THE NEW FRONTIERS OF HEART FAILURE: INFORMATION AND COMMUNICATION TECHNOLOGIES ASSISTED

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ABSTRACT

Heart failure (HF) is a concerning public health burden in Western society because, despite the improvement of medical treatments, it is still associated with adverse outcomes (high morbidity and mortality), resulting in one of the most expensive chronic diseases in Western countries. Hospital admission particularly is the most expensive cost driver among the several resources involved in the management of HF. The present study aimed to investigate the cost of hospitalization before and after the enrolment to a new strategy (GISC) in the management of patients with HF.
***Keywords*:** evaluation, health services research, public health, heart failure, GISC

1. INTRODUCTION

The substantial transformations which the Healthcare systems went through in the late XX century saw a further acceleration during this first phase of the third millennium, showing a series of new criticalities, above all in terms of disequilibrium between the resources available and the emerging needs, in respect of which it is necessary to activate deeply innovating instruments and methods able to ensure the development of care processes which are "highly clinically efficient" and low cost.

In this perspective, the levers of change are represented by a strong reinforcement of the Sanitary Districts activities and, at the same time, by a "total delegation" to GPs of the care processes.

In such a new context, also the Sanitary District (ethics organization with business constraints) is set to undergo substantial changes, reinforced in terms of importance, with high-level specialized services, able to fulfill the complex management role of the care processes of intermediate care, that is to say of patients in subcritical phase or immediately after the critical phase, which is highly-intense and complex from a care point of view (protected hospital discharge).

We live, therefore, in a historical transition phase, whose main components are: a) demographic (population aging), ii) epidemiological (increase in chronic-degenerative diseases, with high resources consumption), iii) economic (globalization, energy crisis, recession and development of new economic powers), iv) political (increasing crisis between Cristian west and Arab world) and, v) cultural (emergence of new trends, cultural contrasts, ethical and bioethical problems).

The main transition effects in healthcare terms have been the following: i) increase in the care intensity; ii) increase in the care complexity; iii) increase in the costs concerning new technologies, iv) increase in the citizens' expectations and, v) increase in the gap between needs and traditional resources (waiting lists and clinical risk).

The evidence of the transition critical effects, together with limited economic resources, highlights a progressive and constant impoverishment of the complex system capability to effectively meet the patient's needs.

A particular criticality derives from the costs growth level of the Healthcare processes, which are linked, in particular, to the increase in the levels of care intensity and complexity and which could only be opposed by a simultaneous development of "synergy" within the system.

In other terms, in standard conditions of clinical effectiveness and patient's safety, the costs are directly proportional to the level of care intensity and complexity and inversely proportional to the levels of appropriateness and efficiency reached.

On the basis of such considerations, the current difficult situation, further aggravated in the least developed regions by possible inequality effects caused by the devolution, suggests the urgent necessity to transfer the management of the intermediate care to the periphery (district, local care), taking care to guarantee the effectiveness and clinical safety to the patient.

Among the diseases mainly involved in this phenomenon, we find complex chronic diseases which are subject to frequent severe exacerbation episodes, heart failure and OCBP. They could find a valid local alternative to the hospitalization, which could be equally valid as regards the clinical outcome and strongly positive in terms of economic outcome (significant cost reduction).

In the management of chronic diseases, the GP and the same Sanitary District, will take care, in addition to the primary care, of the global and total management of the entire intermediate care process, by activating new organization forms and new services able to guarantee high levels of effectiveness and safety at the lowest possible cost.

The problem concerning the intermediate care apparently seems easy to fix but, in fact, some elements of particular criticality still have to be solved: i) the difficulty in correctly defining the boundary between intermediate and hospital care, in order to avoid, on the one hand, a high rate of unwarranted hospitalizations (and consequent wastefulness) and, on the other hand, the far more serious increase in the clinical risk for the patient, linked to low levels of care safety; ii) the technical and organizational difficulty in creating a local care service network, very often conditioned by strained, sometimes opposing, relationship between hospital and territory; the lack of optimization of the continuity care process (e.g. lack of shared care paths).

Coleman *et. al*., (2009) said that the *Chronic Care Model* (CCM) is the reference organizational model in the management of chronic diseases able to reduce the criticalities by guarantying an approach which is: i) multidimensional (evaluation of the person as a whole), ii) multidisciplinary (involvement of several professionals), iii) multilevel (integrated service network) and, iv) continuous (care continuity/taking charge)

It aims at: i) improving the quality of life; ii) preventing the disability and the lack of self-sufficiency; iii) containing and rationalizing health costs through care systems based on the integration and the innovation using organizational systems of GPs (group medicine, etc.), by leveraging the relationship of trust between GPs and patients, following multidisciplinary settings.

It intervenes in the decision processes: i) definition of the precise clinical processes for each pathology; ii) support of the integration among GPs, nurses, specialists and patients; iii) definition together with the patient of the personalized care plans.

It uses the information system: i) a software which has the function of medical records, which becomes the decision support and permits the data collection for the evaluation of chosen indicators and the quality checking.

Self-management support: i) supporting the patients also with the help of nurses, trained in communication techniques and patient's coaching and, ii) making patients responsible by helping them to keep their attention high on the objectives of the care plan.

Application fields: it applies to all complex chronic diseases at high care intensity rate (cardiovascular diseases, chronic respiratory diseases, dementia, rheumatic diseases, malignancies).

CCM develops in processes and applies to the different care levels, which have to be in line in advance with the GP: i) the first care level is assigned to GPS and it takes place, in particular, in the context of the most developed association forms (group medicine), through the institution of: a) devoted clinics (e.g. for diabetes, heart failure, OCBP), where the so-called first care level for such diseases operates. The "Disease and Care Management" operates in this context too. It employs nurses specifically trained in the development of educational projects (improvement of lifestyles), in order to globally manage the disease, b) model based on General Medicine Units with the presence of the Care Manager nurse and, c) district nurse clinics and LCC linked to General Medicine, ii) the second care level is the area of "Disease and Care management" integrated care. It is the revisiting of the present specialized care, which is a merely "impromptu" consultancy, transferring it to clinics for its chronicity, where a teamwork, together with GPs, is expected.

The first level of Chronic Care Model (CCM)

The main protagonist of the first level of CCM is the GP, above all if we take into consideration the always growing adhesion to advanced care models (Group Medicine expected by National Contract).

The main, but absolutely substantial, innovations introduced by the agreement are the *local teams***,** which deeply transform the figure of GP, who no longer merely provides services, but they are introduced in their own right to the responsibility of care service management within the district.

The cooperation among doctors has the aim of reaching the following goals: i) effective care homogeneity thanks to DTCP (common diagnostic and therapeutic care path) sharing; ii) care continuity; iii) solution to the waiting lists dealing with the most serious and common diseases and, iv) promotion of health education activities for the citizens.

The second level of CCM: the evolution of specialized care

The second level of "Chronic Care Model" must be realized through a slow but constant and permanent process of the specialized care services transformation, with the transition to more and more specialized models for the management of the main and most serious chronic diseases, going from *chronic diseases clinics*, *integrated clinics*, to more advanced systems as the *Day Service Clinics(DSC)*, which deal with the management of the most complex clinical records, with multidisciplinary, even invasive, services and *Integrated Multidisciplinary Services (I-MDS)*, which represent the highest integration level, Day Hospital (or Day Surgery) and of Integrated Home Care (IHC).

Heart failure epidemiology

Heart failure is one of the main failures of all the heart diseases. There are more and more patients who, thanks to new medical and surgical therapies, survive and who later develop a heart failure. Its predominance dramatically increases with age, occurring in 2% of people whose age ranges between 50 and 59 and up to 10% of people older than 75 (Bleumink *et al*., 2004).

Furthermore, it also represents the first cause of hospitalization, in patients older than 65 (Framingham Study).

Heart failure affects over 14 million of European people and over one million of Italian people. It is estimated that the number of people who will face this disease is growing and will double within 2030.

In Italy 170000 (Figure 1) new cases are reported every year and there are 500 hospitalizations every day (Gigli *et. al*., 2009).

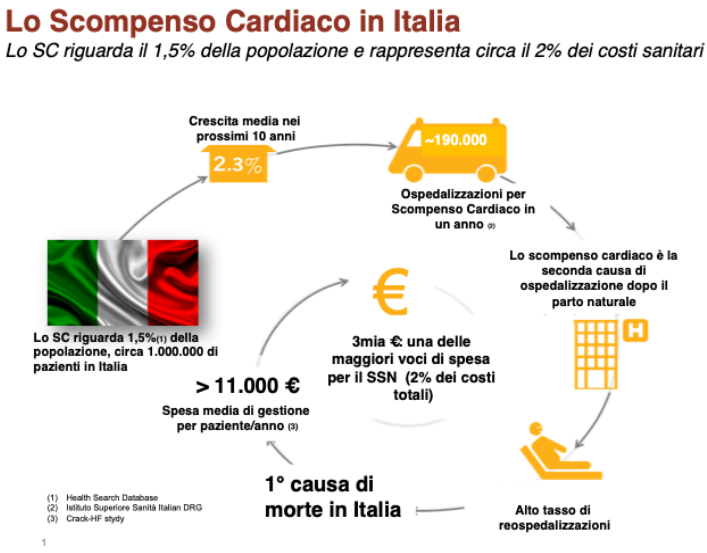


Fig.1: Heart failure in Italy[3].

Heart failure in Italy

HF concerns 1,5% of the population and represents around 2% of health costs.

[3] In Italian

HF concerns 1,5% ((1) Health Search Database) of the population, around 1000000 patients in Italy

↓

Average growth in the next 10 years – 2.3%

↓

Hospitalization for heart failure in a year ((2) Istituto Superiore Sanità Italian DRG) – 190000

↓

Heart Failure is the second cause of hospitalization after natural childbirth

↓

High rate of rehospitalizations

↓

First cause of death in Italy

↓

> 11000 €
Average management expenditure per patient/year ((3) Crack-HF study)

↓

3000 €: one of the highest items of expenditure for the NHS (2% of the total costs)

In Apulia Region, the data related to the ordinary hospitalizations with DRG 127 (Acute Heart Failure) highlight the trend and increase in these hospitalizations (around 150000 per year), mainly in the older age group.

Apulia is the seventh region for hospitalization rate: 372.6 hospitalizations out of 100.000 inhabitants versus the national average of 307.4.

In particular, ASL/LE has a hospitalization rate for heart failure of 326.8 out of 100.000 inhabitants.

The above hospitalization rates (Ministry of Health source 2007-08) refer to a population between 50 and 74 years old and they are underestimated.

In addition to the increase in hospitalizations, there is a significant percentage of re-hospitalizations equal to 40% within 6 months; mortality rate, which is itself high, is equal to 50% within 5 years and to 80% within 10 years; i.e., extremely complex and ineffective clinical management of these patients.

Since 2003 heart failure has been the second cause of re-hospitalization after childbirth in Italy.

The need for innovative management solutions for the chronic heart failure arises from the dimension of the problem and the characteristics of natural history: in fact the clinical evolution not always shows a gradual and

progressive and thus predictable trend but, on the other hand, it is often characterized by "unexpected" instabilities, not always connected or linked to new cardiovascular events.

The coordinated management of the heart failure, chronic disease at high risk and high costs, is considered to be able to provide a high quality level of care together with a consistent saving of health costs: it is about ensuring a care management in a structured manner, both in the acute phases and above all in a long term care, with a global vision of the patient and an integration among the different care settings.

In recent years different organizational models of heart failure management have been proposed. They aimed at the *disease management* with an accurate medical practice and with the active involvement of the patients in the treatment of their diseases (Salvin *et al*., 2012).

In the Anglo-Saxon world some organizational models were above all experimented. They were realized by involving nurses, with mainly telephone interventions and aimed at teaching the patients to manage themselves autonomously (*self-care*). These programs have not reduced the hospitalization episodes, nor the mortality, nor costs.

In Italy reference is made to model of the *dedicated clinic* type, which reduced re-hospitalization and mortality, but not to an acceptable extent, despite the significant development occurred in the last decade of the pharmacological therapy associated to the progresses in the electric therapy through the ventricular resynchronization and automatic defibrillators. So, the heart failure continues to be a highly lethal and high-cost disease for the healthcare systems.

The GISC (Gestione Integrata Scompenso Cardiaco) experience, which takes charge of patients affected by heart failure on the model Chronic Care Model realized by two Health System Districts of ASL Lecce, demonstrated that for this type of patients the activation of a continuous, intense and integrated clinical assistance (at the hospital, clinic or home), with the close collaboration of the general practitioners, ensures a better quality of patients' life affected by it, a mortality reduction, re-hospitalization reduction and consequent expenditure control.

The evolution of the care model to apply in the future is the Chronic Care Model Information and Communication Technologies Assisted (CCM ITC), able to further improve the communication among the different participants, through the routine and up-to-date use of web based computerized medical records and the support of Telemedicine which facilitates the immediate identification of a clinical problem of the patient affected by Heart Failure and the immediate activation of the care path (Buccoliero, 2010).

These new innovative systems are part of the integration network between Hospital and Territory for the management of patients with Heart Failure.

Our project on the Integrated Management of Heart Failure "GISC"

Innovation and integration are the pillars of the GISC experimentation, which is taking place in the Healthcare Districts of Poggiardo and Gagliano.

It is a care model which is inspired by *Chronic Care Model* and based on the Clinical Governance principle.

Chronic Care Model is a functional model and an operative instrument, which contributes to improve the quality of care processes and reduces the costs (optimization of resources use) of chronic diseases management during the non-acute phase (primary and intermediate care).

It is a model able to fulfill a double role: on the one hand it contributes to improve the quality and effectiveness of the care processes; on the other hand, it helps to reduce the care costs thanks to the improvement of the required appropriateness levels.

The G.I.S.C. project is based on the Clinical Governance principle, that is to say the participated and shared management mode of all the health, healthcare and social problems.

It is a model which marks the landmark transition from the so-called defensive medicine to the affirmation and development of the preventive medicine, which realizes itself through a global approach to the disease (*Disease Management Approach*) and to the citizen user (To Care).

In brief, it is a model which guarantees: i) management and control of chronicities thanks to pro-active interventions (you intervene before the disease occurs), ii) care homogeneity thanks to DTP (common diagnostic and therapeutic care path) sharing, iii) families, patients and community involvement, iv) integration between primary and secondary care; v) shared care paths and guidelines, vi) risk stratification, vii) differentiated management of the gravity level, viii) care continuity for citizens, also in case of deferrable urgent conditions; ix) solution to the waiting lists connected to the most serious and common diseases and, x) health education activities for citizens.

The present care model is not appropriate, since it is centered around hospitalization and specialized services, which solve emergency/urgency, but are not able to deal with chronicity.

The consequence is that if on the one hand a reduction of hospital mortality is demonstrated, on the other hand there is no parallel reduction in the mortality out of the hospitals, because of a high precocious mortality after discharge (30% of mortality within 6 months).

The lack of a substantial improvement of the prognosis is due to an under-utilization of home drugs, to inadequate follow-ups, to deficient information to the patient regarding their lifestyle or lack of assistance, to late request of medical intervention in the presence of warning symptoms.

These are the reasons which led the Local Health Authority of Lecce to start on the 30th May, 2011, in the territories of the Healthcare Districts of Gagliano del Capo and Poggiardo an experimental project of "Integrated Management of Heart Failure", for deliberation n. 2658 of 06/08/2009 and inserted in the economic document of Apulia Region, year 2010/2012.

The experimentation proposed an integrated model of diagnosis and care, shared among General Practitioners (75 from each Districts), hospital Doctors from the Divisions of Cardiology and Internal Medicine of both Districts, outpatient Cardiologist and the Care Manager, supported by a powerful and effective computerized communication system which the network guarantees (Figure 2).

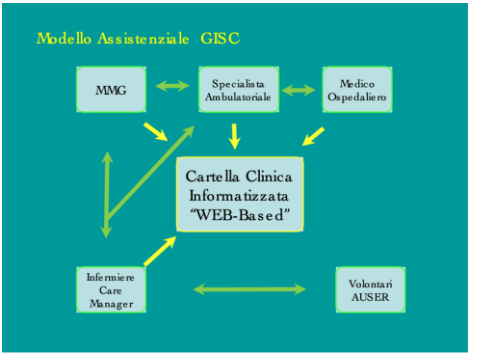


Fig. 2: GISC Care Model[4]

GISC Care Model

GP **Outpatient Specialist** **Hospital Doctor**

"WEB-Based" Computerized Medical Records"

Care Manager Nurse **AUSER Volunteers**

[4] In Italian

Clinical instrumental data of the patients with heart failure are transferred from the cardiologist, at the moment of the diagnosis, real-time on a web-based computerized platform to GPs. The GP accepts the suggestions, shares the path, constantly updates the medical records and communicates the clinical picture and all the following treatment variations to the outpatient and/or hospital cardiologist if necessary.

The following check-ups are carried out on a fixed-term basis at home for the unable patients and at the district clinic, twice a month at the GPs' and every three months at the outpatient cardiologist's, every time warning symptoms make it is necessary.

If the course does not present any instability, the patients are checked up after three months, six months or one year.

We followed these two strategic lines which are interconnected: **i) taking charge of patient:** a) planned clinical-diagnostic-instrumental monitoring, able to follow the disease in different evolution phases; b) hospital-territory integration through an effective communication (*web-based computerized platform*); c) implementation of the most effective therapies with follow-up personalization according to the patient's health needs and, **ii) global education process, patients and relatives counseling**: a) involvement of families supported by the volunteering associations (AUSER) for many disadvantage and poverty situations.

The objective was to demonstrate that a Multidisciplinary and Multidimensional Integrated Management Model can: i) improve the quality of life of patients with heart failure; ii) reduce hospitalizations; iii) reduce mortality; iv) have a remarkable impact on management costs of such a complex chronic disease.

The real experimental phase was preceded by the signature of Memorandum of Understanding among the General and Health Directorate, District Directors, managers of Complex structures of Tricase, Gagliano, Poggiardo Hospitals, GPs and their Union representatives, outpatient Specialists, provincial AUSER Manager (Associazione Nazionale Servizi Anziani).

There was a period of training for all the professionals involved, including associations and volunteers.

Follow up results one year after the enrollment

The reference area includes the two healthcare districts of Gagliano del Capo and Poggiardo (Figure 3), where there are 30 municipalities with an overall population of about 130,000 inhabitants (tab. Figure 3). 75 General Practitioners of both districts, the hospital cardiologist and the district outpatient cardiologist from Gagliano del Capo and Poggiardo joined the study.

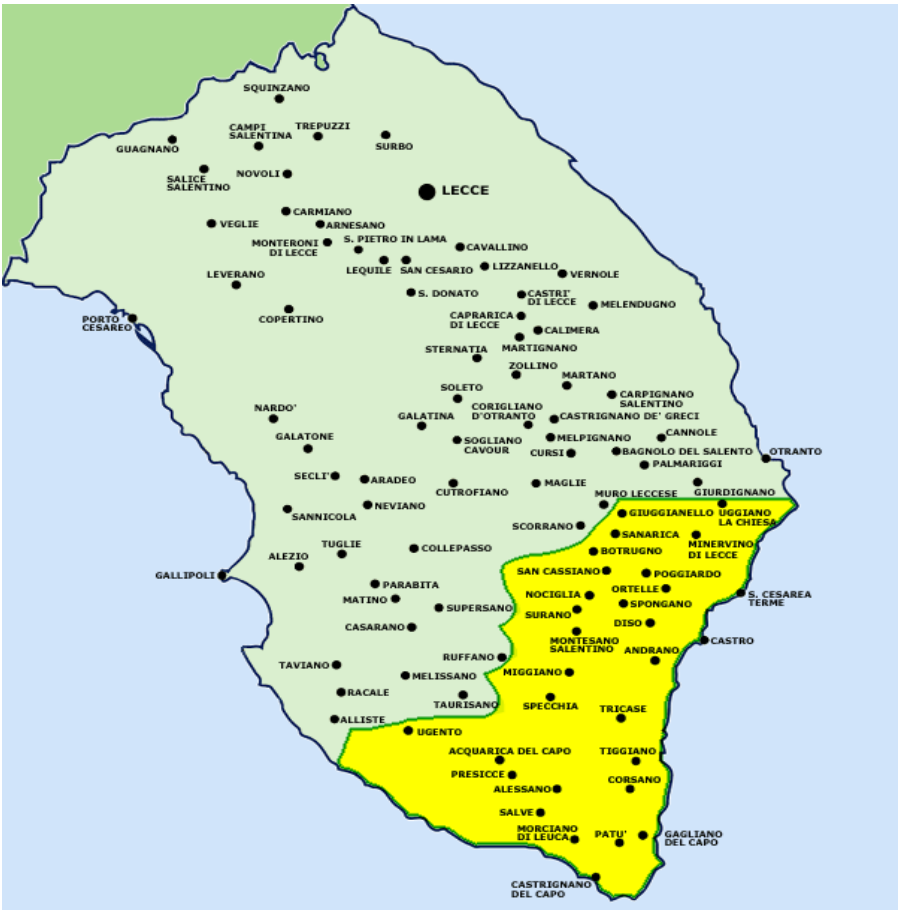


Fig. 3: Lecce.

ASL di Lecce, Distretti Socio Sanitari di Poggiardo e Gagliano del Capo
130 000 Inhabitants
31Municipalities
Department of Cardiology Tricase Hospital
75 General Practitioners
1 Outpatient Cardiologist

The updated data to 31/10/2018 concern the taking charge of 600 patients from the 01/07/2011: 55.03% of WOMEN and 42.80% of MEN, with an

average age of 71. The instrumental clinical controls carried out by the doctors taking part in the test were a total of 12088.

The General Practitioners carried out 9287 and the Outpatient Cardiologist 2801.

Etiology

The etiological classification of the observed patients with heart failure concerns a large percentage of 50% hypertensive Cardiopathy, followed by 25% ischemic heart disease, 14% Valvulopathies, 8% dilated Cardiopathy, and in a small part mixed forms: 1% Hypertensive + Valvopathy, 2% Ischemia + Valvopathy (see chart 1).

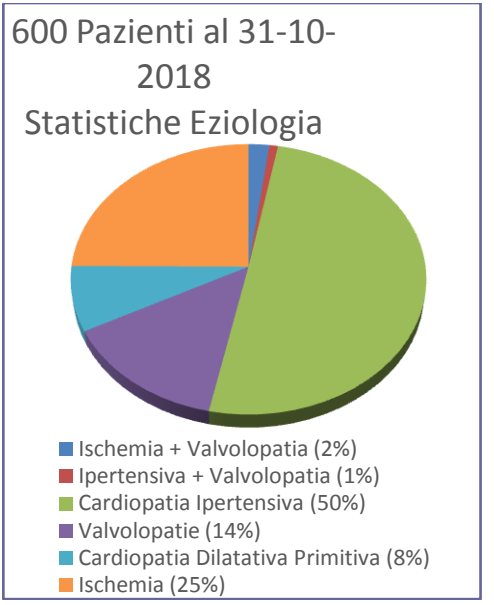


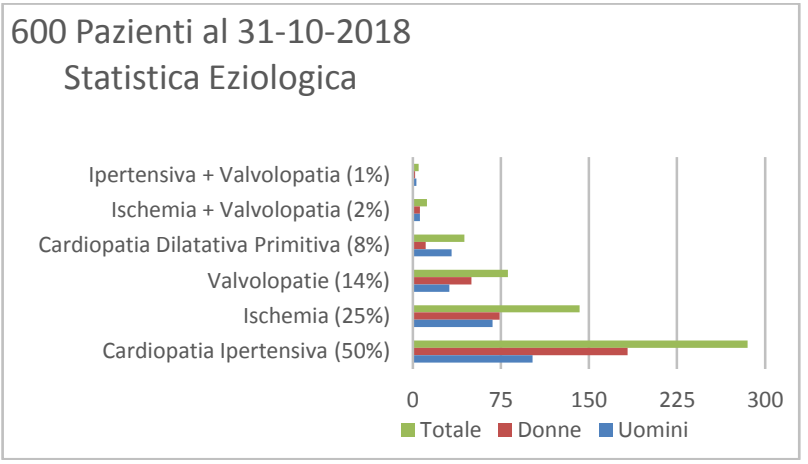
Chart 1: Etiology statistics[5].

600 Patients at 31/10/2018
Etiology Statistic
Ischemia + Valvulopathy (2%)
Hypertensive Cardiopathy (50%)
Dilated Cardiopathy (8%)
Hypertensive + Valvulopathy (1%)
Valvulopathies (14%)

[5] In Italian.

Ischemia (25%)

Prevalence of females (about 55%) for all etiologies except for the prevalent male Dilated Cardiomyopathy. All patients had at least three risk factors, and at least two co-morbidities (Graph 1).



Graph. 1: Etiological statistics for men and women. [6]

600Patients at 31/10/2018
Etiology Statistic
Hypertensive + Valvulopathy (1%)
Ischemia + Valvulopathy (2%)
Dilated Cardiopathy (8%)
Valvulopathies (14%)
Ischemia (25%)
Hypertensive Cardiopathy (50%)
Total women men

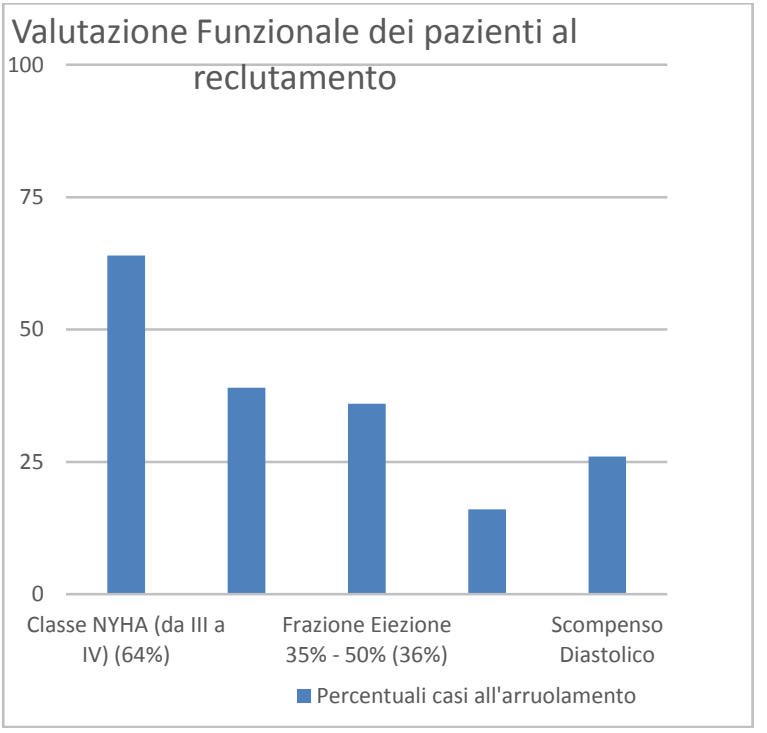
The total number of observations was 12088 from 01/07/2011, with a gender difference, higher for women (7697 observations) than for men (4315 observations).

9287 general medicine check-ups and 2801 specialized check-ups were carried out on 507 patients.

At the time of enrollment, 64% of patients were in NYHA III-IV functional class; 39% had pulmonary hypertension; 36% had an ejection

[6] In Italian

fraction between 35% and 50%, while 13% had an ejection fraction lower than 35%; 26% of patients had diastolic heart failure (Graph. 2).

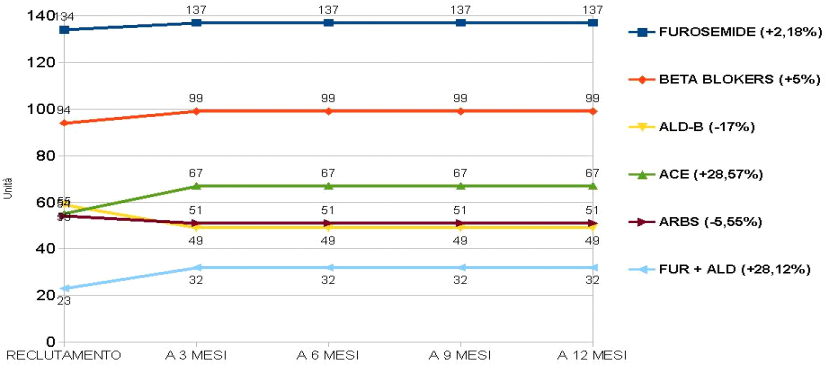


Graph. 2 Functional evaluation of patients at the time of enrolment[7]

Functional evaluation of patients at the time of enrollment (Graph 2)
NYHA Class (from III to IV) (64%)
Pulmonary hypertension (39%)
Ejection Fraction 35%- 50% (36%)
Ejection Fraction 35% (13%)
Diastolic heart failure (25%)
Percentage cases at the time of enrolment

During the follow-up of the first 3 months, we optimized home drugs therapy, customizing it according to international guidelines (McMurray *et. al*., 2012), and we evaluated the need for electrical therapy in patients with extremely compromised ventricular function (Graph 3).

[7] In Italian.



Graph 3. Drugs trends every three months

Patients were subject to instrumental and laboratory clinical check-ups.

The reference standards were left ventricular function (FE), heart rate, pulmonary pressure and the dosage of atrial natriuretic hormone (Bnp), renal function, blood count liver function, vit. D, the PHT, PCR, etc.

If F.E. < 40% are semestrial, if F.E> 40% control is annual (Figure 4).

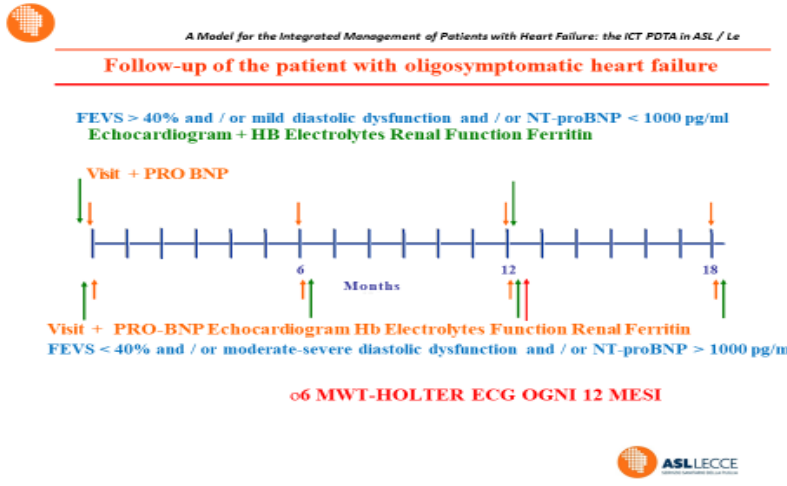


Fig. 4: A model for the integrated management of the patient with heart failure: the ICT PDTA in ASL/ Le.

The GP every 15/30 days currency controls lifestyle adherence, taking medication, symptoms (dyspnea, palpitations, asthenia), objective findings (HR, PA, weight, edemas, pulmonary and/or peripheral congestion, respiratory acts /min): to return to web-based clinical briefcase.

If one of the parameters included in the web-based clinical record is not normal, our software reports an alert: in this case the cardiological check is immediately anticipated.

The results to date are very relevant (Chart 2 - 4).

The controls clinical and instrumental after 1 year from the beginning of the program checks demonstrate an improvement in the functional class, a significant recovery of the ejection fraction, as well as a clear decrease in pulmonary pressure, decrease in atrial natriuretic hormone (TAB 9- 12).

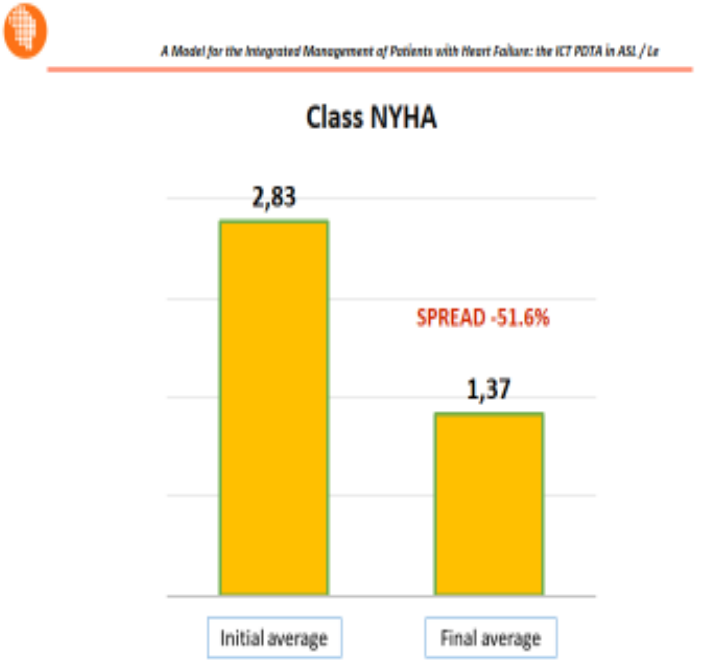
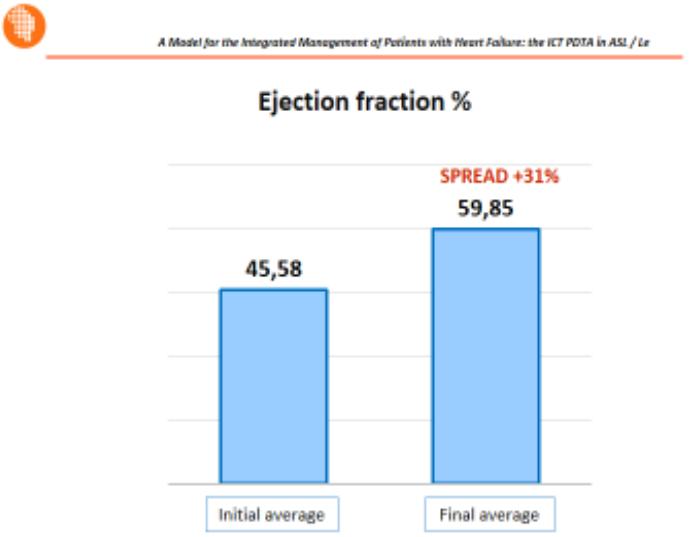


Chart. 2: The model for the integrated management of the patients with heart failure: ICT PDTA in ASL/Le.



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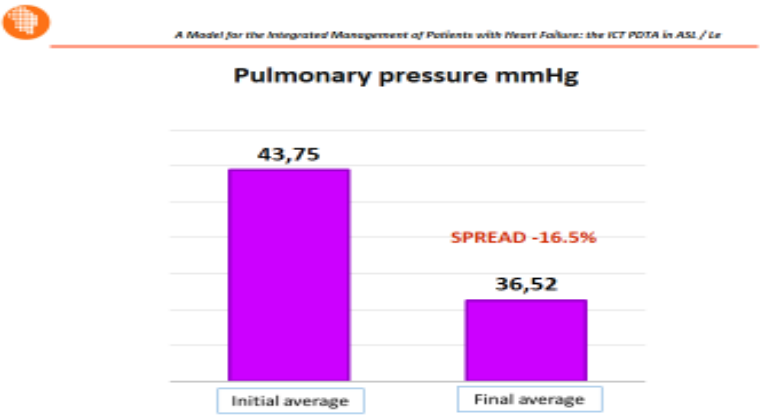


Chart. 3: The model for the integrated management of the patients with heart failure: ICT PDTA in ASL/Le.

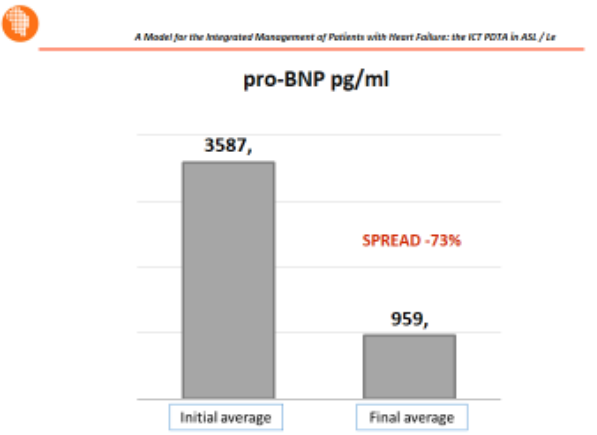


Chart 4: The model for the integrated management of the patients with heart failure: ICT PDTA in ASL/Le.

A very interesting fact is the trend of creatinine.

All this shows that despite the important renal impairment, which these patients often have for etiological, comorbidity and pharmacological (diuretic therapy) reasons, they maintained a moderate compensation and improved renal function (Chart.5).

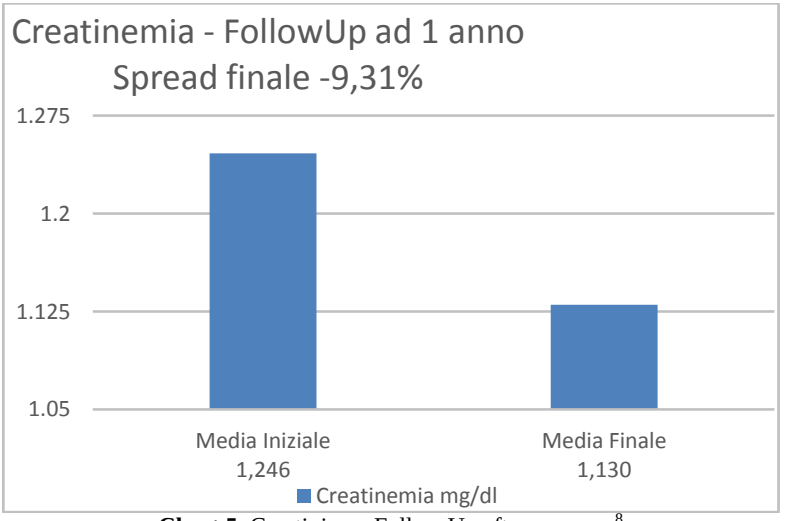


Chart 5. Creatinine – Follow Up after one year[8]

[8] In Italian.

Creatinine – Follow Up after one year
Final Spread – 9,31%
Initial Average 1,246
Final Average 1,130
Creatinine mg/dl

These results prove that an innovative care path guarantees the clinical effectiveness and safety to patients affected by Heart Failure and improves their quality of life (Epping-Jordan, 2004). In addition, it proves the clinical effectiveness and safety and the economic sustainability.

In the economic calculation we evaluated the impact of hospitalization before and during the experimentation.

204 of the total number of the patients observed needed re-hospitalization in the year before the enrollment, and simultaneously, there were 84 accesses to the emergency room for heart failure (see Chart 6).

The end of the first year of program we only had 39 re-hospitalizations, with 80% reduction in re-hospitalizations.

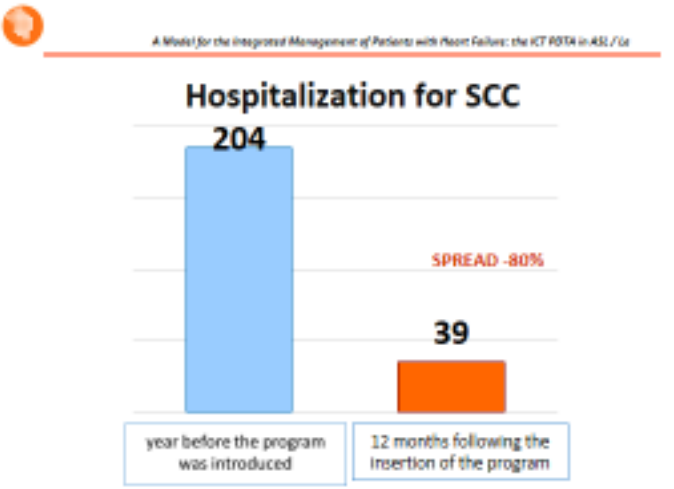


Chart 6: Hospitalization for SCC.

Among the same patients who had 68 accesses to the Emergency Room for emergency interventions in the year before the enrollment, only 4 needed an emergency treatment during the year of observation (Chart 7).

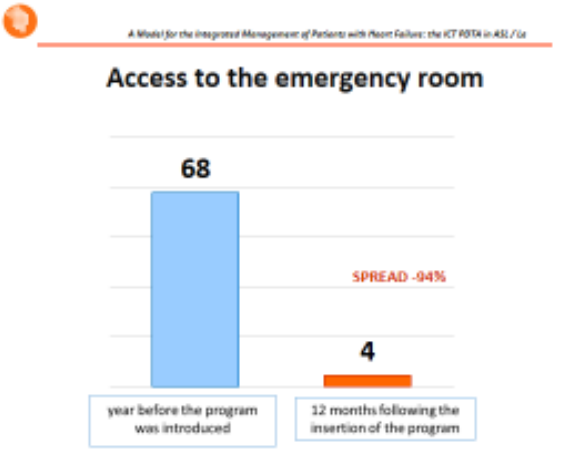
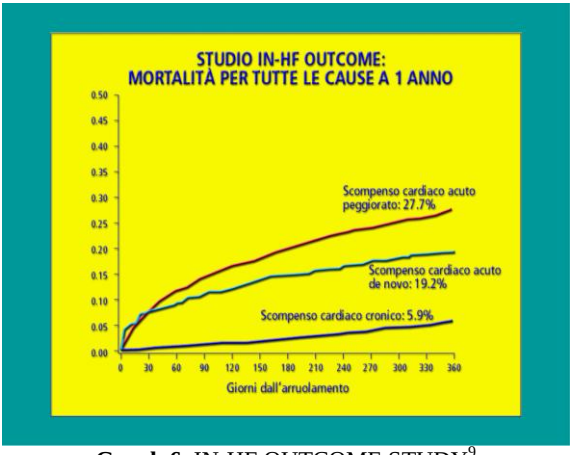


Chart 7. Access to the emergency room.

In the second phase of our path (years 2015-2017), with the creation of the Medical Centre for Heart Failure and with an efficient and tested integrated assistance system, we observed a reduction in ex novo accesses to the hospital thanks to a natural evolution towards a form of home hospitalization.

Mortality

In evaluating the mortality in heart failure patients, we took into account the data related to the Tavazzi IN-HF study (Tavazzi *et. al*., 2013). All-cause mortality in heart failure patients within a year is 17.6% (Graph 6).



Graph.6, IN-HF OUTCOME STUDY[9]

[9] In Italian.

IN-HF OUTCOME STUDY
All-cause Mortality after one year
Acute worsened heart failure: 27,7%
Acute heart failure de novo: 19,2%
Chronic heart failure: 5,9%
Days from the enrollment

The all-cause mortality in the patients observed within a year in the GISC Study was 6.7%

We can conclude that the care model of the GISC project, dealing with the taking charge of patients with Heart Failure, produced extremely important results from both the clinical, prognostic and management costs point of view of such complexity, and these results were the subject of publication on the "Journal of Evaluation in Clinical Practice". These are the results of 90 patients who were over 80 years old and who were taken in charge during the GISC experimentation.

The cost of every hospitalization of these patients, 6 and 12 months before and after the enrollment, was calculated using the cost of DRG 127.

Comparing the cumulative costs for each patient before and after the enrollment we demonstrated that the integrated management of patients with heart failure was less expensive for the National Health Service.

The saving was about € 439,322.00 within six months and € 832,276.80 after a year from the enrollment.

This shows that our intervention represents a cost-saving strategy in the follow-up of patients with heart failure after 6 months from the enrollment in the GISC program, compared to the costs of hospitalization before the enrollment (Tavazzi *et al*., 2013).

The GISC Software platform

The software platform provides the Integrated Management of Heart Failure and consists in a web-based IT platform in the telemedicine / tele-monitoring area, which realizes the interaction between GP, outpatient cardiologist and hospital cardiologist on the clinical, instrumental and haemato-chemical data-therapy of the cardiopathic patient. The software platform creates a network which allows the collection of medical data in order to process them statistically and bring out correlations between apparently heterogeneous data, improving the performance in terms of costs and efficiency of the health system. The constant interaction between the doctors, who use the same "database", drastically reduces the patient's hospital admissions thus allowing them to experience their disease more

normally. The product, designed according to the "three-tier" dynamics, uses technological innovations both in terms of architectural patterns and in terms of design patterns; the reference pattern remains the MVC (Model-Viewer-Controller); this guarantees access to all features through all channels (web, smartphone, tablet). The system is equipped with two sub-systems of statistics based on an expert system and on neural networks. The first one, centered on the patient, guarantees the extraction and the synthesis of statistics which report the dynamic evolution of the clinical status in the patient's time. The second sub-system deals with the extraction of the data and the synthesis of statistics which have the entire patient population present in the system as a focus. Particular attention was paid to the design and development of UX (User experience) to support the study. The interfaces are developed using the most modern client-side programming systems (first of all Ajax and JavaScript frameworks). Users have access to powerful tools for quickly and securely entering all the necessary data. The system functions are provided in SaaS mode (software as a service). The system, hosted on a server, is accessible from any location connected to the internet through any channel. The information is navigated according to the "lead me" paradigm during the data entry and management phases of the personal data and according to the "follow me" paradigm during the research and summary phases of the statistics. The engine is ready to work through big data and appropriate algorithms for the prediction of acute decompensation events among the patients in the study. Moreover, the system is able to bring out correlations between apparently uncorrelated data by bringing out the phenotype of particular conditions of the patients.

CONCLUSIONS

Given the need to reorganize health management (hospital à territory), we need to think about new organizational solutions for the management of chronic diseases.

The DTCP (diagnostic and therapeutic care path) ICT (Information and Communication Technologies) ASSISTED proposed offers concrete support to the territorial and multidisciplinary management of the patient with heart failure (Pisano *et al*., 2015).

The implemented management strategies have enabled the construction of an effective and efficient care system, reducing economic waste, improving clinical outcomes and quality of life in chronic heart failure.

It is strongly desirable the development of research in healthcare management to devise modern, comparable and competitive solutions that

lead to a homogeneous treatment of the chronic heart failure throughout the national territory.

In short, the real challenge of our journey has been cultural: i) we believed in the development of E-Health, ii) but we have maintained a balance between "high tech" and "high touch" based on attention to human contact and, iii) to the clinical preparation conjugated with innovation, there is no lack of the necessary empathic sensitivity towards those who live a disability.

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