, renders possible other advantageous innovations in the emergency system [8]. The clinical recording of the patient could be transferred with ease to the different healthcare operators, as for example to the family physician, facilitating his task and avoiding a duplication of the times of the anamnesis. Even at the level of the scientific research this availability of information and data facilitate the accomplishment of comparative clinical studies and of retrospective and epidemiological clinical studies.

From the spatial point of view the direct consequence is the elimination of the papery archives and the possibility to de-localize in any part of the territory the digitalized archive. Inside the hospitals should be provided suitable spaces for the custody of the different portable instrumentation, as for example the micro–computers already mentioned or machines like those for the mobile monitoring. It could be affirmed that many “instruments of the cure are moving towards the patient” and it is no more the patient that goes towards them and that the hospital is “re–taking possession of its truly medical functions”. The diagnostics area, through the use of the P.A.C.S. (Picture Archive Computer System), is the first to undergo a quick process of spatial transformation that sees the disappearance of the papery archives and of the radiological images printing area. The hospital will offer a universal access to the medical informations, filed into compatible formats, through the creation of the healthcare communication network (fig.3), in a quick development, as a direct external consequence of the internal transformation of the hospital structure [*].

Fig. (3): Hypothesis of an healthcare communication network

[*] The necessity to connect in the web different structures is felt particularly in those countries in which the great extension of the territories in their geografical situation have hence produced the necessity to “bring” the specializations in those deserted or remote areas.
As an example, the Mayo Clinic Foundation, in Phoenix, Arizona, United States, is connecting the new hospital, cabled, with a clinic 12 miles distant to have the possibility to access to the information, to the data and to the patients monitoring.

The Middlemore Hospital in Auckland, New Zealand, is about to build a network of outpatient clinics with the system of the tele-radiology. This first experiment in its genre in New Zealand, will allow to the outpatient clinic centres the transmission of the diagnostical images to the radiologists that works at the Middlemore Hospital for their explanation [9].

So in Georgia, United States, is ongoing the realization of the project of connecting 55 little cities and their rural hospitals with the major medical centres to offer the opportunity of exams and consultation between specialists, local patients and their physicians.

The Finnish experience has adopted the interconnection between the university of Helsinki and the hospitals scattered on the territory integrated with the use of mobile units of C.T. (computerized tomography) and M.N.R. (magnetical nuclear resonance) that moves on the territory and it’s been particularly satisfying for the resolution of the problems of urgent magnetical resonance exams in the sector of the neuro-traumatology.

In Italy an interesting initiative aimed to the application of the orthopedical tele-consultation have been launched since 1996 in the Istituto Rizzoli of Milano, for the patients residing in the regions of the south of Italy that necessitates a first visit of address but also of post-outpatient clinic and post-surgical programmed controls [*].

The transmission of the information from a structure towards other specialized centres finds its valid application even in particular situations like those represented by natural calamities – earthquakes, cloudbursts, etc. – or induced by the human actions – military conflicts, industrial disasters, etc. Another aspect not to be disdained are the possibilities offered by the possibility of at distance monitoring for the creation of domicile assistential networks.

In light of all the above it could be possible to shape a scenario that sees the radiology department becoming an images centre [10]. The radiology of an images centre, with a reduced number of highly specialized technicians, in fact, could carry out the coordination of all the radiological exams performed by peripheral minor units and quickly sends the reported and elaborated images in no more than some hours. Moreover the possibility of using tele-conferences and tele-consultations coordinated by the images centre could represent a further improvement in the management of the image-diagnostics especially for particular cases. This scenario previews the creation of images centres, that serves a certain portion of territory, adaptly equipped exclusively for the reporting, the elaboration and dispatching of the radiological exams coming from whatever kind of machine-system and could be imagined as the virtual depositary of the digital archives of the attended structures.

The data transmission technologies offers to the healthcare informative systems of elaboration, memorization and transmission, on which the final judgement of merit on its clinical and manageable validity and reliability it’s up only to operators. So it could be interesting to note that if initially the debate around the adoption of the data transmission technologies has posed the problem of the dichotomy between “technologization” (high technology) and humanization (high touch), putting in light the risk of the “robotization” of the healthcare, today this problem has been surpassed. «The tele-healthcare doesn’t

impoverish at all the direct relationship physician/patient, on the contrary it is exalted, giving the physician a greater wideness and exactness of information on the matters, even the remote ones, of the health of the patient\textsuperscript{[11]}. In other terms the “technologization” doesn’t excludes the humanization that is pursued not only through a greater attention to the aspects of comfort of the structure in which the cure is erogated, but also through the human relationship of confidence that is established between physician–patient and the technology could fill a determinant role as the guarantee of the results and even rendering not cruent any survey respect to the past.

References

3. Timed, 2a Mostra Convegno Nazionale: Telemedicina informatica e telecomunicazione in sanità, Genova 20-21 maggio, 1999, http://www.it.net/timed/, (downloaded on 24/06/99). This matter is of great actuality inasmuch as is sustained that in the sector of the networks the investments are not comparable with those that are implied in the power and performance increase of the workstations.
5. Virtual reality is a way for the human beings to visualize, manipulate and interact with the computer and extremely complex data». See AuKstakalnis S., Blatner R., Miraggi elettronici, Feltrinelli, Milano 1995, p.25
8. See Ace A., “From early wireless to everest”, Telemedicine today, april-may 1998, pp.16-18