

Intermediate Coronary Care Units: Rationale, Infrastructure, Equipment, and Referral Criteria

Joaquín J. Alonso,^a Ginés Sanz,^b Josep Guindo,^c Xavier García-Moll,^c Alfredo Bardají,^d and Héctor Bueno,^e on behalf of the members of the Spanish Working Group on Coronary Artery Disease of Spanish Society of Cardiology*

^aHospital de Fuenlabrada, Madrid, Spain

^bHospital Clínic, Barcelona, Spain

^cHospital de la Santa Creu i Sant Pau, Barcelona, Spain

^dHospital Joan XXIII, Tarragona, Spain

^eHospital General Universitario Gregorio Marañón, Madrid, Spain

*See Appendix

The Spanish Working Group on Coronary Artery Disease of the Spanish Society of Cardiology has considered to be necessary the development of this document on the need, structure and organization of intermediate cardiac care units (ICCU). Acute coronary syndrome registries show that an important percentage of patients receive suboptimal care, due to inadequate management of health resources or absence of them. Intermediate cardiac care units arise to solve these challenges and to manage these expensive and limited resources in an efficient way. Their aims are: *a)* to provide each patient the level of care required; *b)* to optimize the structural, technical and human resources; and *c)* facilitate continuous care and care gradient. As a result, ICCU should be established as an essential part of the cardiology department aim to cardiac patients requiring monitoring and medical care superior to those available in a regular cardiac ward but whose risk does not justify the technical and human costs of a coronary unit.

This document describes the structure (equipment, human resources, management) required to reach the goals previously reported and includes recommendations about indications of admission in an ICCU. These indications include: *a)* patients with NSTEMI-ACS with intermediate or high risk but hemodynamically stable, and *b)* low risk STEMI or high risk STEMI stabilized after an initial admission at the Coronary Unit. The admission of some patients undergoing invasive procedures or suffering non-coronary acute cardiac diseases, is also considered.

Key words: *Coronary care unit. Intermediate cardiac care units. Acute coronary syndrome. Unstable angina. Myocardial infarction. Clinical management.*

Correspondence: Dr. H. Bueno.

Unidad Coronaria. Servicio de Cardiología. Hospital General Universitario Gregorio Marañón.

Dr. Esquerdo, 46. 28007 Madrid. España.

E-mail: hecbueno@jet.es

Unidades coronarias de cuidados intermedios: base racional, infraestructura, equipamiento e indicaciones de ingreso

La Sección de Cardiopatía Isquémica y Unidades de la Sociedad Española ha considerado necesario el desarrollo de este documento sobre la necesidad, la estructura y la organización de las unidades coronarias de cuidados intermedios (UCCI). Los registros de síndrome coronario agudo (SCA) realizados en España indican que una proporción importante de pacientes recibe una atención subóptima, en parte debido a una organización inadecuada de los recursos asistenciales o a la falta de éstos. Las UCCI surgen de la necesidad de corregir estos aspectos y gestionar con eficiencia unos recursos escasos y costosos. Sus objetivos son: *a)* proporcionar a cada paciente el grado de cuidados que requiere; *b)* optimizar los recursos estructurales, técnicos y humanos, y *c)* facilitar el continuo asistencial y el gradiente de cuidados. Las UCCI se deben constituir en una parte esencial del servicio de cardiología destinada a la atención de enfermos cardiológicos que requieren monitorización, cuidados y capacidad de respuesta médica superiores a los disponibles en una planta de hospitalización convencional de cardiología, pero cuyo riesgo no justifica la utilización de los recursos técnicos y humanos de una unidad coronaria.

Este documento describe la infraestructura (equipamiento, dotación de personal y organización) que se precisa para cumplir los objetivos descritos anteriormente y contiene recomendaciones sobre las indicaciones de ingreso en estas unidades intermedias. Éstas incluyen a determinados pacientes con: *a)* SCA sin elevación del segmento ST de riesgo intermedio o alto pero estables hemodinámicamente, y *b)* infarto agudo de miocardio con elevación del segmento ST no de alto riesgo, o bien, de alto riesgo, pero estabilizado después de una fase inicial complicada en la unidad coronaria. También se contempla el ingreso de algunos pacientes después de determinados procedimientos invasivos y de algunas formas de cardiopatías agudas no coronarias.

Palabras clave: *Unidad coronaria. Unidad de cuidados cardiológicos intermedios. Síndrome coronario agudo. Angina inestable. Infarto de miocardio. Gestión clínica.*

ABBREVIATIONS

AMI: acute myocardial infarction
 ACS: acute coronary syndrome
 nSTE-ACS: non ST-elevation acute coronary syndrome
 CU: coronary unit or intensive cardiac care unit
 ICCU: intermediate cardiac care unit
 ICU: intensive care unit

INTRODUCTION

Ischemic heart disease takes a heavy toll on health resources in Spain. As an example of the extent of the problem of acute coronary syndrome (ACS), it is estimated that more than 70 000 patients with ST-elevation ACS are admitted to our hospitals every year. This number has been increasing by 2.28% a year since 1997, mainly as a result of improved life expectancy and the ageing of the population.¹ Thus, even though some epidemiological studies indicate that mortality associated with coronary artery disease is decreasing, the burden on health services and, in particular, on hospitals that treat this disease, is continually growing.^{2,3} On the other hand, like other diseases, the patients who are admitted to hospital with heart disease have increasingly severe disease and require more attention, and so hospital wards are needed with advanced equipment and more nursing staff.

Diagnosis and management of cardiovascular diseases have advanced markedly in recent decades, particularly in the case of seriously ill patients. Protocols and clinical guidelines have adapted quickly and incorporated the new therapeutic strategies. The same cannot be said for the health resources dedicated to these patients—these have not changed in the last 25 years—and the organization of health care for patients with serious coronary artery diseases has also remained unchanged in the face of these advances. Often, the therapeutic effort dedicated to seriously ill patients depends more on the resources and structure of the hospital where they are admitted than on the needs of the patients themselves. Thus, many seriously ill patients are attended in wards with inadequate facilities because of the lack of space in the special coronary units, whereas other patients receive excessive care, thereby reducing efficiency and detracting from the ideal of equality of care. Excessive care is particularly common when the patients have overcome the most critical phase of their disease but remain in the coronary unit (CU) either because of lack of beds in the conventional wards or because their risk—although not high enough to justify their continued stay in the CU—exceeds what can be safely managed

in a conventional ward. The registries of patients with ACS in Spain indicate that a substantial proportion of high-risk patients receive suboptimal care and remain in the emergency room for several days or are admitted to wards that lack the proper equipment. For example, the IBERICA study showed that 10% of the patients aged between 25 and 74 years old with ST-elevation acute myocardial infarction (AMI) were not admitted to a CU or an intensive care unit (ICU).⁴ In the DESCARTES study, which analyzed 1877 patients with non-ST-elevation ACS (nSTE-ACS), only 17% were admitted to the CU and 9.7% to a general ICU.⁵ Furthermore, of the 25.5% of the patients classified as high risk (ST-segment elevation and elevated troponin levels), almost half were not admitted to an intensive care service (34.9% were admitted to a CU and 15.7% to an ICU).⁶

The intensive cardiac care units, also known as coronary units (in Spanish, both denominations are used interchangeably in many institutional documents and by the Spanish Society of Cardiology), require complex infrastructures and equipment, as well as more staff than a normal hospital ward. There is therefore a need not only to properly equip the hospitals to provide best care for the patients with coronary artery disease, but also the obligation to manage limited and expensive resources more efficiently. To solve these problems of infrastructure and resources, and to guarantee appropriate care, the creation of a different type of care unit was proposed—the so-called intermediate cardiac care units, or intermediate coronary care units (ICCU). These have three main objectives: *a*) to provide each patient with the correct level of care, not excessive but still sufficient; *b*) to optimize the structural, technical, and human resources so as to avoid unnecessary admissions to the CU and to facilitate transfers from the CU to ensure more efficient use of the beds; and *c*) to ensure continuity in the levels of care available. In short, the idea is to improve the quality of care, resource management, and patient satisfaction.

In 2004, the lack of specific and current documents published by scientific societies on the ICCUs and the reticence of many cardiologists encountered by the Working Group on Coronary Artery Disease of the Spanish Society of Cardiology prompted the executive committee of this working group to decide to draw up an expert document on the need, rationale, structure, and organization of this type of unit. In the administrative meeting of the working group that same year, the approach for such a document was agreed. The executive committee designated a panel of experts organized into 3 groups (see Appendix) responsible for the following aspects: *a*) need and rationale for ICCUs; *b*) staff and material infrastructure; and *c*) indications for admission and relationship with other clinical units. Each group drew up a proposal which

was discussed in groups and in a plenary session during a 2-day meeting held in January 2006. The final conclusions were approved after discussion and form the basis of this document.

RATIONALE FOR INTERMEDIATE CARDIAC CARE UNITS

Historical Perspective

Coronary units were developed at the start of the 70s in order to prevent deaths and determine the cause of death in patients with AMI. As a result, notable advances were made in our knowledge of coronary artery disease and this has contributed to the marked reduction in mortality due to AMI. Over the next few years, the indications for admission to the CU were extended to include patients with suspected AMI or nSTE-ACS, in recognition of the fact that prognosis could, in some cases, be similar to that of ST-elevation AMI. In time, the concept of a CU changed, and the structure and function of these units also changed to attend to other patients with acute nonischemic heart disease, in particular, those with severe heart failure and arrhythmias, as well as patients requiring complex invasive techniques. Thus, today these units have become in actual fact intensive cardiac care units in the broadest sense.⁷ This development of the CU should be considered when planning an ICCU, as these intermediate units should also allow for the admission of patients not only with coronary artery disease but also with other heart diseases who require such care during their stay in hospital. Therefore, in this document we will use the terms intermediate coronary care units and cardiac care units indifferently.

The CUs have also been used to rule out diagnosis of AMI in patients with a high clinical risk. Unless the risk of AMI is very high, this approach is not very efficient. Chest pain units have helped avoid admission of low-risk patients, but they have also pointed to the need for beds in ICCUs for patients at intermediate risk. In most hospitals, the patients who come through the critical phase of an ACS are moved to a conventional ward, whose number of nursing staff and infrastructure are calculated for low-risk patients who require little attention. This care model, based exclusively on intensive care units and conventional wards is not flexible and efficient enough to respond to the current needs of critical and semicritical patients with heart disease.

Risk Stratification in Cardiac Patients

The patients who are admitted to hospital with ACS are a heterogeneous group with variable risk. The requirements of these patients are therefore also varied.

Recent studies on the natural history of coronary artery disease have identified the factors that influence prognosis. Early prediction of risk in patients (in chest pain units) before they are even admitted to hospital and the availability of different levels of care would allow the therapeutic effort to be adjusted according to the seriousness of the condition, thereby rationalizing the use of beds in CUs. Patients without a high risk profile can be suitably managed in less expensive and complex care units than the CUs. Nevertheless, the requirements for monitoring and nursing, at least in the first few hours, are greater than those available in a conventional hospital ward. As mentioned earlier, the intermediate care units can adequately attend to these patients without the high costs of the intensive cardiac care units.

Guidelines of the Scientific Societies

A number of scientific societies have published documents on the use of intermediate care units. The guidelines of the Spanish Society of Cardiology on the requirements and equipment of CUs, published in 2001, covered the need for intermediate care units that could facilitate a more rational use of beds in ICUs.⁷ Likewise, the most recent guidelines of the American Heart Association/American College of Cardiology on the treatment of patients with ST-elevation AMI,⁸ and the recommendations of the European Society of Cardiology on the structure, organization, and operation of intensive cardiac care units,⁹ dedicate special sections to intermediate care units and establish indications for admission to these units.

As discussed earlier, it would be appropriate for the Spanish Working Group on Coronary Artery Disease of the Spanish Society of Cardiology to make a statement on the need for this type of unit and its structure and organization in the Spanish health care setting.

DEFINITION AND CONCEPT OF INTERMEDIATE CARDIAC CARE UNITS

The ICCUs form an essential part of the cardiology service and aim to attend to heart patients who require a higher level of monitoring, nursing care, and medical response than that offered by conventional wards of the cardiology service but whose risk does not justify using the technical and human resources of a CU. This suggests that these units should have the equipment (continuous monitoring system and equipment for emergency cardiac care), staff (nurses training in cardiology with a sufficiently high ratio of nurses per bed), and a set-up such that, in emergencies, they can temporarily offer medical and nursing care similar to those of CU through specifically defined care protocols.

ORGANIZATION AND COORDINATION OF INTERMEDIATE CARDIAC CARE UNITS

In line with current approaches to hospital organization and the introduction of clinical management, it is preferable to organize medical practice in hospitals according to care processes. For decision making in the care of coronary patients, it is necessary to bring together clinical and diagnostic information and information on cardiac treatments. Therefore, the ideal situation would be for the care process, from intensive care through to the conventional hospital ward, to fall under the auspices of the cardiology service. It is essential that the person in charge of the whole process is a cardiologist with suitable training. If these principles are respected, the equipment, organization, and operation of intermediate cardiac care units should depend on the type and complexity of the hospital.

Structural models range from multidisciplinary or multifaceted intermediate care units to specialized units. The multidisciplinary units can accept patients with a range of diseases and are suitable only in small hospitals in which specialized units would not be efficient given their size or volume of activity. As mentioned earlier, in these units, the cardiologist can also take on responsibility for attending to patients with heart disease. The intermediate cardiac care units are classed as specialized units, dedicated to one specialty in particular. As these units form part of the cardiology service, they can adapt to different organizational models, which are described below.

Model Integrated Into the Intensive Cardiac Care Unit

According to this model, the ICCUs and CUs are located in the same physical space. In this type of unit, care resources are assigned according to the severity and progression of the patients, who stay in the same place throughout the process until they are moved to the conventional hospital ward. The advantage of this model is that it favors continuity in care and minimizes how often patients are moved. It also allows for the training of nursing staff and maintains a high standard. In contrast, it makes selection of patients with direct admission criteria to intermediate care units more difficult, increases equipment costs, complicates staff management because of the range of types of patient, and is less convenient for the patients. For these reasons, this is the least recommended model for intermediate cardiac care although it may be more appropriate for surgical units.

Model With the Unit Adjacent to the Intensive Cardiac Care Unit

In this model, the intermediate care unit is in close proximity to the CU and so care resources can be shared.

Although such units were originally created with the idea of easing the burden on the CUs, they are currently designed to ensure continuity in the levels of care and to attend to patients who may have to be admitted directly to these units. Unlike the previous model, their physical separation from the CU provides more comfortable and private surroundings for the patients. With the proximity of the CU, transfer of patients who present with a sudden complication is made easier. This model is suitable for cardiology services that have their own CU.

Model Integrated Into the Cardiology Ward

In this model, the unit is located within but structurally differentiated from the cardiology ward of the hospital. The unit is sufficiently well equipped and staffed in accordance with its needs as described in the section on infrastructure. Like the previous model, its main advantage is that it is a flexible unit that allows direct admission, thus reducing the number of admissions to the intensive care units and ensuring continuity in care. The cases admitted are predictable, controllable, and homogeneous, thereby facilitating resource management and staff training. The advantages of these units disappear if they are very small, as the nursing staff would be similar to that of intensive care units resulting in lost efficiency and savings in human resources would no longer be made. This model is the most appropriate one in hospitals in which the coronary unit does not belong to the cardiology service.

EVIDENCE IN FAVOR OF INTERMEDIATE CARDIAC CARE UNITS

Institutions are putting a lot of effort into reducing the costs of care for critical patients and improving the efficiency of care, and there are many articles in the literature on the subject.¹⁰⁻¹² In a study of 17 440 patients admitted to an ICU, more than a third had a less than 10% probability of needing treatment that would justify such close monitoring. In another controlled study, Franklin et al¹³ observed that, after inaugurating an intermediate care unit, the number of unnecessary admissions to the ICU decreased, thereby increasing the availability of beds and reducing mortality. Finally, Byrick et al¹⁴ reported that admissions to the ICU increased 4-fold and the mean complexity of the patients' conditions decreased after closing an ICCU because of lack of funding after 9 years.

There is less experience in cardiac patients. Most studies have been observational and nonrandomized, and the literature that analyzes the economic impact of these units is limited. Nevertheless, there is reasonable scientific evidence to suggest that, in certain patients, the cost of hospitalization is reduced without

negatively affecting clinical outcomes.¹⁵ Thus, from their cost-effectiveness analysis, Tosteson et al¹⁶ concluded that the CU is only cost-effective when the risk of AMI in patients admitted to the unit is greater than 21%. In another similar analysis, Fineberg et al¹⁷ concluded that the intermediate care unit has a good cost-effectiveness ratio in patients with a low risk of infarction. Regardless of the economic analyses, all studies suggest that the ICCUs can avoid unnecessary admissions to the CU and reduce the length of stay in these units, in turn reducing the demand for beds in the intensive care units of the hospital. At the same time, other intermediate or low-risk patients benefit from better care and perceive an improvement in the quality of care.

INFRASTRUCTURE OF INTERMEDIATE CORONARY CARE UNITS

The infrastructure of ICCUs must be appropriate for the target group of patients. The patients with indications for admission to these units basically need: *a*) more medical and nursing care because their management is more complex (intravenous medication that affects vital functions, such as vasodilators, antiarrhythmics, inotropic agents); *b*) constant monitoring by the nursing staff because of the higher risk of arrhythmias, sudden and profound hemodynamic changes, and clinical instability (angina, heart failure) as a result of disease progression or effects of the medication they are receiving; and *c*) more instrumentation and an appropriate physical space. However, these patients do not need intensive care or other complex techniques or devices (invasive mechanical respiration, dialysis, ultrafiltration, mechanical circulatory assistance, or invasive monitoring) to be properly managed to sustain their clinical state. Likewise their clinical state is such that their life is not at immediate risk.

Physical Structure

The physical structure of the units should be functional—not rigid or hermetic—and adapted to the architectural characteristics of their hospital to maximize operational efficiency. The following structural considerations apply:

- The physical structure of the ICCU should be integrated into the cardiology service. It should be located next or near to the CU and/or the conventional hospital ward of the cardiology service
- A traditional requirement of all the units with specialized care has been that the layout allows a direct line of sight between the patients and the normal work stations of the nursing staff. Such arrangements limit the privacy of the patients (large rooms with boxes separated in different ways) and reduce the comfort.

At present, the situation has changed substantially. On the one hand, the need for comfort and a relaxed and quiet atmosphere of the patients who need to be admitted to these units is recognized as an inherent part of their treatment. On the other hand, most patients admitted to these units do not require a direct line of sight for sufficient monitoring of their clinical state, given that monitoring of vital signs can provide sufficient information. At present, high quality and cheap video surveillance systems are available. Therefore, there is no reason not to structure the ICCU into individual rooms, in fact, such an arrangement is preferable

- The rooms of the ICCU must be readily accessible for the health professionals, and it must be possible to readily move beds and equipment (resuscitation trolley, portable X-ray equipment, etc) at times of emergency. The doors should be wide (approximately 1.5 m). The rooms should also be sufficiently sound-proofed and air-conditioned, preferably with windows with natural light

- The rooms should be large enough to deal with emergencies and it is recommended that they have 15 m² of usable space (and certainly not less than 12 m²) in the case of single rooms and approximately 25 m² in the case of double rooms. They should have an appropriately designed en-suite bathroom. The doors should be wide and open outwards

- The rooms should have a bedside call button/alarm and one in the bathroom that the patients can use easily, and the tone should preferably be different to the emergency alarm used by the staff

- There should be at least 1 connection to the oxygen supply and 1 vacuum line per patient

- The ICCU should have a spacious working area for nursing staff (control area) where the center for monitoring vital signs and, if required, closed-circuit television screens for monitoring the patients are located. Likewise, the ICCU should have staff rest areas, offices for medical staff, and a room for attending to family members, either for exclusive use or shared with other units (CU or hospital ward) depending the size of the unit

- The electrical system of the ICCU should be compliant with current legislation for specialized hospital units which requires connection to their own power generators and, if possible, to a continuous power supply system. As for other areas of the hospital, the unit should have its own disaster management plan for a planned evacuation

Size of Intermediate Coronary Care Units

The size of the ICCU should depend on the needs of each hospital. These needs vary greatly according to the characteristics of the population covered (the characteristics are defined by the prevalence of the

different heart diseases) and whether the center is a referral hospital (it is important to take into account whether it has a catheterization laboratory that accepts referrals from other hospitals). There is no established formula for calculating the number of beds. One method is to link the size of the ICCU with the size of the CU. The clinical guidelines on the requirements and equipment of the CU issued by the Spanish Society of Cardiology⁷ recommend that the size of these units be calculated according to the following formula:

$$\text{Theoretical no. of beds} = \frac{\text{Estimated no. of admissions/year}}{\text{Average length of stay/365}} \times$$

To adjust for an occupancy of 75%, and the resulting number should be multiplied by 1.33. If the center is a referral hospital, 2 or 3 extra beds should be added to the final number because the patients usually have more complex diseases and longer stays. The European Society of Cardiology⁹ recommends that the CU has 4 to 5 beds per 100 000 inhabitants of the hospital catchment area, or 10 beds per 100 000 admissions per year to the emergency room. The European Society of Cardiology⁹ recommends that there should be 3 beds in the ICCU for every bed in the CU. That is, an ICCU of 18 beds should be associated with a CU of 6 beds. This estimate includes care for all patients with any heart disease in need of care, and not only patients admitted with problems related to ischemic heart disease. The recommendation of this document is that the ICCUs should have 3 to 4 beds per 100 000 inhabitants on the basis of analysis of the incidence of ACS and other acute forms of heart disease for which admission to the ICCU is indicated. The number of beds should be increased if the hospital accepts patients from other health areas and it should never have fewer than 6 beds to ensure efficient resource usage. In small hospitals that have to attend to cardiac patients, smaller units might be considered.

Equipment

The basic equipment in the ICCU includes elements common to other parts of the hospital and specific devices. The system for monitoring these patients is the most essential and the most characteristic equipment in this type of unit. The traditional and preferred option is to have an electrocardiogram (ECG) monitor and pulse oximetry device. The ECG monitor should show at least 2 leads on a bedside display and have an alarm system connected to a monitoring center in the nurses' work station. However, at present, remote devices are used as often as the traditional monitoring devices (a monitor can be situated at the bedside or only in the monitoring and analysis station). The central monitoring systems currently have many different uses. The

monitoring system, whether remote or not, should at least include the following units:

- Display of 2 or more electrocardiogram leads (bedside or in the monitoring station)
- The monitoring system should preferably display oxygen saturation (pulsed oximetry) and noninvasive blood pressure on the bedside or central monitor
- Central monitoring station that can store the ECG (2 or more leads) and the other biological parameters analyzed for at least 24 hours. The data should be readily accessible for review. Furthermore, the station should have a preset alarm system with different levels of alert that can be controlled from the station, a system for interpreting arrhythmias and ST-segment leads connected to the alarm with different levels of alert, the option of a hardcopy printout, and a system for analyzing trends over at least the last 24 hours
- If remote monitoring is used, portable monitors should be available for bedside treatment in emergencies

The other basic equipment is summarized in Table. Implementation of the computing systems (clinical records and nursing informatics) has been considered a necessity, both for new and existing units. The systems used should be specific and adapted to the needs of the ICCU but it should also be possible to integrate them into the general hospital database.

Human Resources

Suitably qualified and trained staff are essential to ensure that the ICCUs run as smoothly as the CUs.

Medical Staff

There should be a person in charge of the unit who is responsible for organization, clinical management, and training programs for the other staff. This person should be a specialist in cardiology with appropriate experience in managing acute heart disease. Like the person in charge, the staff physicians should also be cardiology specialists. It is recommended to regularly rotate the staff physicians of this unit, those of the CU of the cardiology service, and/or other physicians in the cardiology service, particularly those responsible for continued care. This aspect should be adapted to each specific situation according to the characteristics of each cardiology service, but in general, rotation is considered advantageous, not only from the point of view of training those who form part of the service and are on call, but also because these rotations motivate staff and strengthen commitment to the institution. With regard to the number of cardiologists, the recent guidelines published by the Working Group on Acute Cardiac Care of the European Society of Cardiology recommend 1 physician for every

6 beds. If the unit has more than 12 beds, then the recommendation is 1 physician for every 8 beds.⁹ This number could well vary according to the functional set-up of the cardiology service.

To ensure continuous medical care, a cardiologist should be on call 24 hours in the hospital. However, it is not deemed necessary—given the characteristics of the patients who should be admitted to this type of unit—that this physician is always present in the unit and he or she could be assigned other tasks related to continuous cardiac care. The structure of the duty roster should be adapted to the characteristics of the hospital, the cardiology service, the CU, and the ICCU.

Nursing Staff

The role of the nursing staff in the ICCU, as in the CU, is essential for high quality care. Thus, there should be a sufficient number of properly trained nurses, who should be able to interpret frequent arrhythmias, detect the first indications of deterioration in patients, and take decisions quickly in emergencies (start cardiopulmonary resuscitation maneuvers or perform defibrillation). It is desirable that, in addition to appropriate training, the nursing staff assigned to an ICCU have previous experience in attending to patients in intensive care units or CUs. An appropriately trained and qualified full-time or part-time (also head of the CU or hospital ward of the cardiology service) supervisor should be present. The degree of preparation necessary has forced the government to consider recognizing specialization in the field of cardiology. The task of the supervisor could also be essential in investigational studies done in the ICCU itself. The rotation of nursing staff from the ICCU with the other units of the cardiology service, and particularly the CU, is a useful way of ensuring commitment, sense of duty, and the degree of training necessary for a suitable level of care.

There are no explicit recommendations for Spain regarding the number of nurses per bed needed for an efficient and high-quality care. The Working Group on Acute Cardiac Care of the European Society of Cardiology recommends that a total of 1.8 nurses be assigned per bed in the ICCU. In accordance with the experience of the authors of this document and the aforementioned recommendations, it seems reasonable that the number of nurses assigned to the ICCU is sufficient to ensure a ratio of 1 per 4 to 6 beds (1.2-1.8 nurses per bed), although this ratio will depend on the individual characteristics of each ICCU. At least 2 nurses are recommended if the ICCU is not included or is not close to the CU or the hospital ward of the cardiology service.

In order to run smoothly, the ICCUs also need sufficient auxiliary staff (1 for every 8 beds); hospital porters who work exclusively for the unit or in nearby

TABLE 1. Basic Equipment of the Intermediate Coronary Care Units

Equipment	Characteristics
Monitoring system	See text for an exhaustive description of the characteristics
Beds	Mobile and adjustable, preferably electrically operated, at least 90 cm wide With fold-down or detachable bed rail and an easily removable headboard It is also desirable that radiological studies can be done
Defibrillator	At least 1 synchronized defibrillator, ideally 2, at least 1 which has an external pacemaker device Biphasic defibrillators are recommended
Temporary pacemakers	Available exclusively or shared with other units, 1 for every 4 beds
Resuscitation trolley	This should contain 1 of the aforementioned defibrillators and the drugs and auxiliary equipment necessary for cardiopulmonary resuscitation, intubation, and bag-mask ventilation to achieve high flow
Ventilation systems	Portable volumetric ventilator and, preferably, noninvasive assisted ventilation systems (CPAP and BiPAP)
Cardiac massage board	There should be at least 1 for every 3 to 4 beds
Aspiration system	One per room
IV infusion pumps	At least 2 per bed
Electrocardiograph	12-lead electrocardiograph
Blood glucose measuring device	
Pneumatic compression device	For mechanical or radial compression of the inguinal vasculature to help patients achieve hemostasis after interventional procedures
Computing system	Integrated into the hospital database

units, depending on the size of the ICCU; and administrative staff who, depending on the size of the ICCU, may be shared with other units or work exclusively for the ICCU.

INDICATIONS FOR ADMISSION

The criteria for admission to the ICCU should be guided by the basic objective of attending to patients with acute heart disease, particularly ACS, whose clinical condition does not require admission to a CU but who nevertheless are not sufficiently stable to be admitted to a conventional cardiology ward (because of the appearance of arrhythmias or risk of recurrence of ischemia). These patients therefore need closer monitoring and more intensive care, as described at the beginning of this document.^{7-9,12} In general, we only have data from a few observational studies. Therefore, the recommendations made in this document are based solely on the consensus of an expert committee (level C of evidence). The indications for admission recommended in this document are described below.

Patients With Non-ST-Elevation ACS at Intermediate–High Risk Who Are Hemodynamically Stable

Patients with nSTE-ACS who are hemodynamically stable (without hypertension, heart failure, or ventricular arrhythmias) can be considered for admission if they have one or more of the following characteristics: *a*) prolonged resting angina with ECG abnormalities (ST-segment depression, T-wave alterations) and/or elevated troponin; *b*) impaired ventricular function, kidney failure, or a combination of other comorbidities (infarction or prior revascularization, age, diabetes mellitus, peripheral vascular disease); *c*) recurrent angina (2 or more episodes of angina in the past 24 hours); and *d*) patients with nSTE-ACS initially admitted to the CU because of their high-risk profile, after stabilization with medical treatment (>24 h without recurrence of ischemia).

Risk should be stratified with one of the accepted risk equations and treatment should be administered in accordance with clinical guidelines.¹⁸ Very high-risk patients and those with large (>2 mm) or diffuse (>4 leads) ST-segment changes should not be admitted to the ICCU but rather referred to the CU.

Patients With Uncomplicated ST-Elevation Acute Myocardial Infarction

The following patients can be admitted to the ICCU:

– Patients with early reperfusion after percutaneous coronary interventions (primary angioplasty) who are

free of severe ventricular dysfunction or other clinical or anatomical risk factors

– Patients treated with thrombolytic agents with evidence of coronary reperfusion and without complications, once 24 hours have elapsed since the onset of AMI

– Patients with extensive AMI who have not received thrombolytic therapy, without complications, once 48 hours have elapsed

High-Risk Patients With ST-Elevation Acute Myocardial Infarction, Stabilized After an Initial Complicated Phase

Patients who, after complicated AMI, have stabilized (for at least the last 24 hours), but who need continued close monitoring or strictly controlled medical treatment are candidates for transfer to the ICCU before being definitively moved to the cardiology ward:

1. Extensive anterior AMI with acute phase bundle branch block. In these patients, there is an obvious risk of malignant ventricular arrhythmias (ventricular tachycardia, ventricular fibrillation).

2. Complicated AMI with arrhythmias (ventricular tachycardia, ventricular fibrillation, atrioventricular block, etc). As in the previous case, these patients need ECG monitoring until they are stable.

3. Early phase complicated AMI with heart failure or shock. After initial hemodynamic stabilization and provided the patient does not require invasive measures (postextubation, removal of thermodilution catheter, balloon counterpulsation, etc), the patient should be transferred to the ICCU while the final adjustments to medical treatment are made.

4. Clinically stable AMI with postinfarction angina (without recurrence of ischemia in the previous 24 hours), with known coronary artery anatomy and awaiting revascularization surgery.

Immediate Monitoring After Invasive Procedures

Patients who have undergone high-risk percutaneous coronary intervention (PCI) are candidates for admission to the ICCU in the following situations:

1. nSTE-ACS after uncomplicated coronary artery reperfusion (first 6-24 h).

2. Stable chronic ischemic heart disease during the first 6 to 24 hours after high-risk PCI (for example, percutaneous transluminal coronary angioplasty [PTCA] of the left main coronary artery or the only patent vessel, PTCA patients with severe left ventricular dysfunction or prior kidney failure).

3. Patients with reversible complications during the procedure (excluding major complications such as AMI,

severe heart failure or shock, candidates for admission to the CU), or who need specific treatments (for example, glycoprotein IIb/IIIa inhibitors, etc).

Recipients of an implantable cardioverter defibrillator (ICD) or those who have undergone other invasive procedures, such as percutaneous ablation, pacemaker placement, etc, who need temporary monitoring (complicated procedure or high-risk findings).

Other Acute Heart Diseases

Although the main aim of the ICCU is to attend to patients with ischemic heart disease, at the discretion of the cardiologist in charge—and according to the needs for care at the time—certain other patients with acute heart diseases can be considered for admission:

1. Heart failure. The ideal treatment for these patients might include administration of inotropic agents or vasodilators, or noninvasive mechanical ventilation (CPAP, BiPAP). Two well-defined types of candidate can be considered: *a*) patients with acute heart failure (acute pulmonary edema) with good response to initial treatment that does not require invasive interventions, and *b*) patients with chronic decompensated heart failure or heart failure refractory to optimum medical treatment (excluding patients with severe hypotension or cardiogenic shock requiring admission to the CU).

2. Patients with advanced atrioventricular block or sick sinus syndrome with good hemodynamic tolerance, or those who are stable after implantation of temporary pacing electrodes, while awaiting definitive pacemaker implantation.

3. Treatment of certain supraventricular arrhythmias (usually fibrillation or atrial flutter) or ventricular arrhythmias according to the available protocols. Patients who are awaiting ICD implantation or who are admitted to the emergency room after an ICD discharge can also be admitted to the ICCU (but not patients with repeated discharges or electrical storm; these patients should be admitted to the CU).

4. At the discretion of the cardiologist in charge of the ICCU, admission can be considered for patients with other cardiovascular diseases such as hypertensive crises, type B aortic dissection (after initial stabilization in the coronary unit), bacterial endocarditis in patients awaiting emergency surgery, etc.

Other Clinical Situations in Which Admission to Intermediate Coronary Care Units Could be Considered

In exceptional circumstances, heart surgery patients with cardiac complications (heart failure, arrhythmias, etc) that would make their admission to a general ward inadvisable can be admitted once 36 to 48 hours have

elapsed since the operation (and the patient has been extubated and the chest drains and so on have been withdrawn), provided no other serious extracardiac problems are present that would indicate admission to the general ICU or the specific resuscitation unit.

RELATIONSHIP OF THE INTERMEDIATE CORONARY CARE UNIT WITH OTHER UNITS AND SERVICES

The ICCUs can be very useful for optimizing health resource use in patients with acute cardiac disease. Although these units were initially introduced as a way of reducing the stay of patients without complications in coronary units (or the general ICU), currently, as shown in Figure, there are many services or units which can refer patients to the ICCU. These include the emergency room, the chest pain unit, the CU, or the general ICU and other hospital services such as heart surgery, general surgery, vascular surgery, and internal medicine services, the postoperative recovery ward (cardiac complications during noncardiac surgery), and also the nephrology, endocrinology, and neurology services. There should also be a fluid relationship with other hospitals so that the ICCUs of tertiary hospitals can act as support for patients with acute heart failure from other hospitals.

REFERENCES

- Marrugat J, Elosua R, Martí H. Epidemiología de la cardiopatía isquémica en España: estimación del número de casos y de las tendencias entre 1997 y 2005. *Rev Esp Cardiol.* 2002;55:337-46.
- Boix R, Aragónés N, Medrano MJ. Tendencias en la mortalidad por cardiopatía isquémica en 50 provincias españolas. *Rev Esp Cardiol.* 2003;56:850-6.
- Marrugat J. La funesta sombra de la cardiopatía isquémica. *Rev Esp Cardiol.* 2003;56:848-9.
- Fiol M, Cabadés A, Sala J, Marrugat J, Elosua R, Vega G, et al. Variabilidad en el manejo hospitalario del infarto agudo de miocardio en España. Estudio IBERICA (Investigación, Búsqueda, Específica y registro de Isquemia Coronaria Aguda). *Rev Esp Cardiol.* 2001;54:443-52.
- Bueno H, Bardají A, Fernández-Ortiz A, Marrugat J, Martí H, Heras M. Manejo del síndrome coronario agudo sin elevación del segmento ST. Estudio DESCARTES (Descripción del Estado de los Síndromes Coronarios Agudos en un Registro Temporal Español). *Rev Esp Cardiol.* 2005;58:244-52.
- Heras M, Bueno H, Bardají A, Fernández-Ortiz A, Martí H, Marrugat J, on behalf of the DESCARTES investigators. Magnitude and consequences of undertreatment in high-risk patients with non-ST-segment elevation acute coronary syndromes. Insights from the DESCARTES registry. *Heart* 2006. Publicado on line 27 abril 2006. Available from: doi:10.1136/hrt.2005.079673
- Valle V, Alonso A, Arós F, Gutiérrez J, Sanz G. Guías de práctica clínica de la Sociedad Española de Cardiología sobre requerimientos y equipamiento de la unidad coronaria. *Rev Esp Cardiol.* 2001;54:617-23.
- Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice

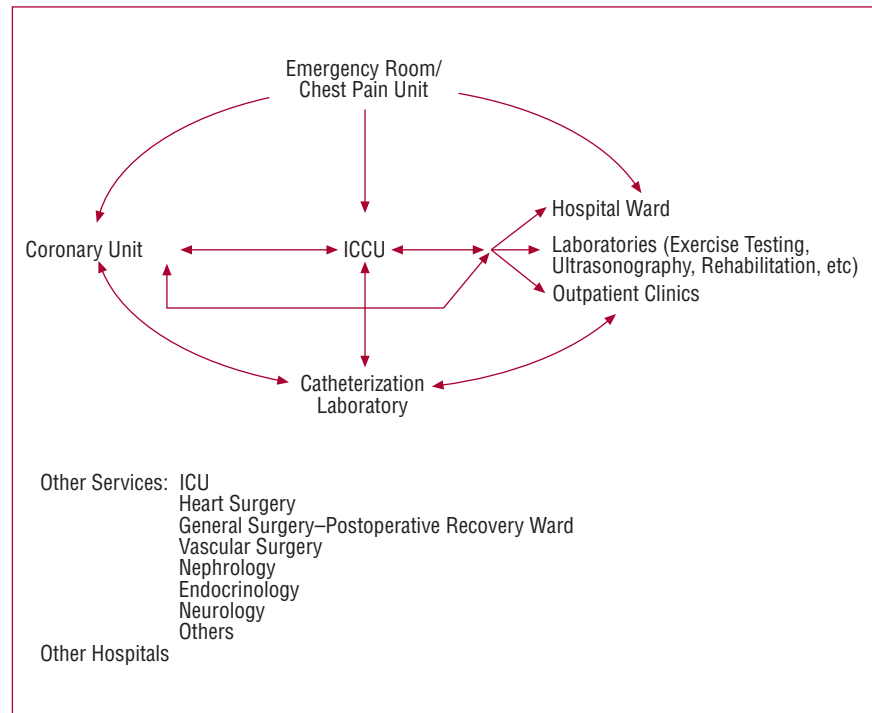


Figure. Patient flow between the intermediate coronary care units and other areas of care

- Guidelines (Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). 2004. Available from: www.acc.org/clinical/guidelines/stemi/index.pdf
- Hasin Y, Danchin N, Filippatos GS, Heras M, Janssens U, Leor J, et al. Recommendations for the structure, organization, and operation of intensive cardiac care units. *Eur Heart J*. 2005;26:1676-82.
 - Angus DC, Black N. Improving care of the critically ill: institutional and health-care system approaches. *Lancet*. 2004;363: 1314-20.
 - Peiró Andrés A. Cuidados intermedios en cardiología. 4.º Congreso Virtual de cardiología. Noviembre de 2005. Available from: <http://www.fac.org.ar/ccvc/llave/c030/peiro.php>
 - Nasraway SA, Cohen IL, Dennis RC, Howenstein MA, Nikas D, Warren J, et al. Guidelines on admission and discharge for adult intermediate care units. *Crit Care Med*. 1998;26:607-11.
 - Franklin CM, Rackow EC, Mamdani B, Nightingale S, Burke G, Weil MHI. Decreases in mortality on a large urban medical service by facilitating access to critical care. An alternative to rationing. *Arch Intern Med*. 1988;148:1403-5.
 - Byrick Rj, Mazer CD, Caskennette GM. Closure of an intermediate care unit. Impact on critical care utilization. *Chest*. 1993; 104:876-81.
 - Bosch X, Pérez J, Ferrer E, Ortiz J, Pérez-Alba JC, Heras M, et al. Perfil clínico, tratamiento y pronóstico de los pacientes con infarto agudo de miocardio no ingresados en una unidad coronaria: utilidad de una unidad de cuidados intermedios como lugar de ingreso. *Rev Esp Cardiol*. 2003;56:262-70.
 - Tosteson AN, Goldman L, Udvarhelyi IS, Lee TH. Cost-effectiveness of a coronary care unit versus an intermediate care unit for emergency department patients with chest pain. *Circulation*. 1996;94:143-50.
 - Fineberg HV, Scadden D, Goldman L. Care of patients with a low probability of acute myocardial infarction: cost effectiveness of alternatives to coronary-care-unit admission. *N Engl J Med*. 1984;310:1301-7.
 - López- Bescós L, Arós F, Lidón RM, Cequier A, Bueno H, Alonso JJ, et al. Actualización (2002) de las guías de práctica clínica de la Sociedad Española de Cardiología en angina inestable/infarto sin elevación del segmento ST. *Rev Esp Cardiol*. 2002;55:631-42.

APPENDIX. Members of the Study Group on Intermediate Coronary Care Units Who Have Drafted This Document on Behalf of the Working Group on Coronary Artery Disease and Coronary Units

Study Group on the Need and Rationale for Intermediate Coronary Care Units

Coordinator: Gines Sanz, Hospital Clinic de Barcelona

Members: Fernando Arós, Hospital Txagorritxu de Vitoria
Héctor Bueno, Hospital General Universitario Gregorio Marañón de Madrid
Carlos Fernández Palomeque, Hospital Universitario Son Dureta, Palma Mallorca
Xavier García-Moll, Hospital de la Santa Creu i Sant Pau de Barcelona
Luis F. Pastor Torres, Complejo Hospitalario Nuestra Señora de Valme de Sevilla
Amparo Peiro Andrés, Hospital General Universitario de Valencia
Luis Rodríguez Padial, Complejo Hospitalario de Toledo
Joan Sala, Hospital Josep Trueta de Girona

Study Group on Material Infrastructure and Staffing of the Intermediate Coronary Care Unit

Coordinator: Joaquín J Alonso, Hospital de Fuenlabrada

Members: Jaume Figueras, Hospital General Universitari Vall d'Hebron de Barcelona
Magda Heras, Hospital Clinic de Barcelona
Ramón López Palop, Hospital San Juan de Alicante
José L. López Sendón, Hospital Universitario La Paz
M. Ángeles Salvador, Hospital Clínico Universitario de Valladolid
Pedro L. Sánchez, Hospital General Universitario Gregorio Marañón de Madrid
Fernando Worner, Hospital Universitari Arnau de Vilanova de Lérida

Study Group on Indications for Admission

Coordinator: Josep Guindo, Hospital de la Santa Creu i Sant Pau de Barcelona

Members: Alfredo Bardaji, Hospital Joan XXIII de Tarragona
Julián Bayón, Complejo Hospitalario de León
Xavier Bosch, Hospital Clinic de Barcelona
Antoni Curós, Hospital Universitari German Trias i Pujol de Barcelona
Antonio Fernández Ortiz, Hospital Clínico de San Carlos de Madrid
Miquel Fiol, Hospital Universitario Son Dureta de Palma de Mallorca
Lorenzo López Besós, Hospital Fundación de Alcorcón
