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Towards logic models for the analysis and evaluation of the criticalities in chronic patients' care paths

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Abstract

Purpose – The aim of the present paper is to examine how the introduction of information and communication technologies (ICTs) can have positive implications in a territorial context, where healthcare organizations are characterized by limited organizational independence and lack of individual statutory autonomy, with limited level of integration between the involved parties (healthcare operators, managers, and patients) and an uneven management of data and of information-sharing.

Design/methodology/approach – The approach taken was an investigation based on a combination of quantitative and qualitative methods for information-gathering and data-analysis in the context of diabetes care. A case study approach was adopted with the aim of enhancing general practitioners' (GPs') performance levels through an evaluation monitoring and by controlling care paths dynamics.

Findings – The realization of the target care path for chronic–degenerative pathologies in the Local Health Trust "Naples 4" in Campania Region (Italy) led to the identification of a suitable framework that modifies, through the implementation of ICT tools, the communications dynamics and the interaction/integration for those actors involved in a patient's care path.

Originality/value – Healthcare markets are currently experiencing an acceleration of technological developments; the study tries to show how the appropriate adoption of new technologies can lead to improvements for the quality of care, managing at the same time the consequent rising costs in the sector.

Keywords Diabetes, Chronic patients, Care paths, Innovation, Communication technologies, Italy, Patient care, Health services

Paper type Case study

Introduction

The current environment named as "healthcare system" can be said to have developed according to a structure of "concentric circles" which gravitate around the citizen, the main actor of the healthcare service, independent from the state of his or her health. The services healthcare assistance are distributed along a continuum of health-illness-health and differentiate themselves in terms of complexity and intensity of care (Cicchetti, 2004) within an expansive corpus of organizational bodies, each contained within a complex ecology complete with financial, regulatory and industrial parties as well as many other organizations.

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Recently, in fact, there has been a discussion of the traditionally intended organizational-administrative paradigm, which has moved from considering these organizations as balanced systems – simple systems in simple environments – to observing and studying them as systems far from balanced – complex systems in complex environments to be handled with management models as classic as they are complex.

Paraphrasing Arrow (1986, p. 31), "the most obvious defining characteristic of the organizational evolution [of healthcare services], in the perception of the individual, is that it is fundamentally unpredictable". This means therefore that significant levels of complexity remain set apart precisely by the level of agreement (between interested parties) and by the degree of uncertainty (tied to both the internal and external setting): a rise in complexity within a system can therefore increase perceived uncertainty, since a larger number of diverse elements interact in a greater variety of ways, developing different levels of connection which in turn transform a system from "rational" to "collective" to "open" (Huber and Daft, 1987; Weick, 1995). In this context the emergent organizational form becomes the "network organization", aimed at governing the network of interdependences between individuals, organizations and communities/populations of organization (Soda, 1998); from another perspective this refers to an important body of literature centered on the analysis of service networks, which studies the movements that are set-up within a network, and whose contributions permit to recognize (or re-interpret) the Healthcare Organizations (HCOs) as complex organizations, thus modifying the cited structure of "concentric circle" orbiting a citizen: Figure 1 shows a new dynamic and fuzzy-shaped structure (Zadeh, 1994), where the diverse chromatic intensities indicate equally great levels of collaborative intensity among the most representative among the aforementioned entities: a product of the multidisciplinary nature of the approaches within the "healthcare system," and within which the possible solutions regarding division of work and coordination are virtually infinite.

The impact of ICT: change or innovation?

All of the processes that regulate and referee the organizational actions in a dynamic network are essentially based on four macro-typologies of resources (Technology Atlas Team, 1987):

(1) material means;

(2) professional skills;

(3) organizational synergy, and

(4) information.

Such an integrated combination of technical knowledge, organizational and management resources is called *technology* (Corti, 2002), that can be consequently defined as a specific type of knowledge. According to Perrone (1990, p. 281), technology can be also defined as "the whole of norms, born of study and experience, that regulate activities of transformation of nature, in light of the fulfillment of man's needs, above all with regard to the use of appropriate tools for making the products of labor more certain and less costly, in terms of time and energy invested".

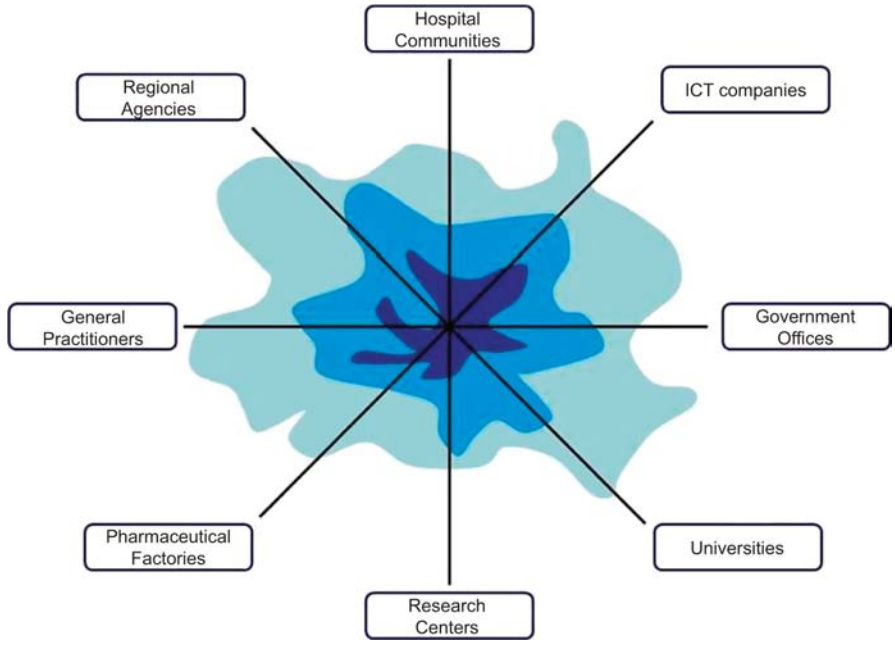


Figure 1.
The new model of network organization

The issues relating to technology management, therefore, bring back to those regarding knowledge management; in a broader sense, the same kind of resources take on the main categories of objects exchanged within a network, which can be distinguished as either tangible or intangible assets: the true added worth of a network is tied to the latter, especially if they are expressed in terms of information, through which the knowledge is communicated, shared and spread (De Toni and Comello, 2005). For this reason we can talk about "information and communication networks", wherein the combination of knowledge – intended as a modality of analysis and management of data flow and codified information – takes the name of "information and communication technology" (ICT). In the following paragraphs, which address the impact of ICTs with relation to the structural business organization, different and interrelated focus of analysis are reported, from which the development of ICT has emerged, whose main unifying element is how the ICTs have developed – and are developing – in so fast and at times unpredictable ways as to render every attempt at schematization useless (Checkland and Holwell, 1998).

The relationship between ICT and organizational framework

Starting with the 1970s and 1980s of the twentieth century (see Table I), the tasks address by ICTs have evolved from mere elaborative technologies to relationship and organizational technologies, progressively increasing the organizational impact on companies and making the phase of integrated planning between ICT and organizational structure crucial.

This phenomenon has been interpreted, on one hand (Braverman, 1974; Strassman, 1985) as a consequence of the fact that technology unequivocally determines

I Cycle: calculation technologies	II Cycle; data resources technologies	III Cycle: communication technologies	IV Cycle: relation technologies
Automation systems	Control and coordination systems	Transactions management systems	Interaction systems
Informatics as working instrument; production technology	Informatics as organization technology for control and coordination	Informatics as intermediation technology	Informatics as interpersonal relationships management technology
Procedures mechanizing	Electronic data warehousing	Communication computerizing	Interaction processes computerizing
Reduction of production costs	Reduction of control and coordination costs	Reduction of transaction costs	Reduction of transaction costs

Source: Pontiggia (1997)

Table I.
Cycles of investment in ICT

organizational shifts: ICT is therefore considered an independent variable, being part of the technical-scientific environment outside the company, which exerts an unilateral effect on organizational behavior (push); on the other hand, according to Galbraith (1973), and Sampler (1996), the informative demands are unambiguous determinants of how widespread ICT is and the extent of its use (pull); actually, ICTs are structurally modular and open, impeding any predefinition of their modality of use without a timely consideration of the specific organizational context (Boddy and Buchanan, 1986). ICTs therefore incorporate "invisible resources" (Itami, 1987), capable of creating a voice that symbolically transforms events, objects and processes, rendering them visible, recognizable and communicable in a new way (Previtali, 2004).

The interdependence between managerial processes, structure, strategy, individual and technology

The scheme proposed by Venkatraman (1991) in Figure 2, which distinguishes between levels of potential benefit obtainable through ICT and levels of business transformation induced by ICT, makes us to reflect on two important aspects:

(1) the technologies, by which it is intended technical knowledge; and

(2) the other resources of the organization.

On the first level, ICTs deal principally with making extent operative processes automated, in a sector-based and not integrated logic in which the organizational impact is limited (automate $>$ informate); on the second level ICTs are used to guarantee better integration of internal processes, while on the third level they are used to reconfigure internal processes (automate $<$ informate); after these follows a fourth level, in which the ICTs are used to redesign the entire value chain, and a fifth and last level in which ICTs' impact is pervasive and challenges the business philosophy itself, bringing the best (potential) benefits to its economy (informate rising).

This evolutionary path effectively expresses the primary role of the technological changes brought about by ICT in an organizational context: that is, a role tied to varying the level of technological or organizational knowledge, obtained, when

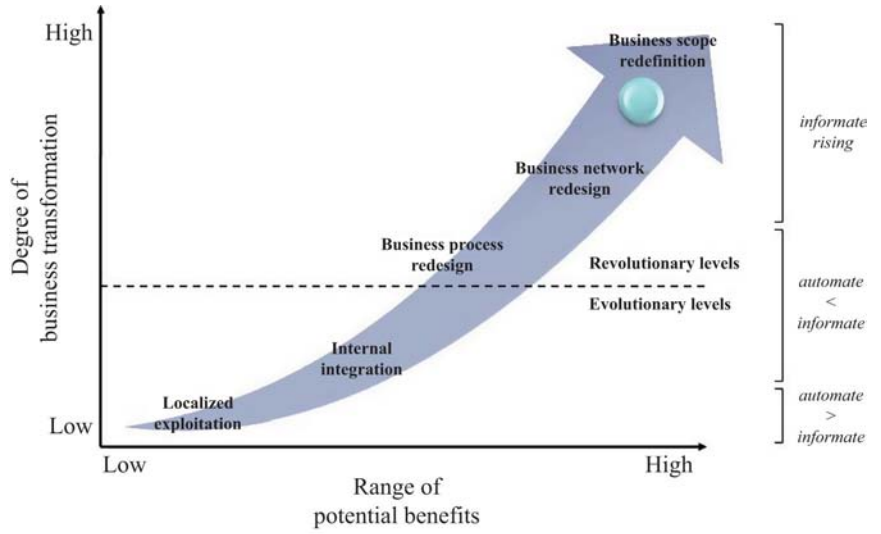


Figure 2.
Impact of ICT on organization

Source: elab. from Venkatraman (1991)

positive, by mediating the acquisition of new knowledge from an external context, or by mediating a persistent improvement in the use of already-possessed, but not entirely utilized, resources (Corti, 2002).

If the variation of quality or use of a given technology as a result is "somehow" aimed at the attainment of a concrete objective perceived as beneficial, the technological change becomes technological innovation (Corti, 2002). This is a generally complex concept, which brings together variations of technological, organizational and management know-how with the issues that pushed the organization to effect the said changes.

The growth in awareness of the necessity of a systematic and coordinated development of ICT in the healthcare sector, so as to make it a dynamic market high in potential and development, is of course moving forward at the same rate as the evolution of an organizational culture capable of influencing (mediating) the modalities with which a technology is adopted, introduced and distributed. From this point-of-view the "significance" of the technology comes from the performance (in clinical and economic terms) which it achieves in the short and middle-long terms. Likewise, the "risk" connected to the possibility of following the favorable performance or not (following both endogenous and external conditions) in respect to various quality, time and cost constraints. ICTs represent the most effective catalyst to respond to these instances, if correctly intended as models and tools for managing the information that are borne out of organizational-type elements (like the structures, characteristics of a job and nature of the environment), to introduce elements of innovation into the organizational structure (Tornatzky and Klein, 1982). Indeed, in primis these can be employed to effectively and efficiently automate production of information processes within the organization (individualization of sectors/care services or even lacking a adequate "information platform": automate); second, they

can play as "triggers" of a pervasive innovative path that tends to modify the organization's performance, its productive processes and its relationships with the operators to whom it connects (informate).

The attention paid to the dynamics of "imperfection" of the healthcare market (also defined as an "almost market" in some cases), which supports informational needs (of managers), professional needs (of healthcare operators) and health needs (of the customers), bring the use of ICT out from the background to the forefront. In this, ICT definitively appears, in a logical progression, as a response to the changes put in action and a tool for the "equality of healthcare treatment" (Borgonovi and Zangrandi, 1988). Table II summarizes the major classes of innovation developed within ICT's sphere of competence over the course of the past few years; the analysis of the literature (a brief representation of which is reported in the last column) has allowed the individualization of four overarching categories (quality of assistance, process characteristics, cost analysis, personal management) which can express, in a very functional way, the instances of both value creation and of the sustainability of the adoption of innovative medical technologies.

Knowledge management in the healthcare sector

Bringing automate and informate elements together produces the creation and dissemination of knowledge in the organizational structure, which in turn can lead to real and true competitive advantages if the link "ICT + knowledge" (Dameri, 2006) reaches the creation of intangible information assets, as a body of knowledge collected and completed by management activities and an adequate distribution among the subjects of the business system.

In HCOs, as in other environments, a large part of the information is of the tacit variety, implicit in the actions and closely linked to the development of processes due both to the extreme compartmentalization of the technical competences of individual professionals, as well as to a traditional and insistent "islands–shaped" concept of information systems which impedes information-sharing. One part of the flow of information can be instead "captured" through adequate practical solutions completed to outline processes and so as to better interpret the information product, so as to be able to integrate it into pre-existing assets in a dynamic way. The bodies of research related to the so-called Health Knowledge Management (HKM) (Ricci, 2005), whose methodology of analysis of doctor-patient typologies within organizational scenarios greatly focalizes on the concepts and dynamics of Knowledge Management Technology, points out as main goals to establishing and granting to the healthcare operators the right tools to improve the ability to chart, codify and transfer knowledge: this therefore can be treated by elements that are already explicit in the environment both internal and external to the HCOs (networking), but it can also arise from operation of processes and from the collaborative and individual activities of those involved.

It is a common opinion that the large part of HCOs are called upon to respond to two major strategic issues (Buccoliero *et al.*, 2002):

(1) the need to marry a growing demand for performance (descending from socio-demographic changes, life expectancy and health, etc.), increasingly personalized and costly, with the whole of available resources (economic, technological and administrative); and

Table II.
Matrix of innovation classes

Classes of technological innovation	Assistance quality	Process characteristics	Costs analysis	Personnel management	Authors
Electronic Patient Record (EPR); Electronic Health Record (EHR)	Control and organization of primary (e.g. operations) and secondary services (e.g. restoration activities)	Improvement of integration between hospital wards Implementation of organizational instruments (managerial, clinical, …) Implementation of communicational instruments between wards/services/ surgeries	Monitoring of pharmaceutical expenses	Increase of managerial competences	European Standardization Commitee (CEN) (2009) Groen *et al.* (2008) Currie, and Brown (1997) Cammelli *et al.* (1996)
Interventions database	Creation of a patient informatical dossier Definition of Profiles of Care (PoC)	Development of the patient diagnostic path through a web of "horizontal" processes Approach to information about beds availability and access to reservation lists	Management of contracts and purchases Hospital Therapeutic Table (HTT) update	Implementation of formative instruments (first aid protocols, online manuals, …)	Doherty *et al.* (1999) Cristiani *et al.* (1996) Halamka (2009) Casati (2000) Suorni (2001) Morosini and Perraro (2001)
Applications of telemedicine	ECGs transmission, digital photos of skin lesions, monitoring during pregnancy	Transmission in real time of scientific information between doctor and patient, through telematic/ informative communicational channels	Single Centre of Reservation (SCR) billing activities	Creation of competences concerning telemedicine managerial processes	European Commission (2008) Council of the European Union (2009) Rossi Mori et al. (2009)

(*continued*)

Table II.

Classes of technological innovation	Assistance quality	Process characteristics	Costs analysis	Personnel management	Authors
Computerising and monitoring of routine interventions	Characterization of care paths focused above particular "patient typologies"	Active protocols, that allow the support and automatization of several medical activities, such as: work-flow management (exams demand in advance, activities' peaks rating, ...), equipments control, data rating	Diagnosis Related Groups (DRG) computation and application	Better tasks sharing between medical and nursing personnel	Della Mea (2003) Sackett *et al.* (1998) Bamfi and Casati (2001) Rossi Mori (2005, 2008); Rossi Mori et al. (2007)
Deployment of medical information instruments	Overall vision of patients data Data displaying (Data selection through preordained models, e.g. pap-test recalls scheme)	Active medical record (including a model of the clinical process)	Diagnosis Related Groups (DRG) computation and application Costs definition on the basis of the implemented path	Help in encoding data from different wards, so to evaluate and improve present care models	Wikkens (1992) Della Mea (2003) Bonoldi (1998) Nonis *et al.* (1998)
Deployment of nursing information instruments	Data collecting for identifying patient needs and programming assistance plans	Informatical management of pharmacological therapies planning Nursing assistance protocols planning Assistance plans standardization	Computation of costs related to nursing therapeutic protocols implementation	Management and programming of daily activities, definition of implemented resources	Fumagalli *et al.* (1998) Øvretveit (2000)Oslash;vretveit (2000) Kaiser Permanente HealthConnect (2008)

Source: Adaptation from Tamburis (2006)

(2) the need to understand that the importance of the supplier-client relationship deals not only with the quality of service, but with the very essence of the entirety of the organization's activities.

The survival of HCOs is therefore linked to their ability to know and understand their own strengths and weaknesses in the certainty that the required change is inevitable, and demands a new mentality and a new strategy, as well as an effective organizational approach. Undoubtedly the medical act, from the first artisanal meaning or at the most mechanical, is slowly becoming a diagnostic-therapeutic productive process, becoming like a variable dependent upon an "organizational" function, whose reference system features as axes the personnel, the operational – structural spaces, and the technological milieu (Ruta, 1993).

The ICT market in healthcare: state of the art and outlook for development

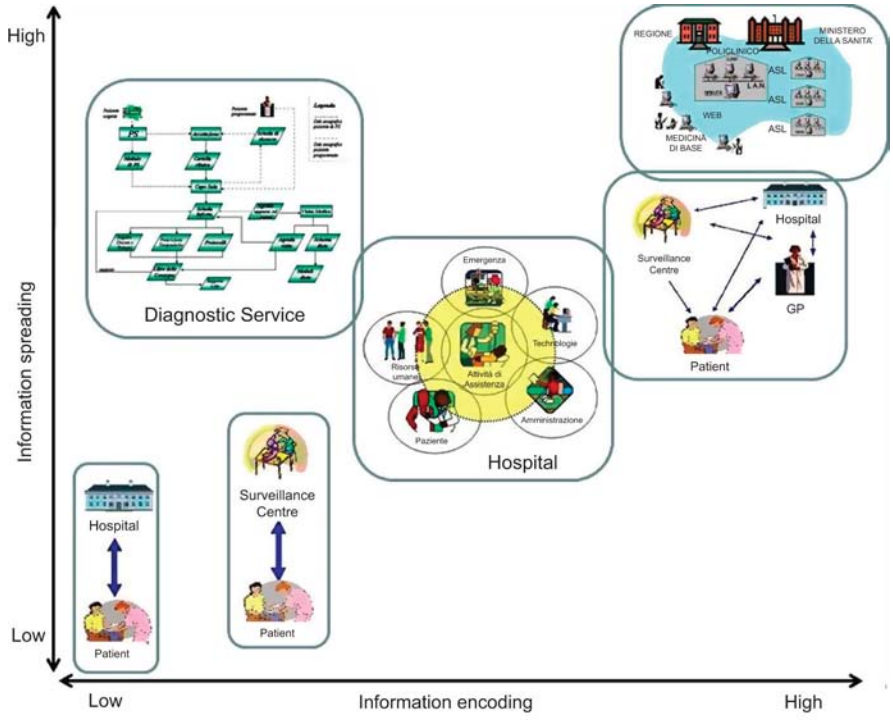
It has become evident from an analysis of international experiences that every region or country is passing through three phases:

(1) *Early 1990s:* the exchange of experiences and comparing ideas have provoked a necessary cultural growth, adding new needs, problems and solutions to our general awareness.

(2) *Late 1990s:* the common needs of the healthcare system turn into issues of political interest. National and regional governments start up huge strategic plans regarding healthcare and entrust initiatives of support for technological-informational infrastructure as well as basic services initiatives to inter-regional agencies.

(3) *2000s:* Soon after interregional agencies begin their work, the need to accelerate and balance the phases of transition, with a more complex process of change management, rises. For this reason, hundreds of millions Euros are immediately granted to "federal" operations.

The path toward a "systematic impact" scenario foreseen in the immediate future, becomes in this way substantiated by a trend toward an approach for solutions capable of integrating hardware components, software and services (infrastructural solutions, otherwise defined as *ERP* Systems) into a single solution capable of dealing with and resolving challenges of performance enhancement. HCOs can be envisioned in the near future as collection of well-oiled networks, care groups that revolve around the patient to deliver the most appropriate services through the coordination of appropriate activities and by adjusting to the needs of the client. The patient is no longer supposed to move, rather it is the service providers that move from one structure to another, all via digital communications, through a path of professional development increasingly based on a logic of horizontal communication between operative entities belonging to different HCOs – therapeutic, diagnostic, rehabilitative and at-home care. In order to fully encompass the diverse effects of these new technologies it is possible to apply the scheme introduced by Boisot (1996) to the development of ICT in the healthcare sector (Figure 3): starting from an integrated hierarchy like that of hospital-patient, the different organizational typologies tend to undergo an increasingly greater degree of decentralization of transactional structuring modalities, which correspond to an increasingly greater degree of encoding and distribution of information (Rossignoli,



Source: elab. from Giustiniano (2001)

Figure 3.
Evolution of healthcare network modalities

2000), most likely coming together to the pathology networks, the at-home hospitalization and the integrated at-home assistance (located in the medium-high part of the scheme). The multiple benefits related to the construction of a network organization in a healthcare setting (Cicchetti and Mascia, 2007), normally come back to:

- following economies of scale, by activating management centralization processes of the most important activities;
- potentially enabling organizational processes adapted to facilitate the integration of care-giving paths, as well as a steady introduction of "clinical governance"; and
- greater data-, information- and knowledge-sharing aimed at improving quality and outcome levels.

Once again the need for organization in modern medicine necessarily emerges, due to the visible fracture between perspectives of development and endurance of "weak links" among different healthcare providers: the implementation of a network implies the adoption of "non-hierarchal" organizational coordination mechanisms, which will work only when supported by a level of organizational culture that stimulates an emotive response and participation from the parties involved. The agents must also be up to the task of increasing awareness regarding the role they play in the setting of an increasingly complex system (Cicchetti *et al.*, 2006).

The research methodology

The proposed research work articulates in two main phases: the theoretical analysis (or desk analysis) and the empirical verification (or field analysis), following the traditional methodology of the social sciences (Bruschi, 1996). The adopted methodology is represented in Figure 4.

Employing ICT solutions serves as an effective catalyst through which to respond to instances linked to bettering both management and services operability provided in HCOs, for a variety of reasons:

- Starting on a steady process of care-giving quality improvement and patient and operator satisfaction (better adherence to prevention guidelines; more attentive care-giving; improving intra-operator communication; progress in pharmaceuticals' prescription and administration; reduction of medical errors; acquisition and presentation of more accurate and timely clinical data; better access to literature and clinical information; recognition among healthcare operators of the need for a higher level of professionalism; possibility for patients to access to a higher qualitative level of service); and
- Growing in efficiency, productivity and of cost-efficiency (more appropriate use of services and pharmaceutical handbooks, positive changes in the care-giving process and time-saving, more effective clinical folder archiving and recalling, better claim reimbursement management, eliminating transcriptions);

These points translate immediately into the need to:

- improve the quality of care;
- update the healthcare network model;
- develop General Practitioners' tasks, as resource to guarantee continuity in therapeutic-care, head off health issues and govern healthcare treatments using regional services and hospital networks; and
- activate adequate systems of strategic planning and company-wise results measurement.

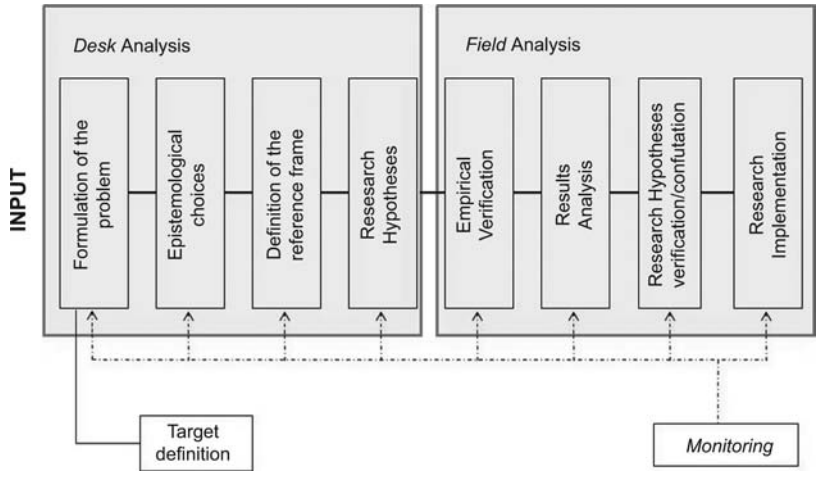


Figure 4.
The research process

These evaluations spring from the following articulation of the research problem:

> There exists a limited distribution of information and communication technologies (ICTs) within Local Healthcare Trusts that, together with a scarce level of integration among players involved, causes weak data management and information flow concerning patients' care paths.

For this reason the objective becomes:

> To define a model which, by implementing ICT tools, modifies the dynamics of communication and the interaction/integration among parties involved in a patient's care path, in order to attain an informational framework adapted to the circulation and exchange of precise, individual and complete clinical data.

The complex expression of relevant research constructs has suggested an investigation based upon the combining of quantitative and qualitative methods for information-gathering and data-analysis.

Using a case study approach, (Flanders, 1964; Edwards and Scullion, 1982) allowed to analyze the complexity of the relationships between healthcare operators – professional figures characterized by a strong propensity toward independence which accompanies and is set against an elevated sense of professional autonomy (Cicchetti, 2004) – with the aim of enhancing General Practitioners' (GPs') performance levels through an evaluation monitoring and by controlling Care Paths dynamics, to assure at last:

- the validation of the aforementioned methodological approach by means of its application and improvement in a significant number of complex healthcare operations, therefore guaranteeing reproducibility; and
- the strengthening of professional staff called to manage the passage from the initial phases of experimentation to a definitive change, by means of overseeing the expansion of the methodology to all potentially applicable healthcare operations;

From this point-of-view, multidisciplinary cooperation from a larger number of professional individuals with specialized training, under the direction of the GP, can pre-arrange the implementation of an integrated – that is, no longer departmental – management of patient data. More generally it proposes the foundations for these basic principles:

(1) Company-wide technological and operational integration.

(2) Analysis and redesign of all business practices, to verify if and how technology might become a "mediator" of interaction modalities between involved parties throughout the whole of the healthcare system, creating flexible service practices (Casati, 1999; Casati and Vichi, 2002; Del Missier and Tedeschi, 2007).

(3) The adoption of the following line of reasoning (Rossi Mori and Mazzeo, 2009), according to which:
   - the clinical and social "background" of a subject affected by a chronic-degenerative disease (requiring Long Term Care) determines;
   - the care tasks involved, which determine;
   - the burden on the Management of Information, Communication and Knowledge, which determines;

- the best group of technology solutions, which determines; and
- the expected organizational and economic impact.

The following research proposals have therefore been formulated (Table III):

The research

The empirical research was performed in two steps:

(1) The first focused on individualizing potential settings for the application of ICT solutions within the Districts the Local Health Trust "Naples 4" is comprised of, as regards the sustainability of Integrated Management programs for chronic-degenerative pathologies, with particular reference to Diabetes Mellitus Type 2. The research is carried out via the implementation of quantitative methodology tools, based on a survey administering.

(2) The second aimed to deepen the results achieved in the first step, bringing to light the relationship between different phenomena within the logics of disease management, by running a qualitative investigation (participant observation and interviews with "key informants"; establishing of a "Pathology Group").

Research scopes	Analysis units	Verification
1 Identify the actual general care path for Diabetes Mellitus Type 2 in Local Health Authority Na 4 Verify the degree of interaction/ integration between the subjects involved in the patient care path in the Local Health Authority Na 4	Subjects and groups (GPs; members of the Pathology Group involved in the care path building)	?
2 Verify the level of diffusion of ICTs in the Local Health Authority Na 4	Subjects and groups (GPs; members of the Pathology Group involved in the care path building)	?
3 Identify obstacles and advantages in the implementation of a correct process for the informatic handling of clinical data (communication network) in the Local Health Authority Na 4	Subjects and groups (GPs; administrators; members of the Pathology Group involved in the care path building)	?
4 Analyze the advantages connected to the implementation of ICT solution in the design and the validation of a reference care path for Diabetes Mellitus Type 2 Verify General Practitioners' skills in becoming process owners of the care path	Subjects and groups that have realized or are realizing a communication networking process (GPs; administrators; Pathology Group)	?
5 Identify limits and potential of the research approach framework Verify the opportunity to reproduce the research methodology to a second framework of pathologies	Subjects and groups that have realized or are realizing a communication networking process (GPs; administrators; Pathology Group)	?

Table III.
Summary of research proposals

The analysis was conducted on a sample of about 50 among General Practitioners (GPs) and Specialists (Diabetologists, in particular) operating in the districts of the Local Health Trust "Naples 4" (LHT), located in the north–east province of Naples, Italy. In this context, an early development of awareness (and a culture) about the adoption of Integrated Management programs to care for chronic-degenerative pathologies already traces back to the mid-1990s. These pathologies, among which Diabetes Mellitus Type 2, represent a collective group of pathologies, all different from one another but characterized by the same clinical path, and cases throughout the population have increased, especially as average life expectancy has increased. In such circumstances, GPs have an incredibly important role to play in both clinical and economic and managerial aspects, and represent a figure as important in the diagnostic phase of a disease, as in the prevention, proactive monitoring and early intervention therapy.

As for the following years, it was possible to get to precise data only in the population on December 31 2006 (ISTAT, 2008); looking at the operators involved in the mid-1990s experiment, it became evident, to an acceptable level of approximation, that in the decade from 1996-2006 the prevalence of diabetics grew quite steadily about 1 percent in the area, keeping all the shifts in population demographic in mind (aging, mortality, birth rate, movement from and to outside the region, etc.). Jumping off from this new data on the prevalence of the disease, it was possible to trace, with a reasonable estimate, the population of Diabetics (undergoing pharmaceutical treatment), as shown in Table IV. Finally, the professionals involved in the research study confirmed that, as to the selected population, in the four-year period 2006-2009 there was no significant variation of numbers recorded for 2006 and referenced in Table IV.

The population related to the sample group, obtained by adding up the number of patients relative to the involved GPs, is about 68.000 individuals, equal to 11,6 percent of the whole of the LHT population (according to the data represented in Table IV). It was possible to analyze the data concerning their Type 2 diabetic patients in a three-years period (2006-2008). Figure 5 and Figure 6 show the historic sequence relative to the sample's numerical trend, in an absolute sense and percentage-wise

Districts		Local Health Trust Na 4 Population	Number of diabetics in pharmacological treatment	Prevalence (%)
Acerra	*69*	48,300	2,029	4.2
Marigliano	*70*	60,801	2,493	4.1
Pomigliano	*71*	54,626	2,240	4.1
Casalnuovo	*72*	56,834	1,989	3.5
Nola	*73*	70,323	2,743	3.9
Roccarainola	*74*	41,120	1,892	4.6
Volla	*75*	65,651	2,101	3.2
Somma Vesuviana	*76*	64,542	2,631	4.1
S. Giuseppe	*77*	53,913	2,534	4.7
Palma Campania	*78*	25,473	1,091	4.3
Poggiomarino	*79*	46,557	1,955	4.2
Total		588,140	23,696	4.0

Note: Estimate at 31 December 2006

Table IV.
Representation of the reference universe (year 2006)

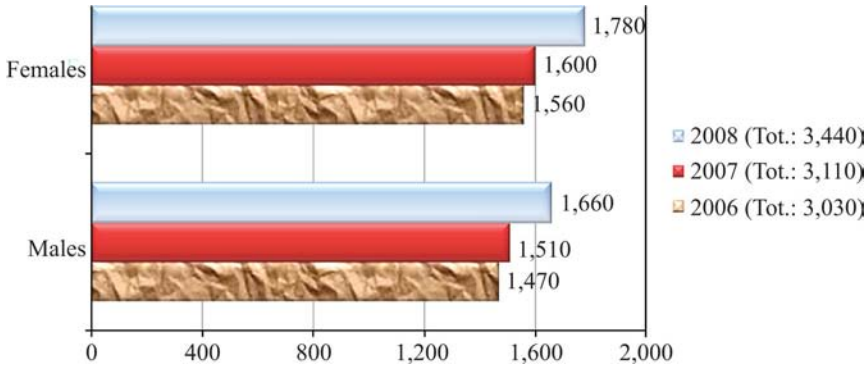


Figure 5.
Diabetic population of the sample group

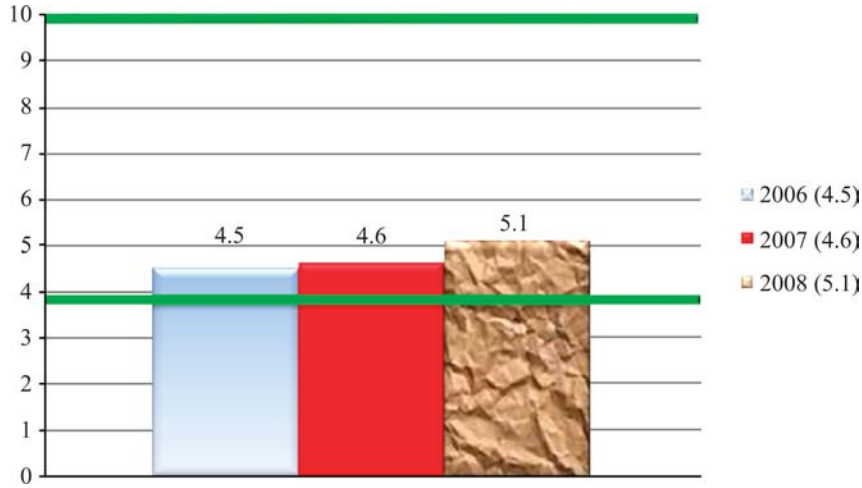


Figure 6.
Prevalence of diabetes in the sample group

respectively (displaying a variation for gender): by analyzing the latter, emerges an almost linear increase in the prevalence of diabetics, thus bringing back a study sample whose composition satisfactorily represents the larger population.

The questionnaire

The data-gathering was carried out via a timely arranged questionnaire, organized mainly with closed questions, and broken into three sections:

(1) *Knowledge of the pathology*: respondents analyzed the major voices related to the diabetic patient's management on the part of the GP, to verify the properness of behavior and the respect for both national and regional guidelines regarding the treatment of the disease;

(2) *Approach to information and communication technology*: respondent's sought to evaluated the GP's know-how as of their available information tools, as well as archiving and electronic data transfer systems. Then, their level of propensity has been verified toward an innovative approach to communication flow management within the reality of their concern (Electronic Medical Record);

(3) *Intra- and inter-organization communication flow management*: respondents sought to evaluated the whole of the level of communication and interaction/integration among those involved in the treatment plan of the diabetic patient.

The first of the three sections of the questionnaire is more properly clinical and was developed with the help of the Diabetological Specialists who took part in the research. Figure 7 indicates the distribution of the total number of patients for each GP, that ranges between about 1,200 and 1,500 patients (for the maximalists). Figure 8 shows the percentage of diabetics in relation to the patient population for each GP: it should be underlined how in this case 80 percent of the GPs involved have between 50 and 100 total diabetics under their care, with a tendency among other things to continual growth, a phenomenon that confirms the increase in occurrence of those developing Diabetes (almost entirely Diabetes Mellitus Type 2) in the reference sample just as within the entire area covered by LHT "Naples 4".

Of the selected sample, about 60 percent are the GPs operating solely in their own private offices, and the remaining 40 percent are GPs that collaborate with associated clinics; there were no other related forms of organization of care-giving in the area, like a GP Cooperative or Coordinated Medical Unit for General Practitioners/Pediatricians. All the doctors involved declared they use a computer for clinical patient data gathering and storage. Figure 9 shows therefore the percentages relative to each response, while in Figure 10 all the combinations of answers have been analyzed in response to the same question: the papery transfer of data, alone and paired with the use of the telephone, represents 60 percent of reported occurrences. Much more modest percentages regard other possible combinations ensuing from data processing.

In Figure 11 the responses provided are analyzed regarding the most relevant aspects that would result from the implementation of an information network at a

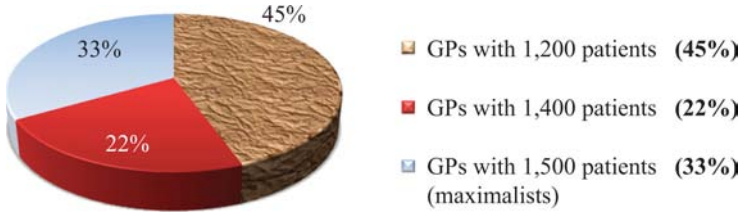


Figure 7.
Patients' larger population

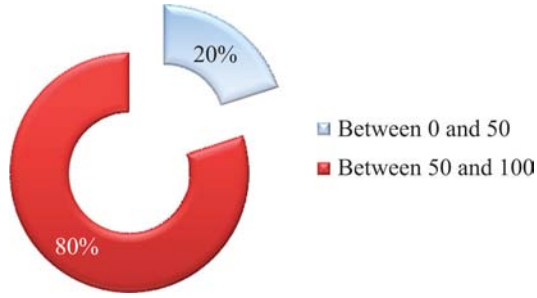


Figure 8.
Diabetic patients' population

company-wide level. The most common issues are those relative to the possibility of reducing waiting time and implementing periodic and continuous checks of their patients according to the adopted care path.

The difficulties on the part of doctors in following organizational or diagnostic-therapeutic guidelines and the low frequency with which the patients follow the prescribed treatment plan are well-documented in the literature (e.g. Cabana *et al.*, 1999; Mosca *et al.*, 2005); Figure 12 reports the distribution percentage of provided responses to questions on which aspects were considered most relevant from a shared Diagnostic-Therapeutic Path definition, in respect to protocols/guidelines approved for the management of a Type 2 diabetic patient: it's worth noting how no prevalent alternative (or group of alternatives) stands out in respect to the others. Such this situation shows the lack of a homogenous formative path shared company-wide, that thus leaves individual professionals a free choice, but actually without a real guidance, other than strong dichotomy between the hope to provide information and communication technologies, and the lack of concrete awareness of the availability of an actual investment, of their influence on work productivity, of service efficiency and the duties of operators.

Data analysis: the general care path (As Is)

The analysis conducted by studying the questionnaires has inevitably caused to underline how the introduction of information technologies, either that appear as

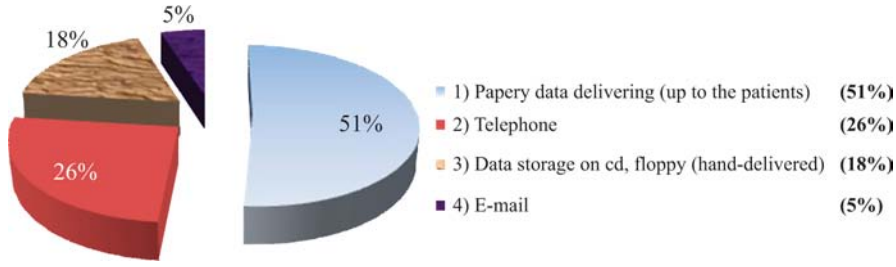
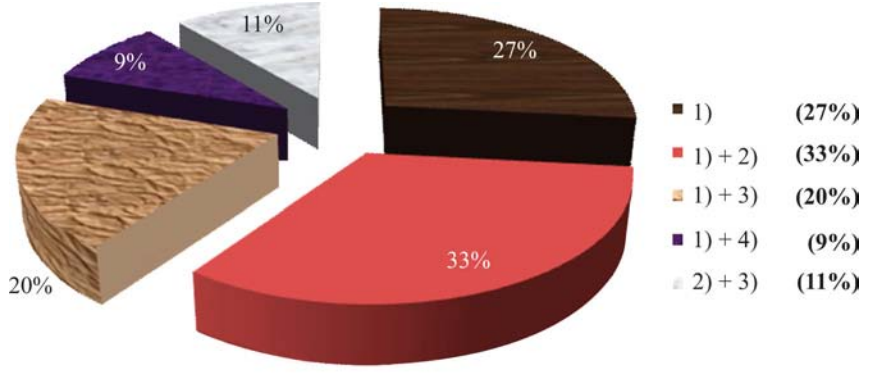


Figure 9.
Major modalities of data transfer in the district/LHT



Note: See Figure 9 for keys

Figure 10.
Major combinations of data transfer modalities

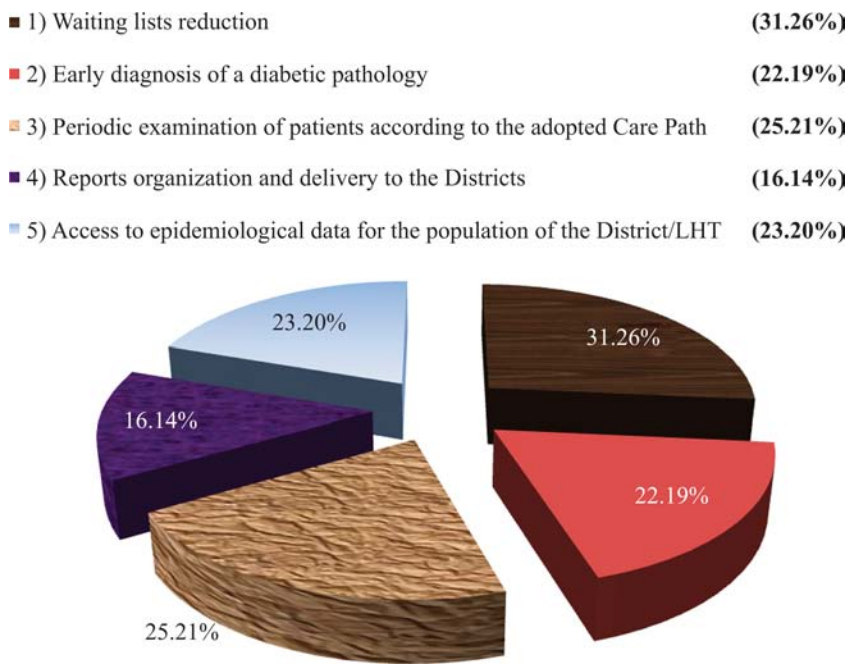


Figure 11.
Major advantages related to digital data transfer in treating diabetic patients

change or innovation, is generally experienced as an extraordinary event, rather than widespread, avoidable, outside the organization itself: perceived as a positive idea as for providing services and the relationship with users, but quick to become a negative concept when it concerns into organization, forcing its agents to modify behaviors and roles. It was possible to formalize the General CP for Type 2 diabetic patients by gathering data within the Reference Universe (Figure 13).

The flow chart seems to be the most representative form to display the logical sequence of the episodes that make up the General CP, since it is able in a synthetic and flexible way to pull out both the different performances of every healthcare operator, as well as the HCOs' modalities of response to patients' health issues. Moreover, the flow chart offers a clear vision of the whole picture of how a determined category of patients is treated in the HCO and the surrounding local setting.

The process of defining the General Care Path started with an analysis of the actual care paths designed by each individual GP, that is by displaying, for each of them, the real series of diverse episodes that make up the care-giving and treatment process of the followed diabetic patients. The best treatment path realized by each GP has been named Reference path. The synthesis of the most efficacious (from the clinical viewpoint) and at the same time most effective (from the organizational viewpoint) Reference paths has originated then the General Care Path (As Is).

Elaborating upon "As Is" General Care Path has caused various reflections and questions. In the first place, the most evident result of the experience is the consistent heterogeneity of the effective plans initially identified for the GPs involved, but above all a substantial gap emerged between them and what recommended by major guidelines for the integrated management of Type 2 diabetic patients.

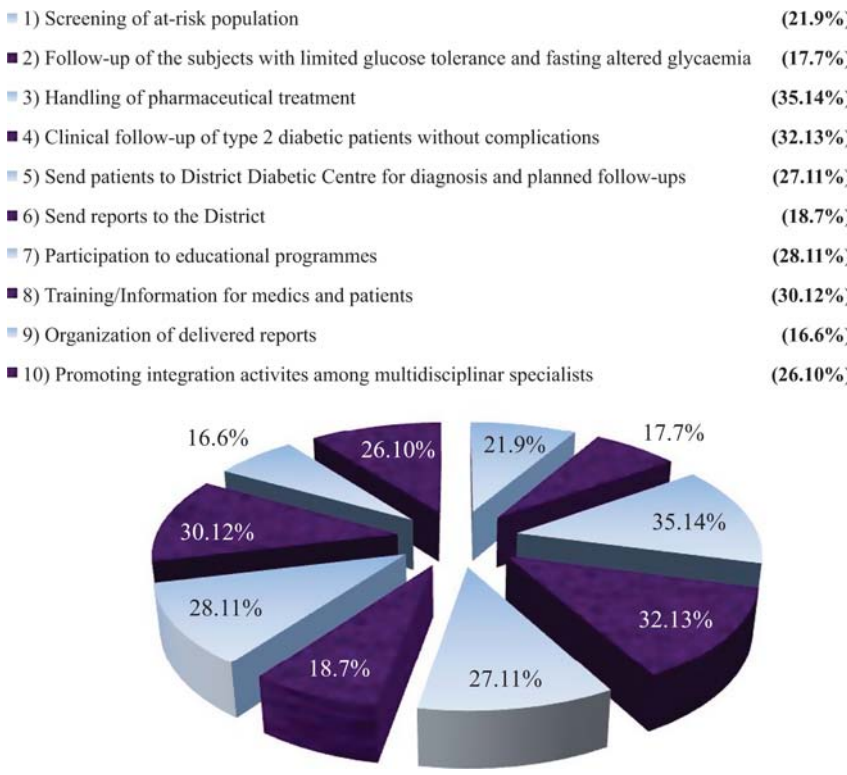
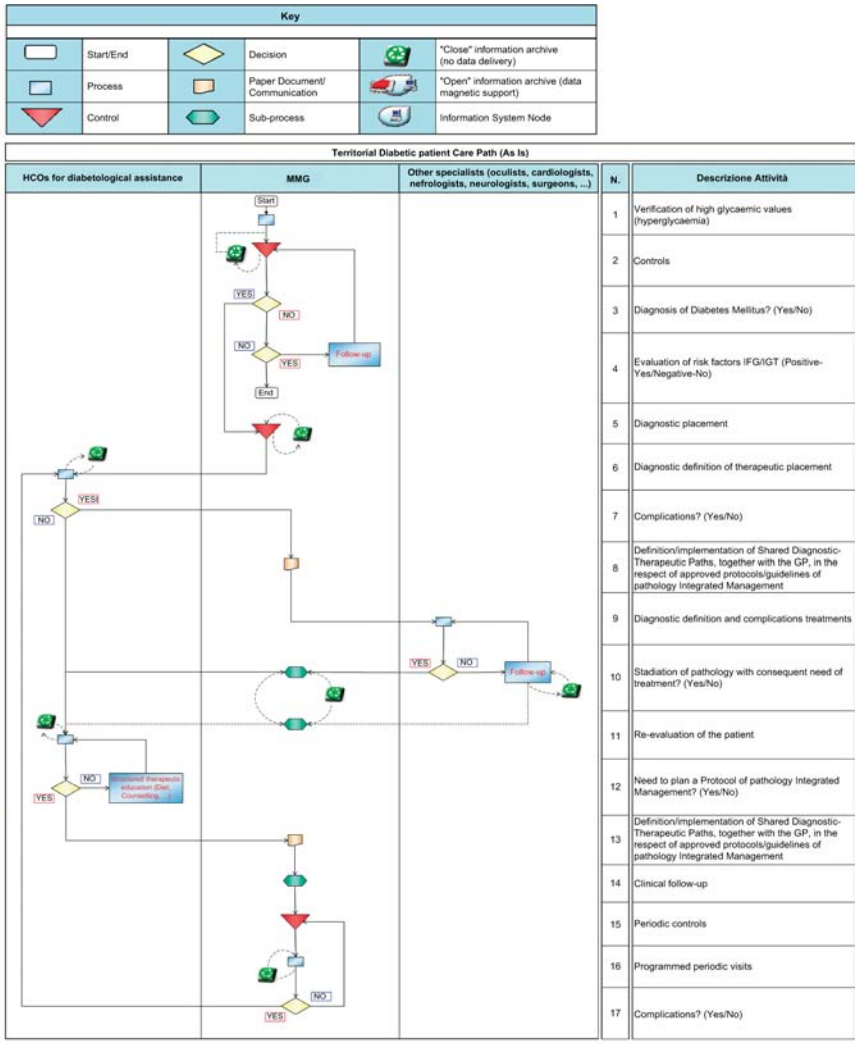


Figure 12.
Major aspects concerning the definition of the Integrated Management Path of Diabetes Mellitus Type 2

The same elaborating has brought out a general scene composed of a series of delicate, interconnected equilibriums (above all organizational), characterized by an embedded "institutionalization" process, that is the achievement, for each healthcare operator, of a whole of accepted behaviors which take on the aspects of stability and repetitiveness within one specific social context, entailing the definition of automatic decision-making models (Grandori, 1995).

Such networks of balance have involved an unequal development of the aforementioned macro-typologies of resources from which spring the integrated combination of technical know-how, organizational and management resources (Corti, 2002) on which ICTs are founded. For each of the three macro-areas the CP has been divided into (concerning: the entrance to/the exit from the CP; the development of the CP; monitoring and staging measures) a recourse of greatly limited ICT solutions has been revealed, not much as in the types of available solutions, but in the methods of employment.

Capillarity in the dislocation of centers where local organization for the management of the diabetic patient's CP unfolds does not have a correspondent in the implementation of the network organization dynamics: the GP has an extremely limited knowledge of the course carried out by his patients: the transfer of data takes place together with the patient, who physically moves from one structure to another carrying with him/her their



Note: Original source

Figure 13.
General care path flow chart

papery personal clinical history. The acquisition, on the part of operators, of clinical data necessary for transferring a patient from one step/episode of the CP to the next is often circumscribed by a limited temporal horizon, so that the final outcome is an impossibility to guarantee a traceability of the actual care-giving path.

The pathology group and the target care path

Some GPs and Specialists, among those who received the questionnaire, showed a more advanced cultural baggage, in terms of being proactive and planning ahead in

their dealings with integrated management dynamics for Diabetes Mellitus Type 2, having among other things already gathered a significant experience of collaboration with the exponents of the Healthcare Agency of Campania Region, through the accomplishment of directives promoted by the so-called "IGEA Project" (Italian acronym for: Integration, Management and Assistance for Diabetes) (IGEA Project: www.epicentro.iss.it/igea).

The opportunity to create a group characterized by a multidisciplinary and multi-professional logic – called "Pathology Group" – has been realized, with the aim of making clear the features of the studied Care Path. The first goal of the Pathology Group was to formalizing the main issues highlighted from the analysis of the questionnaires, and that became more evident by shaping the General Care Path through the use of flow charts. The output of this first step is summarized in the following points:

- difficulty in pointing out the main features and the care-giving priorities of the diabetic patient;
- difficulty in communicating to the healthcare operator, called to evaluate the same patient in different steps of the CP, the diagnostic and therapeutic issues in need of deepening or the simple subjective impressions and reflections that are not normally recorded in the file; and
- the need, especially for the GP, of a facile access to an overview of data, to set apart diabetic patients dealing with particular characteristics or problems, so as to be able to implement a file analysis with a care-giving or research aim.

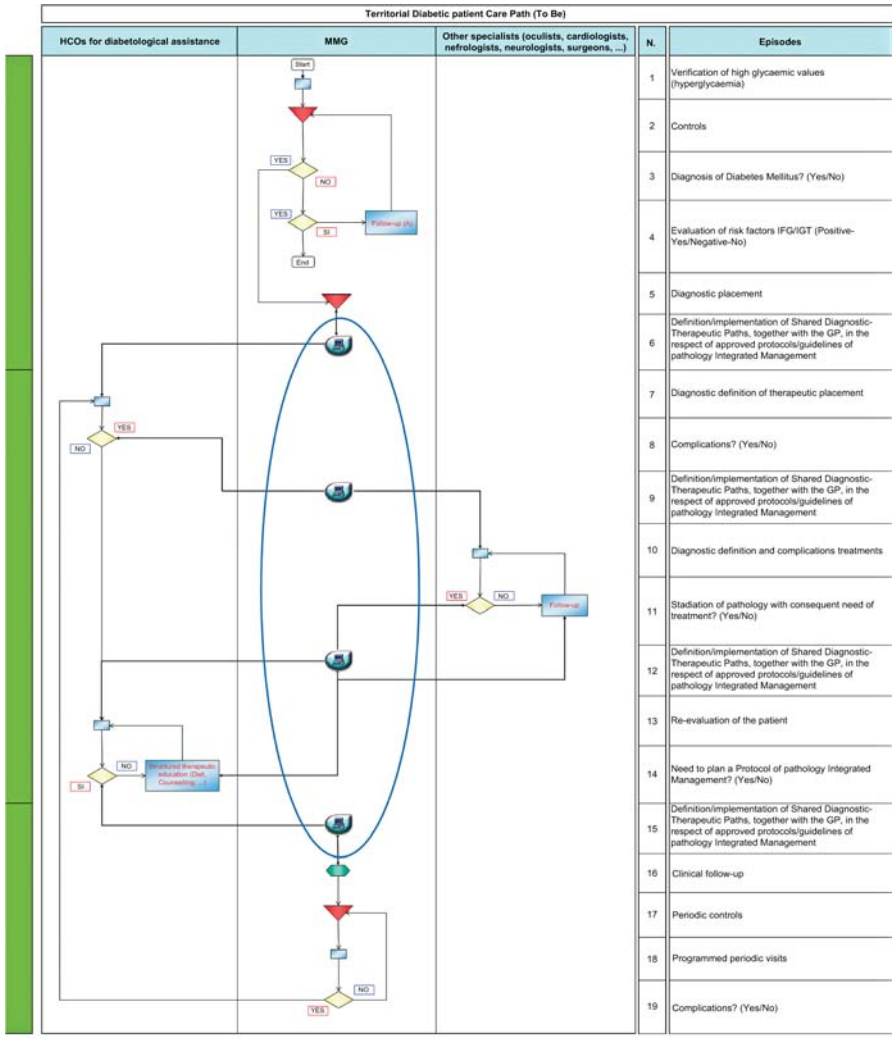
This analysis brought forth the need to move forward along a path completed by the realization of an integrated disease management, according which an effective organizational need is supposed to translate into a logical reconfiguration of care-giving processes in a local context, through the exploitation of suitable healthcare technologies, in order to:

- identify the target population;
- evaluate the processes and the outcomes;
- develop a proactive function of recalling patients within the process; and
- help healthcare operators to share, effectively and in a timely manner, the information necessary to the patient's management.

The result was the creation of a Target Care Path model, defined "To Be".

The "to be" care path

The passage from "As Is" to "To Be," represented in Figure 14, is also expressed through a flow chart; it appears as centered on the implementation of an integrated information platform (middleware) capable of supporting an electronic management system for patient data. Such middleware represents a "connective information tissue" upon which an infrastructural data-management architecture is built, whose aim is to homogenize and integrate the patients' clinical records (originating from: electronic management of documents, management of images, laboratory data-management, GP's office or specialists office, etc.), in an interoperable and interconnected setting,



N.	Episodes
1	Verification of high glycaemic values (hyperglycaemia)
2	Controls
3	Diagnosis of Diabetes Mellitus? (Yes/No)
4	Evaluation of risk factors IFG/IGT (Positive-Yes/Negative-No)
5	Diagnostic placement
6	Definition/implementation of Shared Diagnostic-Therapeutic Paths, together with the GP, in the respect of approved protocols/guidelines of pathology Integrated Management
7	Diagnostic definition of therapeutic placement
8	Complications? (Yes/No)
9	Definition/implementation of Shared Diagnostic-Therapeutic Paths, together with the GP, in the respect of approved protocols/guidelines of pathology Integrated Management
10	Diagnostic definition and complications treatments
11	Stadiation of pathology with consequent need of treatment? (Yes/No)
12	Definition/implementation of Shared Diagnostic-Therapeutic Paths, together with the GP, in the respect of approved protocols/guidelines of pathology Integrated Management
13	Re-evaluation of the patient
14	Need to plan a Protocol of pathology Integrated Management? (Yes/No)
15	Definition/implementation of Shared Diagnostic-Therapeutic Paths, together with the GP, in the respect of approved protocols/guidelines of pathology Integrated Management
16	Clinical follow-up
17	Periodic controls
18	Programmed periodic visits
19	Complications? (Yes/No)

Note: See figure 13 for the keys

Figure 14.
Target care path flow chart

harmonizing individual horizontal and vertical systems in order to feed a single clinical database which all the agents involved in defining the CP can access – i.e.: on the web.

Actually, the transition of healthcare and social documentation from paper form to electronic is very complex, and is expressed between two extreme solutions within the clinical information systems continuum (Rossi Mori and Mazzeo, 2009):

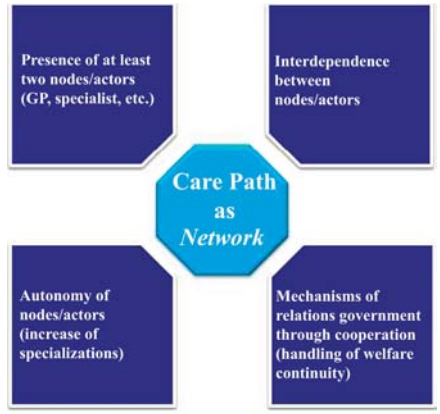
(1) the "*l*ocal clinical documentation", that is the clinical documentation that relates to a perspective concerning a single GP or a single healthcare team; this solution is also known as "Electronic Patient Record"; and

(2) the "Personal Healthcare File", that refers to more complete forms of service that provide for a way of integration and of network access, regarding documentation originating from diverse healthcare facilities with heterogeneous clinical applications. These various forms are generically known as "Electronic Health Record."

The deployment of these levels of service would allow each healthcare provider to have a broad overview on the entire therapeutic procedure, so as to be able to directly intervene on its structure suggesting not initially foreseen procedures, to put into action on patient data, or interpreting the data to make them clinically useful. What actually happens is that every GP in general sets up peculiar care paths available to his/her patients, which most likely differentiate from the ones set up from his/her colleagues, mostly because of varying work conditions that require different responses from an organizational and clinical point-of-view. Elaborating an analytic path of reference for every single professional is a complex operation that requires a significant amount of work. The benefits of interoperability that can be derived are therefore greatly emphasized, as they favor dynamics of integration between the hospital and the surrounding context, on the basis of progressively shared operations, facilitating forms of "strong" associationism among GPs. To this end, it has to be highlighted that the 2006-2008 Italian National Healthcare Plan stressed on two correlating aspects: on the one hand, the reorganization of Primary Care, to overcome the vision of primary care based on the individual offices of doctors in favor of multiprofessional organizational forms; on the other hand, the integration between different levels of assistance, to arrange a Care Paths shared by the territory and the hospital.

An inter-operational and interconnected setting helps in the same way to reconfigure the inside processes, with a stronger interweaving between the formal and informal dimensions as for the access and the integrated sharing of information: the logic sequence of the episodes the Care Path is comprised of (the "chain of evaluation") is also redesigned (automate $<$ informate), conferring renewed and elevated depth to the entire sphere of relational dynamics among the operators involved in it. In this new scenario, the CP acquires the peculiarities of a network (Figure 15), as it can be expressed as a synthesis of the following points (Soda, 1998):

- The presence of at least two autonomous entities or actors – which can be methodologically defined as nodes.
- The autonomy of the actors, that must occur even without whatever form of singular direction. To this the problem of "weak links" – that characterize healthcare providers – comes back: their need to perform high levels of autonomy has joined along time with an increase of specializations and the consequent fragmentation of skills.
- The conditions of interdependence, as strong as in the autonomy of individuals, due to a need for an increasing integration between specialized operations (Cicchetti, 2004).
- The presence of dynamics of governance of connections, based for example on reciprocal influence and cooperation (Grandori, 1995, p. 430; Ebers, 1997). The ongoing epidemiologic change, focused in great part on an increasing



Source: elab. from Soda (1998)

Figure 15.
The features of the CP as a network

distribution of chronic-degenerative diseases such as Diabetes Mellitus Type 2, forces the management of a continuity in care-giving that involves diverse organizational units at every level of the Healthcare System. In this, the deployment of ICTs allows organizations to face acute and critical situations, where the timely and effective coordination of expertise goes necessarily beyond the dynamics of simple reciprocal adaptation – certainly effective, but slow.

In such a network, the cooperation between nodes/actors allows each one of them to focus on their own distinctive skills (autonomy), even "capturing" comprehensive efficiency through other nodes (interdependency) which, in turn, can focus on and enhance their own distinct skills (Jarillo and Stevenson, 1991): this assumes primary importance especially for the GP, whose privileged and long-lasting relationships with the patient makes him/her the ideal co-leader of the diabetological team (together with the diabetologic specialist), but above all process owner of the entire process of integrated disease management, so to:

- coordinating and checking on the dynamics of communication and interaction/integration between the parties involved in the diabetic patient's CP;
- promoting, together with the other important agents, the activation of adequate systems of strategic planning and measurement of company performance;
- identifying and proposing eventual corrective measures that are tied to trade practice, or that require an intervention from decision-makers; and
- advancing a "transversal social control" by various professionals, stimulating an inter pares comparison to further appropriate normatives.

Conclusions and future prospects

The investigation conducted on the selected sample group has brought to light a high complex reality as for the organizational aspects, especially at a district level. With this in mind, most importantly as regards the management of the CP of a Type 2 diabetes patient, a strong dichotomy between clinical and organizational features has been

discovered. This behavioral asymmetry, however, causes the absence of a common background through which to convey the acquired know-how, as well as to apply the obtained skills.

The research has set forth several critical points, in particular regarding the relationships between ICT and the organizational structure (Pontiggia, 1997). Recalling Table I, it can be ascertained for example how the development of ICT for the management of the CP for Type 2 diabetes patient doesn't exceed the second cycle (Data Resources Technologies), since the "As Is" applied capabilities don't push beyond electronically recording data. Intersecting these results with the Venkatraman's diagram in Figure 2, a level of localized exploitation shows up, in which ICTs are principally exploited to computerize already-extent productive processes, within a sector-based and non-integrated logic featuring a limited organizational impact (automate < informate: Figure 16).

In terms of the tendency to regard a network as a complex organizational form, the "As Is" state corresponds to low values regarding information encoding as much as it does information spreading: the presence of sporadic and informal ties in fact is recognizable only through individual nodes/actors, tied up by rigid hierarchies that, while emphasizing individual healthcare providers' levels of autonomy, make difficult more advanced forms of interaction and integration (Figure 17).

Designing a Logic Model for the passage from "As Is" to "To Be" is therefore principally related to the definition of a common predefined strategy, which relies on already-proven information solutions, to be able to prepare a gradual plan for development, and to achieve the minimum level of know-how and services in the shortest possible amount of time: the extent (not necessarily comprehensive) of these organizational changes is obviously performed with the support of administrative bodies (first of all in the Local Health Trusts), so as to develop them in a relatively brief

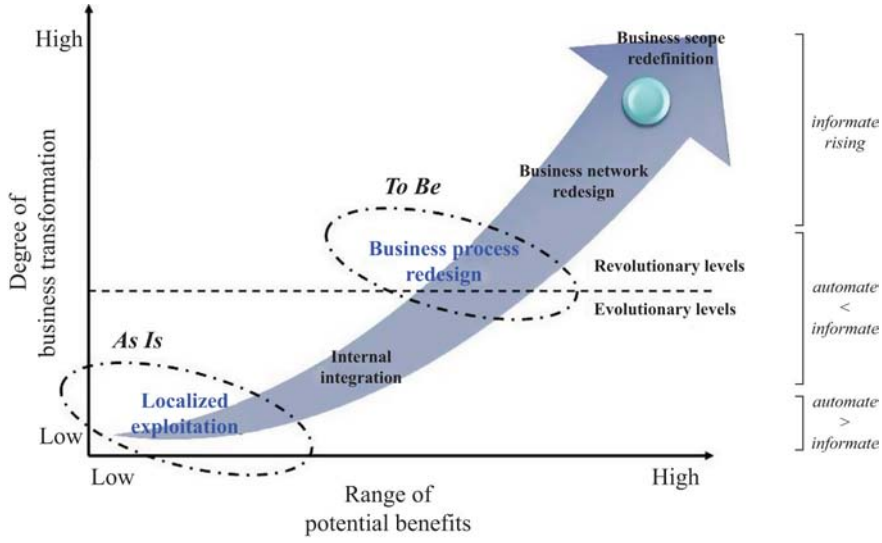
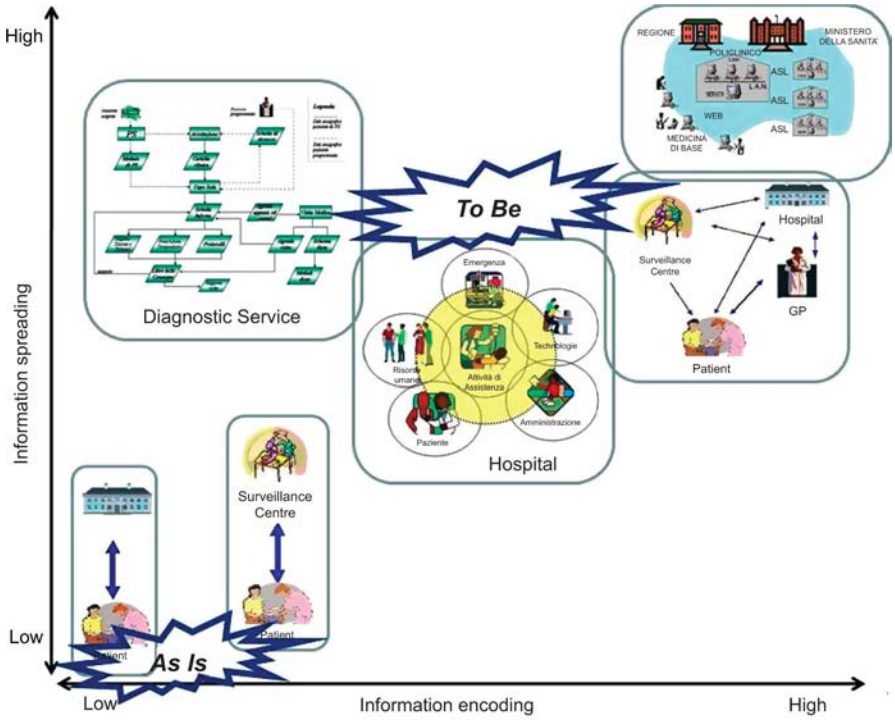


Figure 16.
Impact of ICT on the organization: "As Is" and "To Be"

Source: elab. from Venkatraman (1991)



Source: elab. from Giustiniano (2001)

Figure 17.
Evolution of healthcare networks dynamics: "As Is" and "To Be"

timeframe. The outcome can already become significant in the middle period, through a Business Process Redesign path (Figure 16) carried out in four steps (Achard, 1999):

(1) analysis of organizational connections between different processes of the care management system (both at the hospital level and local level);

(2) analysis of clinical aspects, not in terms of therapeutic methods, as much as in potential organizational connections in patients' diagnostic-therapeutic care paths;

(3) analysis of structural assets with the aim to implement process management forms that come through functional barriers; and

(4) analysis of the organizational system and of the structure of logistic assets.

The main goal is to make possible the outcome described in Figure 17.

Taking into consideration the aforementioned research targets, it becomes possible thereby to summarize the achieved research results (Table V).

The possibility to expand these developed methodologies on another block of chronic-degenerative diseases characterized by a common social impact, is supported by the methods through which the study was conducted, privileging an analysis of behavior and correlation between objective variables, inferred and shaped by observing the selected sample group, which comprehensively represented the larger population. The Disease Group made a great effort to help describe the scenarios and

Research scopes	Analysis units	Verification
1 Identify the actual general care path for Diabetes Mellitus Type 2 in Local Health Authority Na 4 Verify the degree of interaction/ integration between the subjects involved in the patient care path in the Local Health Authority Na 4	Subjects and groups (GPs; members of the Pathology Group involved in the care path building)	YES
2 Verify the level of diffusion of ICTs in the Local Health Authority Na 4	Subjects and groups (GPs; members of the Pathology Group involved in the care path building)	YES
3 Identify obstacles and advantages in the implementation of a correct process for the informatic handling of clinical data (communication network) in the Local Health Authority Na 4	Subjects and groups (GPs; administrators; members of the Pathology Group involved in the care path building)	YES
4 Analyze the advantages connected to the implementation of ICT solution in the design and the validation of a reference care path for Diabetes Mellitus Type 2 Verify General Practitioners' skills in becoming process owners of the care path	Subjects and groups that have realized or are realizing a communication networking process (GPs; administrators; Pathology Group)	Next research step
5 Identify limits and potential of the research approach framework Verify the opportunity to reproduce the research methodology to a second framework of pathologies	Subjects and groups that have realized or are realizing a communication networking process (GPs; administrators; Pathology Group)	YES

Table V.
Verification of hypotheses

the progressive dynamics for a chronic-degenerative disease like Diabetes Mellitus Type 2; their work can be seen therefore as the result of a "robust design" methodology (e.g. Taguchi and Clausing, 1990; Tsui, 1992) applied to the principles of E-Health (as the way of "improving healthcare locally and throughout the world through the use of information and communication technologies" (Eysennbach, 2001, p. 20)), in an attempt to shape a scalable and exportable model.

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