

Impact of the Management of a Cardiac Unit on Cardiac Care Delivery. Evolution of Clinical Effectiveness Indicators

Luis Rodríguez Padial, Arturo Romero Gutiérrez^a, José Moreu Burgos, Carolina Maicas Bellido, Juan Alcalá López, Eduardo Castellanos Martínez and Soledad Alonso García

Servicios de Cardiología y ^aAdmisión and Documentación Clínica. Hospital Virgen de la Salud. Toledo. España

Introduction and objectives. Cardiac care is one of the most important and rapidly rising costs in the health-care system. Therefore, any improvement can produce significant savings. We analyze the evolution of classical clinical effectiveness indexes in a cardiac unit after a change in clinical management.

Methods. We reviewed overall clinical effectiveness indexes and the most significant DRGs of a cardiac unit and general hospital between 1992 and 2000. A change in management (optimization of time for studies, responsibility of professionals for tasks, close follow-up, and preventive problem management) was introduced in September 1995 by team members without a parallel change in the hospital. Clinical effectiveness indexes were compared before and after the organizational change and compared with the rest of the hospital.

Results. There was a progressive improvement in clinical effectiveness indexes in the hospital (reduction of 22% in length of stay). On the other hand, a significant improvement was also noted in the cardiac unit starting the month after implementing the new management strategy (reduction of 54% in the duration of the hospital stay; 9.74 days preintervention vs 4.97 days postintervention; $p < 0.001$). Improvement has been progressive throughout the years of follow-up. Overall indexes and specific DRG indicators improved.

Conclusions. A change in management strategy can have a significant impact on cardiac care and improve clinical effectiveness. Therefore, the attitude of a small team can have a significant impact on healthcare.

Key words. *Cardiology service. Hospital. Organization and administration. Efficiency. Organization.*

Full English text available at: www.revespcardiol.org

SEE THE EDITORIAL ON PAGES 1226-1229

Correspondence: Dr. L. Rodríguez Padial.
Servicio de Cardiología. Hospital Virgen de la Salud.
Avda. de Barber, 30. 45004 Toledo. España.
E-mail: lrpadial@meditex.es

Received 23 October 2001.

Accepted for publication 28 June 2002.

Efecto de la gestión de un servicio de cardiología en la atención del paciente cardiológico. Evolución de los indicadores asistenciales

Introducción y objetivos. La asistencia cardiológica supone un coste importante y progresivamente creciente del sistema sanitario. Su optimización puede, por tanto, conllevar un importante ahorro. Se analiza la evolución de los indicadores de hospitalización en un servicio de cardiología en el que se aplica un cambio de gestión.

Métodos. Se revisan los indicadores de hospitalización globales y los de los grupos relacionados por el diagnóstico (GRD) más representativos del servicio entre los años 1992 y 2001. En septiembre de 1995 se inicia el proceso de reorganización (optimización de demoras, responsabilización del personal en determinadas actividades, seguimiento y solución de problemas) por iniciativa del propio servicio, y sin cambio simultáneo en el resto del hospital. Se comparan los indicadores asistenciales antes y después de la intervención, así como con la evolución seguida por el resto del hospital.

Resultados. El hospital mejora progresivamente en los indicadores asistenciales (reducción del 22% en estancia media). El servicio de cardiología presenta una mejoría desde el mes siguiente a la aplicación de las medidas (reducción del 54% en estancia media; 9,74 días preintervención frente a 4,97 días postintervención; $p < 0,001$). La mejoría aparece tanto en los indicadores globales, como en los específicos de los GRD seleccionados.

Conclusiones. La aplicación de sencillas medidas de gestión puede conseguir una mejora en la eficiencia de la asistencia cardiológica, con la consiguiente optimización de recursos. La actitud de un grupo reducido de profesionales puede tener un impacto significativo en la asistencia sanitaria.

Palabras clave: *Servicio de cardiología. Hospital. Organización y administración. Eficiencia. Organización.*

INTRODUCTION

Cardiovascular diseases are the principal cause of death and illness in the developed world,¹ including in Spain.^{2,3} In fact, in this country, cardiovascular illnesses, particularly cardiologic illnesses, are one of the

ABBREVIATIONS

MBDG: minimum basic data group.
DRG: diagnosis-related group.
AMLSI: adjusted mean length of stay index.

primary causes of hospital admissions.⁴ The progressive aging of the population and the increased incidence of cardiovascular diseases with age indicates that there will be a corresponding increase in cardiovascular diseases in the future.⁵

In recent years, there has also been a significant increase in diagnostic and treatment options related to cardiovascular illnesses; these have contributed to a notable increase in the overall cost of treating these debilitating diseases.⁵ This phenomenon, in combination with other factors, contributes to the economic crisis that is threatening all health care systems, which are saddled with a progressive increase in expenditures coupled with a need to make choices that ensure their survival.

Admittedly, the necessary changes must occur in an appropriate manner, with decisions aimed at ensuring financing and coverage of healthcare systems.⁷ It is not clear, however, what the impact will be of measures that aim to manage individual services for the care of cardiovascular disease, although some positive experiences have been reported.⁸⁻¹⁰ In addition, the training of professionals charged with providing health care for patients with cardiovascular disease does not encompass, at this time, these aspects.¹¹ In fact, training of cardiologists in our country emphasizes clinical, technical, epidemiological, and scientific parameters,¹² which are obviously necessary, but does not address basic concepts of managing health resources, which are essential for supporting the aforementioned factors efficiently and equitably.¹³

The aim of this study was to analyze what impact management measures could have on delivery of care to patients with cardiovascular disease in a cardiology service, adopted by a group of professionals independently and not coordinated with other services in the hospital system.

MATERIALS AND METHODS

Our study analyzed hospital health care in a cardiology service in a general hospital with 600 beds, a clinical, non-invasive cardiology service, and a coronary care unit that is dependent on the intensive care unit and incorporates hemodynamic (1997) and electrophysiological (1999) components, but which is de-

pendent on other referral centers for surgery. This was a practical study dedicated to evaluating the efficacy of treatment strategies initiated in conjunction with health care indicators.¹⁴

We reviewed the changes that occurred over time in regard to indications for treatment that the service used from the period before modification of management up to the present. The study encompassed 9 years (1992-2000). The changes were analyzed according to overall data (mean length of stay, occupancy index, etc.), as well as with data related to specific illnesses treated,¹⁵ which were vital in order to evaluate the activities of the cardiology service. The services rendered data were compared with co-occurring data from the hospital area to which the unit belonged, with the goal of extracting information about overall changes in the center and changes specific to the service analyzed. We also compared the data from five other medical services in the same center.

The definitions used for the various indicators¹⁶⁻¹⁸ are shown in Appendix 1. These indicators are the same as some of those used by Insalud (Spanish National Institute of Health) to evaluate their hospitals, and they have not been modified over time, thus allowing comparison.

The DGR were selected for specific analysis because they were more representative of the activities developed by the cardiology service and were compared over time for the same service. The DGR consisted of: 143 (chest pain), 140 (chest angina), 122 (myocardial infarct without complications), and 127 (cardiac insufficiency).

We used information from the center's admissions department, which included all patients admitted to the hospital and treated by the cardiology service, and which was gathered prospectively without knowledge of the information being used for this study.

From 1992 through 2000, there have been 2 updates to the classification system for illnesses and procedures (ICD-9-CM). From 1992 through 1996, the second edition of the ICD-9-CM was used to code the minimum basic data group (MBDG) at hospitalization. From 1997 to 1998, the third edition of the same classification system was used. Beginning in 1999, the fourth edition of the ICD-9-CM was used; this new version includes some major changes in the classification guidelines of cardiology patients. The different versions of ICD-9-CM are a result of successive updates in coding procedures. This produces occasional changes in the method of assigning codes that can affect the grouping results, without there being real changes in the casuistry. The successive versions of the group software (All-Patient DRG) has incorporated the advances in knowledge of the casuistry and adapted to the lower requirements of the inter-group variance in estimating costs or resources consumed. During the period studied, we worked successively

with versions 10.0, 12.0, and 14.0 of the DGR grouper. Nevertheless, in order to simplify the analysis of the results in this study, we have grouped all the total annual MBDG with the current version of the grouper (All Patient version 14.3). Although this may produce some errors in validation for the older cases, the relative importance of this problem is quite negligible.

Strategy used

The strategy used to implement changes in patient management was simple and consisted of: *a)* discussing with all professionals the idea of the ethics of efficiency, with the goal that all, or most of them, feel responsible for the optimization of resources and hospital stays;¹⁹ *b)* making designated providers responsible for specific areas of the services, especially in the diagnostic non-invasive unit; *c)* establish as a priority complementary testing of patients pending discharge to avoid admitting patients who are waiting for such testing; this later entailed redesigning the processes involved and, finally, developing clinical pathways (chest pain, chest angina, myocardial infarct, cardiac insufficiency);²⁰ *d)* partner with Madrid referral services to expedite complementary testing and treatments that were not initially available in our center (hemodynamic, electrophysiological, surgical) with the objective of trying to shorten (as much as possible) the patient's hospital stay (several days were reserved for interpreting tests from Toledo); *e)* perform strict follow-up of the development and implementation of the management measures, in order to assure the measures were accomplished and to assure resolving problems in advance as they occurred; and *f)* establish, with managerial staff, a developmental strategy for the service by incorporating new techniques such as hemodynamic and electrophysiology measures, in order to avoid the delays caused by patient transfer.

Measures 1 through 4 were implemented during the first month of the strategic plan, and measure 5 was developed during the next 2 years, after the managerial staff of the center was convinced of the convenience of using new diagnostic techniques in the center. The clinical measures were implemented during the last 2 years. It should be pointed out, nevertheless, that the most important element of the plan was the strong determination of the majority of the members of the service to achieve improvement, a factor that is recognized by some researchers as the most important for improving quality of care.²¹

Staff development

Over time, the application of this plan produced a progressive increase in medical staff and actions taken, which has contributed to improved initiative. Nevertheless, it is important to note that 2 physicians

were assigned to the hospital floor during the entire study period, with the occasional support of another part-time staff provided when there was a significant increase in hospital admissions.

Statistical methods

The data is presented with values given for each parameter. Given that the intervention was performed after the last 3 months of 1995, we divided the data analysis into 2 time periods: the first (pre-intervention period) spanning 1992 through 1995, both inclusive, and the second (post-intervention period) spanning 1996 through 2000, both inclusive. The data from the service was compared before and after changes in managerial staff (September 1995), and was compared between the data from the service and data from the hospital overall. The data comparison, which included the MBDG records of all patients, was performed with non-parametric tests (Mann-Whitney U test) using the SPSS program.

RESULTS

Table 1 shows the hospitalization data for the 9-year observation period. It is evident that the mean hospital stay decreased over time, and the number of admissions and discharges increased significantly during this time.

The number of beds (24) assigned to the service remained the same over the study, and as can be seen in Table 1, the number of beds used significantly decreased (30% decrease) from the time before intervention (33.46 beds) compared with the time after the intervention (23.38 beds). This held true despite the fact that total admissions significantly increased (by 86%) from the time before intervention (1262 admissions) to the time after intervention (2344 admissions). The number of re-admissions did not change significantly over this time, and was similar to that of other hospital services.

Mean hospital stay progressively improved over the years (Figure 1). Upon analysis of the mean length of stay in the cardiology service, we observed a marked improvement in the year 1995, which has continued to improve up to the present. The difference in mean length of stay between the pre-intervention period (9.74 days) and the post-intervention period (4.97 days) was statistically significant ($P < .001$). The cardiology service over the years studied experienced a 54% drop in overall length of stay, while the hospital in general recorded only a drop of 22%. Thirty-one percent of the drop in the mean hospital stay was a result of the drop in length of stay in the cardiology service during this period (0.61 days vs 2.00 days), as is shown in Figure 1.

The difference between the mean overall hospital stay (calculated without including internal transfers)

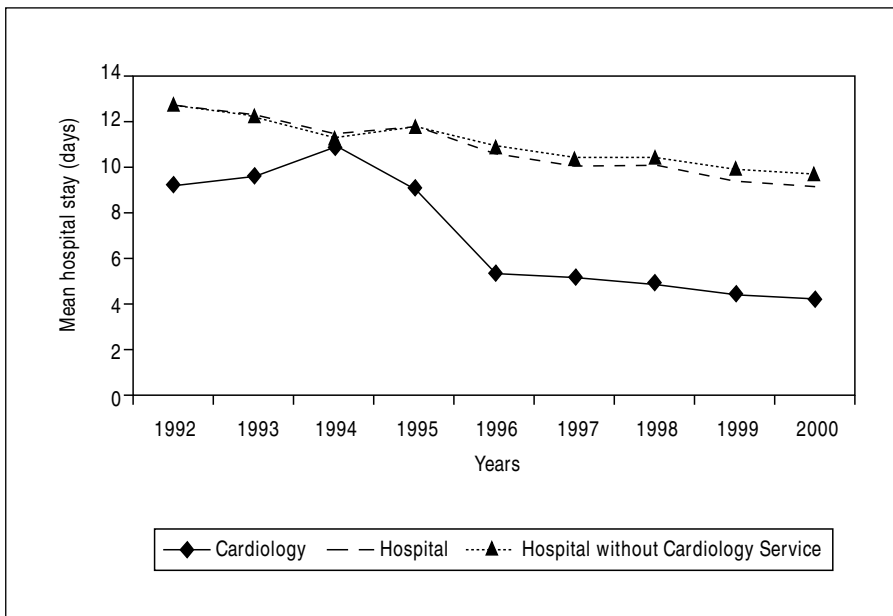


Fig. 1. Graphic showing mean length of hospital stay in the cardiology service and overall in the general hospital (excluding the maternity or pediatric ward) with or without cardiology service during the study period.

and the cardiology service (with internal transfers) was 2.4 days (mean) in the time before the intervention and 5.03 days (mean) after the intervention.

Figure 2 depicts the development of the mean length of stay for 5 medical services in the same hospital. The trend is different that that observed in the cardiology service, with several services recording an increase in the mean length of stay over the past few years.

Upon analyzing the mean hospital stay during the study period, we noted a significant decrease in the median and interquartile ranges after the intervention was implemented, indicating that not only severe cases had a reduced length of stay. This development was noted not only in the planned admission but also in patients admitted from the emergency department.

As is evident in Figure 3, the intervention had an effect in the month in which was first implemented

(September 1995), an effect that is not evident in Figure 2.

Figure 4 shows various care indicators in the cardiology service during the study period; Table 1 contains the corresponding numerical values. The mean length of stay, as indicated previously, decreased significantly over time. The occupancy index was significantly reduced immediately after intervention, and since that time has grown slowly and progressively, without reaching the values recorded prior to the intervention. The number of admissions increased markedly during the second phase of the intervention period, parallel to the incorporation of diagnostic and therapeutic techniques (interventional cardiology in 1997 and electrophysiology in 1998), and has rendered the service a model to reference. As a result, this, in spite of a drop in mean length of stay and an increase in the patient-

TABLE 1. Healthcare data from the cardiology service during the study period

Indicator	Years									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Beds (n)	24	24	24	24	24	24	24	24	24	
Beds used (n)	32.45	33.54	34.94	32.89	20.55	20.60	21.95	26.03	27.78	
Admissions (n)	1262	1,267	1,171	1,317	1,373	1,408	1,583	2,061	2,344	
Length of stay (n)	11 889	12 244	12 755	12 007	7522	7521	8015	9502	10 171	
Mean hospital stay, days	9.26	9.67	10.91	9.13	5.45	5.34	5.07	4.63	4.36	
Occupancy, %	135.34	139.77	145.60	137.06	85.63	85.85	91.49	108.47	115.79	
Patient/bed rotation (n)	52.62	52.79	48.79	54.87	57.20	58.66	65.95	85.87	97.66	
Admissions/day (n)	2.43	2.24	2.05	2.43	2.58	2.86	3.27	4.51	5.34	
Re-admissions (n)	-	0.015	0.011	0.018	0.018	0.011	0.017	0.015	0.014	
Mean DGR weight		1.07	1.13	1.16	1.12	1.07	1.14	1.03	1.32	

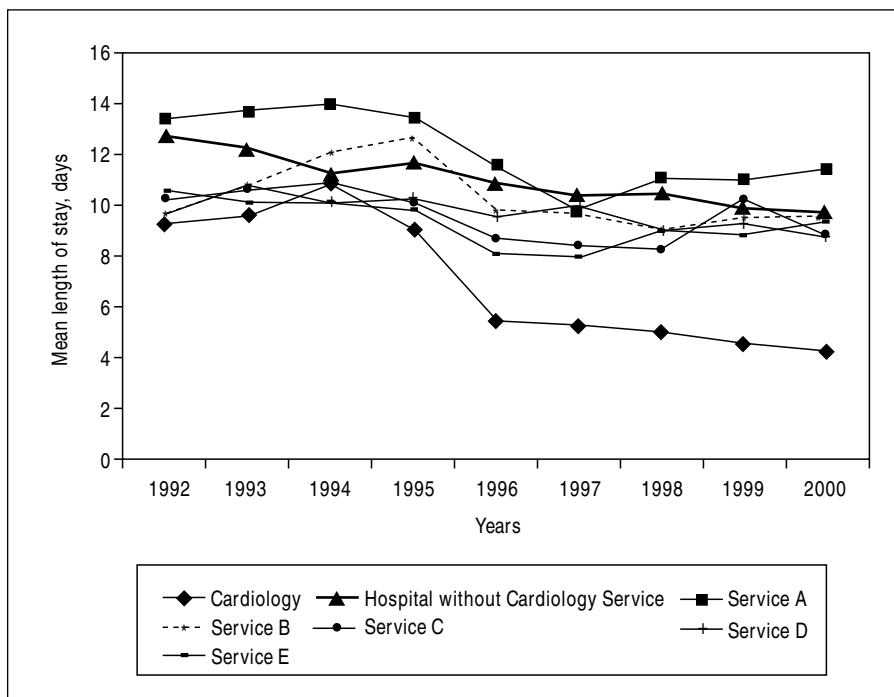


Fig. 2. Graphic showing the mean length of stay in the cardiology service, the overall general hospital length of stay without including the cardiology service, and the length of stay in 5 medical hospital services during the period analyzed.

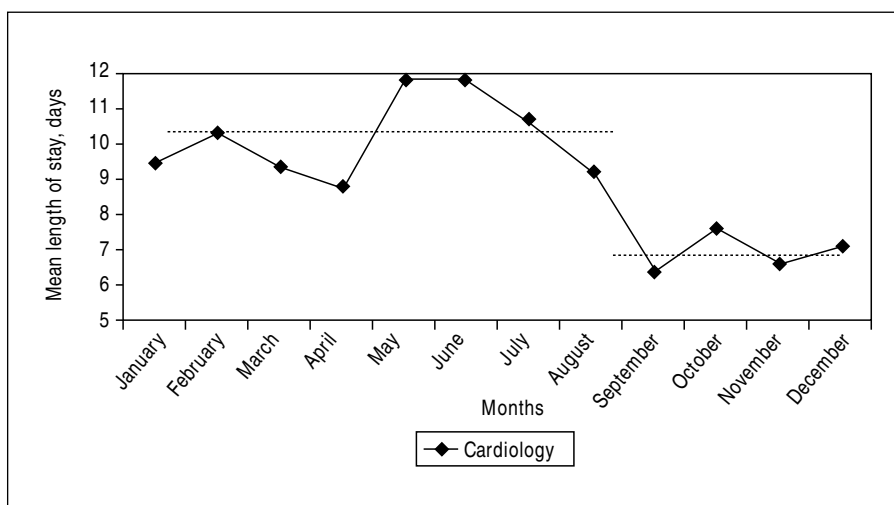


Fig. 3. Graphic showing the development of mean length of stay in the cardiology service during the year 1995.

to-bed rotation, an increase in the occupancy index was noted over the last 2 years (1999-2000). The improvement in managing bed occupancy has allowed the service to significantly increase its level of care.

The mean weight associated with the various DGR of patients cared for in the cardiology service has not changed substantially overall during the study period, although we noted an increase in the mean DGR weight over the later years (Table 1).

Table 2 shows the data related to selected DGR. We observed that the management of this type of patients is more efficient overall. The analysis of the distribution of the relative DGR weight values shows that the general mean hospital stay is not the result of admit-

ting patients with a non-serious illness.

In order to analyze the change over time in the DGR selected, we compared the DGR in 1993 and 2000 with what was typical as published by the Insalud in 1998 (Table 3) since no comparable data exist from the Insalud for the initial years of the follow-up period. As can be observed, the management of these DGR improved notably during the study period. At the beginning of the study, management was worse than typical (between 37% and 57%), while at the end of the observation period the management was better than typical for all the DGR studied.

Table 4 shows the data from the comparison of the cardiology service and the data from the rest of the

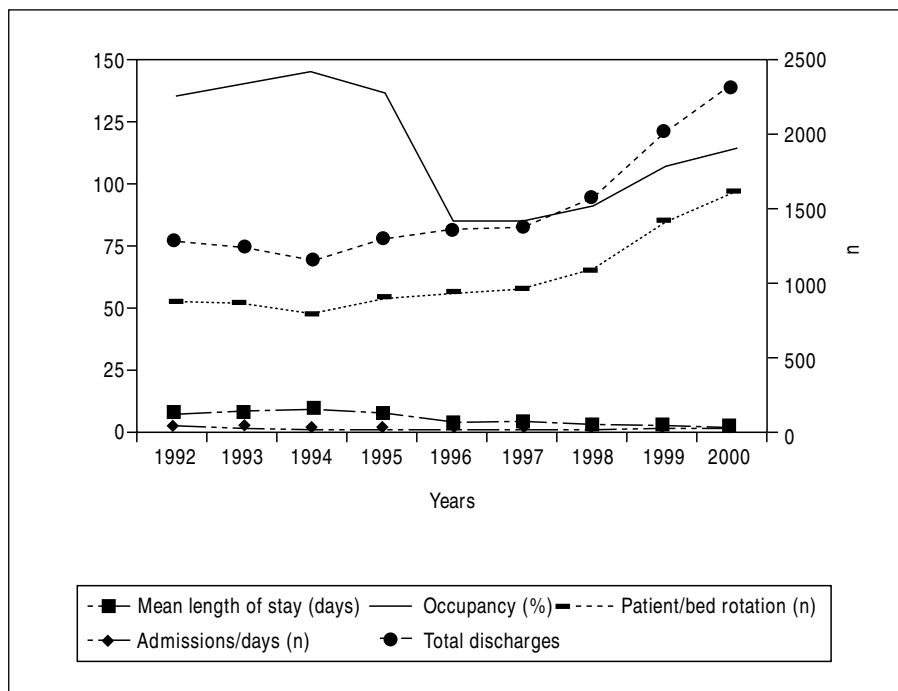


Fig. 4. Graphic showing certain health care data from the cardiology service during the study period. The total number of discharges is represented by the right vertical axis, while the remainder of the data is represented by the left vertical axis.

cardiology services performed by the Insalud in group 3 of the Insalud for the year 2000.²³ The adjusted mean length of stay index (AMLSI) was 0.81, indicating that the cardiology service achieved more efficient management (19% more efficient with regard to hospital stay) for the same illness than the mean efficacy of the other cardiology services in hospitals managed by the Insalud.

The ratio of patients to beds to the number of physicians in charge of the floor has risen from 26.3 in 1992 to 48.8 in 2000, showing increased efficiency of the medical personnel assigned to the hospital floor.

Figure 5 shows the impact in savings in terms of length of hospital stay attributable to the cardiology service in the year 2000 as an example of the impact of a change in management techniques. During this year, the cardiology service used 2264 less hospital days as compared with the Insalud regulations for hos-

pitals in group 3 for DGR with more than 7 cases, a reduction much greater than that observed in other hospital services.

We do not present a detailed cost analysis because the procedure used by the INSALUD has changed during this time, which makes comparison difficult. Nevertheless, the improvement in the efficiency of the service avoided a significant amount of unnecessary hospital stays (3679 days per year), savings which could be applied to other services.

DISCUSSION

This study shows that the changes in the management of a cardiology service can improve the efficiency of the service significantly, which can have an impact on the health care system. The value of the study is that it documents real experience in our

TABLE 2. Health care data from the cardiology service for the 4 DGR with the greatest number of patients

DGR	Years							
	1993	1994	1995	1996	1997	1998	1999	2000
143 (chest pain)	156 (7.6)	156 (8.1)	206 (6.3)	219 (2.9)	186 (3.1)	206 (2.7)	315 (2.9)	345 (2.4)
140 (chest angina)	255 (10.8)	251 (12.1)	302 (10.7)	299 (7.0)	215 (6.2)	242 (6.1)	309 (5.9)	310 (5.2)
122 (myocardial infarct)	133 (16.1)	118 (16.9)	73 (13.7)	69 (10.4)	114 (11.1)	132 (9.7)	167 (9.1)	112 (9.5)
127 (cardiac insufficiency)	107 (12.9)	107 (12.7)	118 (11.6)	115 (10.4)	117 (9.1)	131 (9.5)	163 (8.5)	157 (7.1)

The number of patients admitted is shown and the mean hospital stay (days) is shown in parentheses.

TABLE 3. Comparison of the mean hospital stay of certain DGR in cardiology services of the Insalud in 1998 and data from the cardiology service at the beginning and at the end of the study period

DGR	Insalud 1998	Cardiology 1993	Cardiology 2000	Cardiology 1993/Insalud	Cardiology 2000/Insalud
143 (chest pain)	5.19	7.6	2.4	1.46	0.46
140 (chest angina)	7.43	10.80	5.20	1.45	0.70
122 (myocardial infarct)	10.22	16.1	9.3	1.57	0.91
127 (cardiac insufficiency)	9.39	12.9	7.10	1.37	0.76

The mean hospital stay in days is shown and the 2 last columns show the relationship between the mean lengths of stays indicated.

TABLE 4. Comparison of the mean hospital stay in the cardiology service per the cardiology regulations of the Insalud for the year 2000, the number of hospital stays avoided by DGR for that year are indicated

DGR	Cardiology service	Insalud cardiology regulations	Difference	Hospital stays avoided
143 (chest pain)	2.45	3.86	-1.41	-486
140 (chest angina)	5.15	6.2	-1.05	-325
122 (myocardial infarct)	9.52	9.70	-0.19	-21
127 (cardiac insufficiency)	7.09	8.30	-1.21	-190

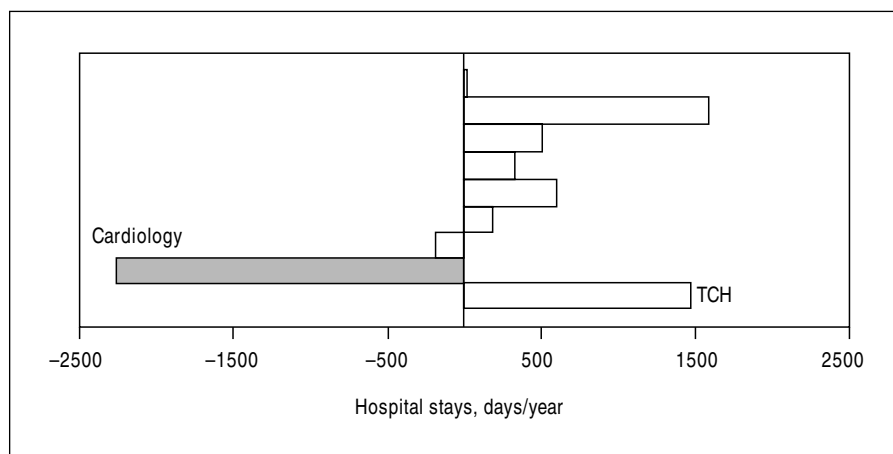
country, performed in a hospital that is part of the National Health System under a typical management system, which makes the results more applicable than those contained in models and examples taken from other social environments and management models. The key difference is that the study utilized the experience of professionals who were responsible for providing the health care, and not from external sources which are often more theoretical, not useful, and ineffective.²⁰

The strategy used was fairly simple, which is more likely a strength than a weakness, given that it has been shown that improvement in the efficiency of medical services can be achieved without great methodological changes. The plan was implemented by a group of professionals, physicians and nurses, interested in improving the quality of health care. The participants

did not receive special incentives and frequently had to endure the resistance inherent in the change process itself, both in terms of other professionals and in terms of directives. The experience proves that one of the most important elements for improving quality is a strong determination to ensure such improvement.²¹

The improvement in efficiency has allowed for a significant increase in admissions without a corresponding increase in resources designated for hospitalization. The hospital has habitually endured a shortage of beds, forcing the suspension of planned surgical procedures and, frequently, leading to the admission of patients who must be assigned supplemental beds. This last problem has decreased over the past years, and we believe that the management of beds by the cardiology service has contributed to this improvement in a significant manner. Contributing to maintain-

Fig. 5. Hospital stays avoided by the cardiology service for the year 2000 compared with the performance of other services in the same hospital with respect to the regulation Insalud group 3 for the year 2000 for DGR with more than 7 cases. Toledo hospital system (THC), cardiology (grey bar), and other medical services.



ning the hospital's schedule and the dignity of patients by avoiding inappropriate assignment is the reward of better management and, in spite of the intangibility of its importance, is a fact that clinicians frequently forget. It is not incidental that efficiency should be considered one of the basic tenets of quality care.²⁴

Overall, mean hospital stay is a gross indicator of health care, given that it is dependent on the nature of the illness being treated. It may be, therefore, something that can be manipulated by the selection of patients admitted (less serious illnesses), in addition to being very dependent on extreme values. As is indicated by the development of the mean hospital stay of the DGR with the greatest number of patients, the goal of reducing the mean length of hospital stay was achieved through putting for effort with each patient (the reduction was achieved in all the DGR), and with changes evident in all the variables studied, and not only the extreme values. The development of the mean weight associated with the DGR also indicates that significant changes have not been achieved in the identification of illness, except for an increase in the complexity of the cases admitted over the last years.

The re-admission rate on the service did not change during the follow-up period, which suggests that the changes did not result in inappropriate discharges during the study period. However, the overall rate of re-admissions is not very reliable and must be adjusted to the casuistry. The mean hospital stay adjusted by level of functioning indicates the efficiency of the service in the use of hospital stays; our results indicate that the mean length of stay on the service was 20% better than that of the remaining cardiology services in our Insalud comparison group (group 3).

The initial improvement in the mean length of hospital stay indicates that, from the beginning, the primary problems of delay and coordination of health care that were present in the service were resolved. The later progressive improvement in the mean length of hospital stay could be due to the overall improvement in the hospital (central services) and the adoption of new management strategies for various illnesses (for example, early discharge for patients with myocardial infarct thanks to the introduction of primary angioplasty). The improvement in mean hospital stay was achieved before hemodynamic and electrophysiology services were incorporated into the center, indicating that efficient coordination between hospitals can contribute to a substantial improvement in length of hospital stay in both medical centers.

The increase in health care activity occurred without an increase in medical staff involved in the hospital stay. The number of medical service personnel itself has increased; for doctors from 10 to 13 people (during the year 2000 there were 14 doctors), although this increase has been in staff involved in the hemodynamic, electrophysiological, and external consult ser-

vices, which obviously could have had an indirect positive effect on bed management. The improved bed management has allowed the incorporation of hemodynamic and electrophysiological services without an increase, and in fact with a decrease, in the need for beds.

This management strategy over the past 2 years has been accompanied by measures for improving the quality of health care as perceived by the patient (welcome program, prompt information regarding the timing of their schedule of tests and discharge, etc.); therefore, the improvement and more efficient management of beds was not viewed by patients as a lack in health care. Given that these measures have not been consistent for the entire intervention, these facts were not taken into account for this analysis. During this intervention period, there were also significant changes in the management of external consultations and in diagnostic and therapeutic techniques. Both have been avoided in our analysis due difficulties (the Insalud procedures for analyzing the management of external consults changed substantially during the study period) and because the changes are the results of factors that have surfaced only during the later years of the study period (hemodynamic and electrophysiology).

Limitations

This study has various limitations. The study design is non-randomized before and after, which tends to overestimate the efficacy of the intervention; future randomized studies will be needed to confirm our data. In addition, it is not possible to know which of the possible components of the intervention strategy are really effective and which are unnecessary; or to know the mechanisms that make each effective.

It would have been desirable to complement the study with a cost-analysis that truly demonstrates the economic impact of the intervention. Nevertheless, the Insalud had not developed a reliable cost analysis system until recently, and it has modified the way each cost is attributed over time, making any conclusion difficult, if not erroneous, that is based on these cost calculations. Nevertheless, it is evident that the increase in efficiency achieved diminished the daily cost of hospital stays, which has positive repercussions on the cost of the condition treated.²⁶

This study should have been accompanied by an analysis of the results of our performance; in other words, the clinical development of patient in the medium-term and long term, in order to give a better idea of the results. Nevertheless, this is a complex process, fairly difficult to implement. The fact that the strategies and the therapeutic procedures used were standard and similar to those used by services in our facility leads us to suppose that, given that the short-term prognosis is no worse (re-admissions), the short-term

and medium-term clinical course should also not be worse.

In conclusion, our study describes an experience with hospital management of cardiologic health care in a public hospital in our country, with a typical management system, and provides evidence that, in this context and with these tools, it is possible to provide intervention that has a real impact on the efficacy of the health care provided.

REFERENCES

- Tom TJ, Kannel WB, Silbershatz H, D'Agostino RB. Cardiovascular diseases in the United States and prevention approaches. En: Fuster V, Wayne Alexander R, O'Rourke RA, Robert R, King III SB, Wellens HJJ, editors. *Hurst's the heart*. New York: McGraw-Hill, 2001; p. 3-17.
- Villar Álvarez F, Banegas Banegas JR, Rodríguez Artalejo F. Mortalidad por cardiopatía isquémica en España. En: Plaza Pérez I, editor. *Cardiología preventiva*. Barcelona: Doyma, 2000; p. 1-7.
- Ministerio de Sanidad y Consumo. Sociedad Española de Cardiología. *Cardiopatía isquémica en España. Análisis de la situación 2001*. Madrid: Sociedad Española de Cardiología, 2001.
- Rodríguez Artalejo F, Guallar P, Banegas JR, Rey J. Trends in hospitalization and mortality for heart failure in Spain, 1980-1993. *Eur Heart J* 1997;18:1771-9.
- Weintraub WS, Krumholz H. Cost-effective strategies in Cardiology. En: Fuster V, Wayne Alexander R, O'Rourke RA, Roberts R, King III SB, Wellens HJJ, editors. *Hurst's The heart*. New York: McGraw-Hill, 2001, p. 2487-512.
- Cavasés Hita JM. Establecimiento de prioridades en política sanitaria. En: Llano Señaris J, Ortún Rubio V, Martín Moreno JM, Millán Nuñez-Cortés J, Gené Badía J, editores. *Gestión sanitaria. Innovaciones y desafíos*. Barcelona: Masson, 1998; p. 31-48.
- Belenes R. Innovaciones en la gestión. Nueva cultura empresarial en los servicios sanitarios. En: Cuervo JI, Varela J, Belenes R, editores. *Gestión de hospitales. Nuevos instrumentos y tendencias*. Barcelona: Vicens Vives, 1994; p. 118-71.
- Eagle KA, Moscucci M, Kline-Rogers E, Chaffee BW, Barry PA, Robert S, et al. Evaluating and improving the delivery of heart care: the University of Michigan experience. *Am J Manag Care* 1998;4:1300-9.
- HCIA-Sachs LLC. Top ten in cardiac care perform 4.7% to 31% better than others. *Clin Resour Manag* 2000;1:92-4.
- Mehta RH, Das S, Tsai TT, Nolan E, Kearly G, Eagle KA. Quality improvement initiative and its impact on the management of patients with acute myocardial infarction. *Arch Intern Med* 2000; 160:3057-62.
- Yedidia MJ, Gillespie CC, Moore GT. Specific clinical competencies for managing care. Views of residency directors and managed care directors. *J Am Med Assoc* 2000;9:1093-8.
- Cosín Aguilar J, Plaza Celemín L, Martín Durán R, Zarco Gutiérrez P, López Merino V, Cortina Llosa A, et al. Guía de formación del especialista en cardiología en España. *Rev Esp Cardiol* 2000;53:212-7.
- Cerese J. Leveraging performance measurement and management: the quality and efficiency edge. *Top Health Inf Manage* 2001;22:73-8.
- Rodríguez Artalejo F, Figaredo Alvargonzález C, Hernández Vecino R. Investigación de resultados. En: Llano Señaris J, Ortún Rubio V, Martín Moreno JM, Millán Nuñez-Cortés J, Gené Badía J, editores. *Gestión sanitaria. Innovaciones y desafíos*. Barcelona: Masson, 1998; p. 529-42.
- Casas M. Los sistemas de clasificación de pacientes. Conceptos básicos. En: Jiménez Jiménez J, editor. *Manual de gestión para jefes de servicios clínicos. Conceptos básicos*. Madrid: Díaz de Santos, 1997; p. 289-301.
- Insalud. Sistema de información de asistencia especializada: Manual de exploración. Sistema de Información. Madrid: Insalud, 1999.
- Peiró Moreno S. Medidas de actividad y producto sanitario. En: Llano Señaris J, Ortún Rubio V, Martín Moreno JM, Millán Nuñez-Cortés J, Gené Badía J, editores. *Gestión sanitaria. Innovaciones y desafíos*. Barcelona: Masson, 1998; p. 97-217.
- Berenguer J. Gestión de los servicios asistenciales. En: Cuervo JI, Varela J, Belenes R, editores. *Gestión de hospitales. Nuevos instrumentos y tendencias*. Barcelona: Vicens Vives, 1994; p. 262-301.
- Gracia Guillén D. Consideraciones éticas de la gestión sanitaria. En: Llano Señaris J, Ortún Rubio V, Martín Moreno JM, Millán Nuñez-Cortés J, Gené Badía J, editores. *Gestión sanitaria. Innovaciones y desafíos*. Barcelona: Masson, 1998; p. 147-62.
- Oteo Ochoa LA, Hernández Yáñez JF. Rediseño de/en organizaciones sanitarias: de la teoría a la práctica. En: Llano Señaris J, Ortún Rubio V, Martín Moreno JM, Millán Nuñez-Cortés J, Gené Badía J, editores. *Gestión sanitaria. Innovaciones y desafíos*. Barcelona: Masson, 1998; p. 433-58.
- Donabedian A. The effectiveness of quality assurance. *Int J Qual Health Care* 1996;8:401-7.
- Instituto Nacional de la Salud. Subdirección General de Coordinación Administrativa. Conjunto mínimo básico de datos 1998. Madrid: Insalud, 1999.
- Instituto Nacional de la Salud. Subdirección General de Desarrollo. Sistema de información sobre casuística 2000. Madrid: Insalud, 2000.
- Donabedian A. The seven pillars of quality. *Arch Pathol Lab Med* 1990;114:1115-8.
- Varela J. Gestión de pacientes. En: Cuervo JI, Varela J, Belenes R, editores. *Gestión de hospitales. Nuevos instrumentos y tendencias*. Barcelona: Vicens Vives, 1994; p. 224-61.
- Cardiovascular benchmarking saves hospital nearly \$897000. *Health Benchmarks* 1997;4:137-40.

APPENDIX 1. Definitions used

The indicators used to analyze hospital activity were:

- Total admissions: the number of outside patients with an admission order registered in the admission department and assigned to a hospital bed. These were scheduled admissions (order for scheduled admission) or urgent admissions (order for urgent admission). For departmental indicators, we included internal transfers from other hospital units (for example, CICU).
 - Total length of stay: a stay was defined as a patient being in a hospital bed for 24 hours. This was calculated by estimating the total number of hospital stays registered during the study period.
 - Mean overall length of stay: average number of days in the hospital for the patients admitted. This was calculated by dividing the total number of stays by the total number of admissions (urgent and scheduled admissions and internal transfers).
 - Mean length of stay adjusted for casuistry (MLSAC): mean length of stay in a unit treating patients with standard procedures (reference or average of a database with various similar hospitals) with mean hospital stay by DGR.
 - Mean length of stay adjusted for function (MLSLF): mean stay the health care unit would have by to the cases of each DGR the mean standard stay.
 - Adjusted mean length of stay index (AMLSI), also known standard function ratio: ratio of mean length of stay observed in the hospital to the mean length of stay adjusted for function.
 - Rotation index: average of the number of admissions by functioning bed during the study period. This was calculated by dividing the total number of admissions (scheduled plus emergency and internal transfers received) by the average of functioning beds.
 - Index of overall occupancy: percentage of functioning beds occupied during the study period. This was calculated by dividing the total length of stay by the product of the average number of functioning beds by the number of days in the study period, and multiplying this total by 100.
 - Re-admissions: admission within 30 days following hospital discharge by the cardiology service due to an illness related to that which was the reason for the initial admission (same principal diagnostic category) to any hospital service.
-