European Heart Journal Supplements (2025) **27** (Supplement 5), v205–v215
The Heart of the Matter
https://doi.org/10.1093/eurheartjsupp/suaf075

ESC
European Society
of Cardiology

ANMCO position paper: functional reorganization of Intensive Cardiac Care Units (ICCUs) in Italy

Evolution of ICCUs: Growing Needs and the Necessity of a Network With Varying Levels of Care Complexity

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KEYWORDS
Cardiac Intensivist;
Network;
Healthcare system;
Intensive Cardiac Care Unit

Recently, intensive cardiac care units (ICCUs) have undergone a significant transformation related to the evolution in management of acute coronary syndrome and influenced by other factors such as the epidemiological transition, the increasing complexity of clinical cases, the technological advancement, and the growth of clinical and scientific expertise of cardiologists. In the context of this evolution, a functional reorganization of ICCUs in Italy has to be implemented in order to meet the changing needs of the population with cardiovascular disease requiring critical care. Therefore, the Italian Association of Hospital Cardiologists (ANMCO) proposes this position paper for the reorganization of CICUs into three levels with increasing functional complexity, based on the hospital characteristics, the available technology, and the clinical cases treated. The system would be functionally integrated into a regional ICCU organization modelled on a time-dependent care network. This proposed network aims to standardize diagnostic and therapeutic protocols and establish unified data collection registries to facilitate self-assessment and support clinical research. The document delineates specific requirements for each ICCU level, including the management of clinical cases, the expertise of intensive care cardiologists, the technological facilities, and the medical and nursing staff needed to ensure optimal care delivery.

Introduction

Intensive cardiac care units (ICCUs) were established in the 1960s to ensure early diagnosis and treatment of arrhythmic complications of acute myocardial infarction (AMI).[1] Their creation led to a drastic reduction in mortality from AMI, from 31% in the 1960s to 15% in the pre-thrombolytic era.[2]

The clinical success of ICCUs quickly led to their spread both in the United States and in Europe; in Italy, the first coronary unit was opened in 1967 by Fausto Rovelli at Niguarda Hospital in Milan, and in the following years, there was rapid and widespread expansion in all Italian cardiology departments.[3]

Over the following 60 years, ICCUs underwent profound transformations, partly related to the evolution of treatment for acute coronary syndromes (ACS), and partly due to changes in other more general and universal factors: the epidemiological, cultural, and social transition, the increasing complexity of cases with ever-older patients suffering from multiple comorbidities and severe cardiovascular diseases, the evolution of technologies, the expansion of clinical-scientific skills among cardiologists, and the consequent evolution of their position within hospital structures.[2,4]

In recent years, both American and European cardiological scientific societies have produced various documents that review the transformation of ICCUs and the competencies that clinical cardiologists must acquire to ensure quality and safety for patients hospitalized in ICCUs.[2,5-8]

In Italy, a functional reorganization of ICCUs that reflects the radical changes already in place has not yet occurred. However, the results of the recent census by the National Association of Hospital Cardiologists (ANMCO) in 2022, data from recent national registries, sociocultural changes, as well as the current economic situation of the country, all demand urgent reflection aimed at identifying and implementing a specific plan. This project should ensure the following:

i. Quality and equity of care for the 'critical' cardiovascular patient, in order to make treatment uniform across the entire national territory, regardless of the hospital of first admission.
ii. Definition of technological equipment and medical and nursing staff based on the type of hospital where the ICCU is located and the patient case mix.
iii. Reorganization of the use of existing ICCU beds, with reassessment and optimization of economic resources.
iv. Network of ICCUs and cardiological emergencies, extending the time-dependent network model for myocardial infarction to other acute cardiovascular diseases.
v. Recognition of the professional figure of the 'cardiac intensivist' in the management of cardiological intensive care and in the critical care area more

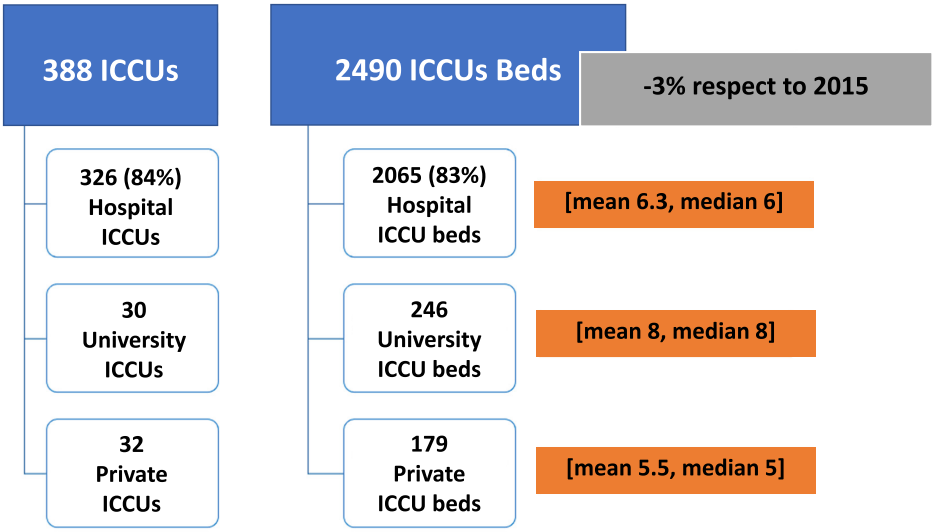

Figure 1 Distribution of intensive cardiac care units (ICCUs) and ICCU beds in Italy. Reproduced with permission from Oliva et al.[9]

generally, on par with interventional cardiologists, cardiac imaging specialists, and others.

vi. Network of ICCUs for sharing care protocols and data collection for clinical research purposes in the field of cardiological critical care.

The current context of Italian intensive cardiac care units

The data from the eighth Census of Italian cardiological structures,[9] promoted by ANMCO in 2022, which involved 790 Italian cardiology departments (99%), revealed the presence of 388 ICCUs, of which 326 (84%) are hospital-based, 30 are university-based, and 32 are private, with a total of 2490 beds, equivalent to 1 ICCU bed per 23 635 inhabitants, reduced by about 3.5% compared to 2015. According to the findings of this document, ICCUs currently have an average of 6.3 beds, with one ICCU for every 153 657 inhabitants (*Figure 1*), and a coronary interventional catheter laboratory is active for every 217 161 inhabitants.

Hospitals with cardiac surgery are present across the national territory at a ratio of 1.6 per million inhabitants, or one hospital for every 626 071 inhabitants.

There are 16 hospitals in Italy with a heart transplant programme, but only 15.8% of cardiology departments are part of a network for heart failure.

The census reveals that 89% of Italian ICCUs have a network for the treatment of myocardial infarction with ST-segment elevation (STEMI), and 62% for myocardial infarction without ST-segment elevation (NSTEMI). Only 16% have a network for heart failure and 39% for cardiogenic shock; for other cardiological emergencies, such as fulminant myocarditis, massive pulmonary embolism, and electrical storm, the data are not well known (*Figure 2*).

The lack of a network for time-dependent cardiological emergencies other than STEMI results in very high mortality from cardiogenic shock, around 70% according to recent data from the National Agency for Regional

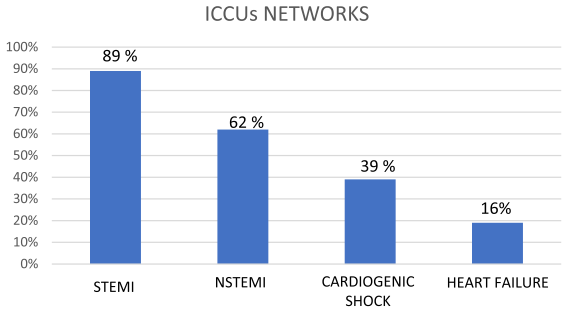

Figure 2 Distribution of networks between intensive cardiac care units (ICCUs) dedicated to specific cardiovascular diseases. NSTEMI, non-ST elevation myocardial infarction; STEMI, ST elevation myocardial infarction. Reproduced with permission from Oliva et al.[9]

Health Services (AGENAS) (*Table 1*).[10] International literature shows that critically ill cardiac patients, such as those with cardiogenic shock, when admitted to a high-volume ICCU, managed by cardiac intensivists, working in teams with other specialists, have a better prognosis, and mortality is reduced to levels below 50%.[11-13]

Recently, we analysed the profiling data of members of the 'ANMCO ICCU Club'; of the 902 members, 868 completed their registration forms, revealing that about 50% work in ICCUs that are not equipped with mechanical circulatory support systems, and only 36% work in ICCUs with invasively ventilated patients. It is likely that many patients requiring organ support, such as those with cardiogenic shock, fulminant myocarditis, massive pulmonary embolism, post-cardiac arrest syndrome, and other critical cardiological emergencies are not managed in ICCUs due to the lack of a structured network and often end up in general intensive care units, as highlighted by the data from the PROSAFE project.[14,15]

Table 1 In-hospital mortality in patients <75 years with cardiogenic shock (CS)

Regional code	Region	2019		2020		2021	
		HF Admission	Mortality (%)	HF Admission	Mortality (%)	HF Admission	Mortality (%)
	Italy	**5506**	**66.69**	**5818**	**70.85**	**5834**	**69.06**
010	Piemonte	406	51.23	513	57.31	442	52.94
020	Valle d'Aosta	9	55.56	16	81.25	9	77.78
030	Lombardia	875	56.23	894	55.93	868	53.69
041	PA Bolzano	23	65.22	30	50.00	32	65.63
042	PA Trento	64	57.81	36	41.67	57	64.91
050	Veneto	342	65.50	339	69.62	384	62.24
060	Friuli-Venezia Giulia	67	50.75	67	53.73	66	69.70
070	Liguria	234	77.78	309	87.38	268	80.97
080	Emila-Romagna	343	55.10	326	67.18	368	58.42
090	Toscana	331	54.38	329	53.19	302	55.63
100	Umbria	61	57.38	57	64.91	62	61.29
110	Marche	144	67.36	142	67.61	110	57.27
120	Lazio	600	81.00	753	86.59	736	82.74
130	Abruzzo	100	80.00	72	68.06	113	70.80
140	Molise	50	66.00	76	63.16	124	80.65
150	Campania	674	75.96	681	82.97	604	75.99
160	Puglia	381	74.80	394	76.65	443	85.10
170	Basilicata	65	84.62	48	87.50	63	77.78
180	Calbria	205	75.12	189	71.96	143	80.42
190	Sicilia	424	68.63	424	78.30	518	77.61
200	Sardegna	108	72.22	123	73.17	122	71.31

Data extracted from AGENAS.[10]

In the publications of the PROSAFE project 'National Report on Multi-Disciplinary Intensive Care Units—Year 2022',[14] in the section dedicated to 'Characteristics of the Population at Admission—Non-COVID Adult Medical Patients Evaluated in the GiViTI Model,' several results are reported that deserve careful consideration: out of a total of 13 867 patients admitted, 1252 (9%) had cardiogenic shock. Among the clinical conditions at admission, cardiovascular diseases were present in 3455 patients, equal to 24.9% of all medical admissions: cardiac arrest 1166 (8.4%), left heart failure with acute pulmonary oedema 770 (5.6%), cardiac arrhythmias 428 (3.1%), heart failure without acute pulmonary oedema 460 (3.3%), and acute myocardial infarction 442 (3.2%).

Also, in the 'National Report on Cardiac Surgery Intensive Care Units,' 11.8% of the hospitalized population is categorized as medical patients.[15] It is evident that, in many cases, the most critically ill cardiac patients are not treated in ICCUs but in general intensive care units, under the care of intensivists. This is further supported by an analysis published by Tavazzi et al.[16] which showed that in 316 general intensive care units across Italy, affiliated with the PROSAFE software, 11 671 patients with cardiogenic shock were admitted between 2011 and 2018, with a hospital mortality rate of 53.9%.

In the Ministerial Decree of 2 April 2015, No. 70,[17] regarding the definition of qualitative, structural, technological, and quantitative standards for hospital care, healthcare facilities are classified into three levels of complexity, which correspond to cardiological structures of varying complexity:

- Hospitals with Emergency Departments (ED), serving a population between 80 000 and 150 000 inhabitants, without a cardiology department or ICCU.
- Hospitals with a First-Level ED, serving a population between 150 000 and 300 000 inhabitants, equipped with a cardiology department, ICCU, and sub-intensive care, sometimes also multidisciplinary. In some cases, depending on regional policies and local territorial needs (e.g. remote areas), a 24/7 coronary interventional catheter laboratory service is also available. Hospitals serving populations between 300 000 and 600 000 inhabitants are expected to have a cardiology department with 24-hour cath-lab as a part of the cardiology unit. These hospitals essentially function as Hub centres for the cardiology emergency network.
- Hospitals with a Second-Level ED, serving a population between 600 000 and 1 200 000 inhabitants, with a cardiology department equipped with ICCU and 24-hour coronary interventional catheter laboratory, as well as cardiac surgery, cardiothoracic intensive care unit, vascular surgery, and other specialties typical of second-level ED hospitals.

Reorganization of intensive cardiac care units: ANMCO proposal

The reorganization of ICCUS proposed by ANMCO is in line with the position paper of the Association for Acute Cardiovascular Care (ACVC) published in 2018[6] and with the classification of healthcare facilities outlined in Ministerial Decree No. 70 of 2 April 2015.[17]

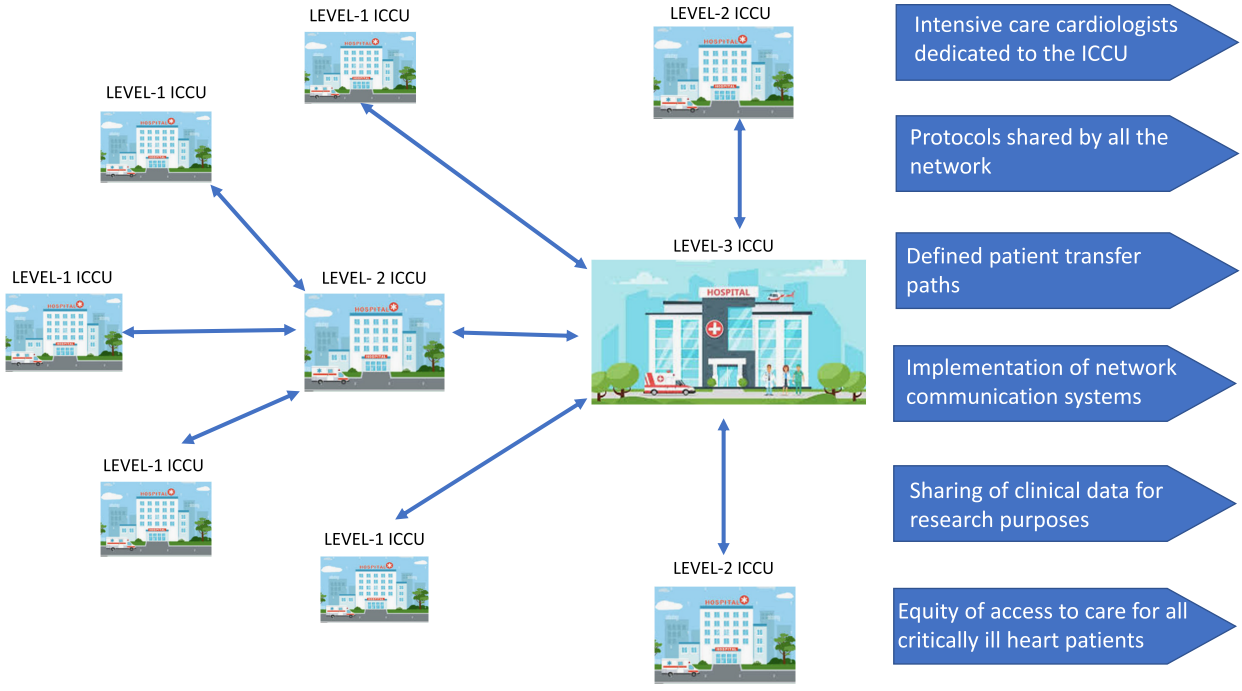

Figure 3 Proposed reorganization of the intensive cardiac care units (ICCUs).

ANMCO suggests three levels of ICCUs with different complexities, based on the characteristics of the hospital in which they are located, and interconnected within a regional network of ICCUs, following the model of time-dependent networks, so as to ensure all the levels of care a patient needs, regardless of the hospital of first admission.[10,18]

Shared regional programs among healthcare professionals and public decision-makers should define the organizational methods of the 'cardiological critical care area' by standardizing diagnostic and therapeutic protocols among professionals, ensuring constant information exchange facilitated by IT systems, and organizing efficient telemedicine and teleconsultation services for the online and real-time sharing of the critical patient's care pathway discussed in a heart team (*Figure 3*). The myocardial infarction network has shown that with this type of organization, it is possible to reduce mortality and ensure uniform treatment.[19] International literature demonstrates that this organizational model can also be effective for the most critically ill patients, such as those with cardiogenic shock, and that outcomes are better when these patients are admitted to high-volume ICCUs, managed by a multidisciplinary team led by cardiac intensivist, rather than when they are admitted to general intensive care units.[20,21]

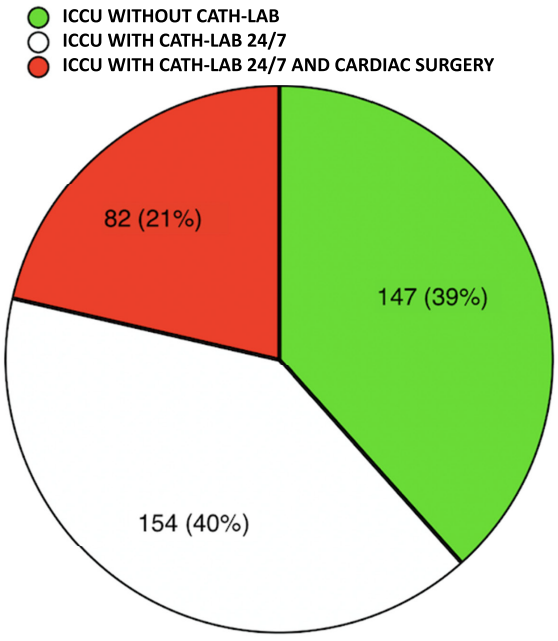

Figure 4 Distribution of intensive cardiac care units (ICCUs) based on the presence or absence of 24-hour coronary interventional catheter laboratory and cardiac surgery.

Levels of intensive cardiac care units

Level-1 ICCUs

These are located in hospitals with an Emergency Department and a Cardiology Unit, but without a coronary interventional catheter laboratory. They are the ICCUs of first-level healthcare facilities, as outlined by Ministerial Decree No. 70 of 2 April 2015, which specifies that a Cardiology Unit with ICCU should serve a population of 150 000–300 000 inhabitants. Currently, ICCUs that can be classified as level 1, as highlighted by the ANMCO 2022 census, make up 39% of Italian ICCUs (*Figure 4*).

The patient cases to be admitted are more traditional and 'less critical': ACS that do not require immediate

Table 2 Requirements for level-1 intensive cardiac care units (ICCUs)

CASE SERIES	SKILLS	INSTRUMENTAL EQUIPMENT	BEDS AND STAFF
LEVEL-1 ICCU • STEMI/NSTEMI after pPCI • Type 2 AMI • ACS without indications for early invasive strategy • Acute heart failure without the need for advanced monitoring • Hypo/hyperkinetic arrhythmias without haemodynamic instability • Post non cardiac surgery monitoring in patients with heart diseases • Non-cardiac conditions (e.g. acute respiratory failure, and sepsis) requiring ECG and/or non-invasive hemodynamic monitoring in patients with known and severe heart diseases • All common cardiovascular conditions requiring non-invasive ECG and/or haemodynamic monitoring	• Knowledge of cardiovascular disease guidelines, particularly for ACS and heart failure • Level-I and Level-II echocardiography • Insertion of ultrasound-guided central venous and arterial catheters • Management of oxygen therapy devices (including high-flow, CPAP, and NIV) • Implantation and management of transvenous pacemakers • Principles of fluid therapy • Management of inotropic and vasopressor medications • Principles of antibiotic therapy	• Multiparameter monitors • Invasive blood pressure monitoring • Non-invasive haemodynamic monitoring • Defibrillator • Transcutaneous and transvenous pacing • Echocardiograph with cardiac, vascular, and convex probes • NIV device • Teleconsultation service with reference ICCU available 24/7	Needs: • 8 beds/150 000–300 000 inhabitants • Nurse/patient ratio 1:4 • Cardiologist/patient ratio 1:8 • Staff: 2 cardiologists dedicated to ensuring daytime shifts • All cardiologists of the Cardiology Unit participate in on-call shifts

CPAP, continuous positive airway pressure; ECG, electrocardiogram; AMI, acute myocardial infarction; NIV, non-invasive ventilation; NSTEMI, non-ST elevation myocardial infarction; pPCI, primary percutaneous coronary intervention; ACS, acute coronary syndrome; STEMI, ST-elevation myocardial infarction; ICCU, intensive cardiac care unit.

invasive intervention, stable STEMI/NSTEMI patients already treated with effective coronary angioplasty (PCI) at a reference center, acute heart failure that does not require circulatory support or organ support, ventricular and supraventricular arrhythmias without haemodynamic compromise, patients needing pre-implantation monitoring for a permanent pacemaker, and cardiology patients who, due to non-cardiological acute conditions, require advanced monitoring of vital signs (*Table 2*).

The necessary equipment should include multi-parameter monitoring systems (including invasive blood pressure monitoring), a defibrillator, transcutaneous and transvenous pacing devices, an echocardiogram with cardiac, vascular, and convex probes, and devices for oxygen therapy (including high-flow oxygen, continuous positive airway pressure [CPAP], and non-invasive ventilation [NIV]). Depending on the local capabilities of some centres, it may be optional to perform activities in a Level-1 ICCU such as aortic counterpulsation, continuous renal replacement therapy (CRRT), and electrophysiological (EP) study or pacemaker/implantable cardioverter-defibrillator (ICD) implantation procedures, provided that there is a dedicated lab and properly trained staff.

For Level-1 ICCUs, it is essential to work in a network with Level-2 and Level-3 ICCUs, with shared therapeutic and management protocols, and active telemedicine and teleconsultation programs available 24/7.

The proposed nurse-to-bed ratio is 1:4, while for physicians, it is recommended that there be one cardiologist per eight beds and at least two cardiologists dedicated to ensuring the continuity of care during the day. All cardiologists in the unit should participate in on-call shifts. The sharing of diagnostic and therapeutic protocols with the referring ICCU must be complete, as if they were part of a single heart team.

The competence of cardiologists working in a Level-1 ICCU should include complete mastery of pharmacotherapy related to ACS, heart failure, arrhythmias, knowledge of antibiotic therapy, principles of fluid therapy, inotropic and vasopressor drugs; expertise in the use of Level I and II echocardiography, arterial monitoring, non-invasive haemodynamic monitoring, eco-guided placement of central venous catheters, oxygen therapy, CPAP/NIV systems and interfaces, and transvenous pacemaker implantation and management (*Table 2*).

In summary, Level-1 ICCUs are an important decision-making hub in the management of ACS, acute exacerbations of chronic cardiovascular diseases like heart failure, and the care of complex cardiology patients who require intensive care. Their diagnostic and therapeutic pathways must be shared with the referring Level-2 or Level-3 ICCU, with common protocols and employing 24/7 active telemedicine and teleconsultation programs.

Level-2 ICCUs

These are the reference ICCUs in the time-dependent network, located in healthcare facilities serving a population between 300 000 and 600 000 inhabitants, with a First-Level ED and a Cardiology Unit with a 24-hour coronary interventional catheter laboratory (a unit within Cardiology, as provided by Ministerial Decree

Table 3 Requirements for level-2 intensive cardiac care units (ICCUs)

CASE SERIES	SKILLS	INSTRUMENTAL EQUIPMENT	BEDS AND STAFF
LEVEL-2 ICCU • All case series of Level 1-ICCU • ACS of very high or high risk • Acute heart failure of any aetiology requiring advanced clinical-instrumental monitoring • Cardiogenic shock class SCAI A, B, and early phase C • Hypo/hyperkinetic arrhythmias with haemodynamic instability • Post-procedure monitoring of coronary/structural/electrophysiology interventions • ECG and mini-invasive/invasive haemodynamic monitoring post-non cardiac procedures in patients with complex heart diseases • Cardiovascular diseases of any aetiology requiring intensive monitoring	• All competencies required for a Level-1 ICCU cardiologist • Transthoracic and transoesophageal echocardiography • Management of IABP and percutaneous axial pumps • Echoguided pericardiocentesis and thoracentesis • Implantation/management of transvenous pacing • Knowledge/management of NIV • Management of patients with tracheostomy • Application and management of CRRT • Treatment of sepsis and septic shock • Principles of enteral and parenteral nutrition • Treatment of delirium/sedation • Knowledge and management of critical illness • Palliative care principles	• All equipment of Level 1-ICCU • Echocardiograph with transoesophageal, vascular, and convex probes • Point-of-care systems for monitoring haemo-coagulation parameters, ABG • Non-invasive ventilators • Mini-invasive haemodynamic monitoring systems • IABP • Transvenous pacing • CRRT devices • Teleconsultation service with reference ICCU available 24/7 • Palliative care reference service	Needs: • 8–12 beds/300 000–600 000 inhabitants • Nurse/patient ratio 1:3 • Cardiologist/patient ratio 1:6 • Staff: 4 cardiac intensivists dedicated to ensuring daytime shifts • Cath-Lab available 24/7

CRRT, continuous renal replacement therapy; ECG, electrocardiogram; ABG, arterial blood gas analysis; TOE, transesophageal echocardiography; TTE, transthoracic echocardiography; IABP, intra-aortic balloon pump; ACS, acute coronary syndrome; SCAI, society for cardiovascular angiography and interventions; ICCU, intensive cardiac care unit.

No. 70 of 2 April 2015). Currently, about 40% of Italian ICCUs are located in hospitals with these characteristics.

The patient case load includes those with myocardial infarction (STEMI and NSTEMI), cardiogenic shock in stages A–B and the early phase of stage C according to the Society for Cardiovascular Angiography and Interventions (SCAI) classification, acute heart failure that does not require advanced circulatory support, intermediate-to-high or high-risk pulmonary embolism, ventricular and supraventricular arrhythmias, monitoring following coronary and peripheral revascularization procedures, percutaneous treatments for structural heart diseases, post-surgical monitoring of non-cardiac surgery in high-risk cardiac patients, cardiovascular diseases of any aetiology requiring intensive monitoring, etc. (*Table 3*).

The equipment should include short- and medium-term cardiac assist devices (at least the intra-aortic balloon pump, but also percutaneously implanted axial pumps), potential CRRT devices, non-invasive ventilators, echocardiographs with transoesophageal, vascular, and convex probes, and 'point-of-care' systems for monitoring haemocoagulation parameters and blood gas analysis.

All Level-2 ICCUs must work in a network and have shared protocols with Level-1 ICCUs, which they represent as reference ICCUs, and with Level-3 ICCUs, which are affiliated centres. Active teleconsultation programs and the ability to activate the heart team 24/7 are essential.

For better resource optimization, the most appropriate size for Level-2 ICCUs is 8 beds, linked to a less intensive area, but with vital sign monitoring systems (electrocardiogram, arterial saturation, and respiratory rate) where patients who are no longer 'critical' but still need close monitoring and surveillance, or those with comorbidities requiring high levels of nursing care, can be transferred.

The proposed nurse-to-bed ratio for Level-2 ICCUs is 1:3, while for physicians, it is recommended that there be one cardiologist per six beds and ideally four cardiac intensivists dedicated to ensuring the continuity of care during the day. All cardiologists in the unit must participate in on-call shifts.

Cardiac Intensivists in Level-2 ICCUs should also be proficient in non-cardiological areas such as ventilation

Table 4 Requirements for level-3 intensive cardiac care units (ICCUs)

CASE SERIES	SKILLS	INSTRUMENTAL EQUIPMENT	BEDS AND STAFF
LEVEL-3 ICCU • Cardiac and vascular conditions that, due to clinical complexity and the need for devices, cannot be managed in Level-1 and Level-2 ICCUs: • Cardiogenic shock • MOF • Myocarditis with haemodynamic or electrical instability • High-risk pulmonary embolism • Post-cardiac arrest syndrome • Electrical storm with haemodynamic instability • Acute aortic syndromes • Mechanical complications of MI • Infective endocarditis with haemodynamic complications • If a HT/VAD programme is available: management of critically ill patients awaiting heart transplantation and/or VAD implantation, and post-operative management.	• Advanced cardiological knowledge of critically ill patients and specific knowledge of critical care medicine • Knowledge and management of short- and medium-term circulatory support devices (IABP, micro-axial pumps, ECMO) • Knowledge and management of VAD • Management of ventilators • Knowledge of CRRT methods and device management • Insertion of Swan–Ganz catheter and interpretation of curves • Management of post-cardiac arrest syndrome • Training in palliative care	• All equipment of Level-2 ICCU • Short- and medium-term circulatory support devices (IABP, Impella, ECMO) • Ventricular assist devices (VAD) • Ventilators • Devices for sepsis treatment • Devices for invasive haemodynamic monitoring • Devices for temperature control	Needs: • 8–12 beds/600 000–1 200 000 inhabitants • Nurse/patient ratio 1:2 • Doctor/patient ratio 1:4 • Staff: 6 cardiac intensivists dedicated • Ideally, an intensivist available during night hours and holidays • Cath-Lab for structural and endoprosthetic procedures available 24/7 • Cardiac surgery available 24/7 • 24/7 connection to HT/VAD program if not on-site • Vascular surgery, stroke team, interventional neuroradiology • Multidisciplinary team including perfusionist, physiotherapist, infectious disease specialist, nutritionists, palliative care specialist, psychologist • Heart Team available 24/7 for network-affiliated ICCUs • Teleconsultation available 24/7 for affiliated ICCUs

ACR, cardiac arrest; CRRT, continuous renal replacement therapy; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; STEMI, ST-elevation myocardial infarction; LVAD, left ventricular assist device; MOF, multi-organ failure; HT, heart transplant; ICCU, intensive cardiac care unit; VAD, ventricular assist device.

management, delirium treatment, sepsis and septic shock management, CRRT, principles of enteral and parenteral nutrition, critical illness, and palliative care principles (*Table 3*).

The head of a Level-2 ICCU should be a cardiac intensivist who has completed a specific and documented training programme, such as a second-level master's degree or ANMCO/ACVC certification, capable of supporting the ICCU team with intensive care competencies that are not traditionally part of a clinical cardiologist's training.

Level-2 ICCUs are the most common in Italy (40%), working in interdependence with cath labs and emergency departments. They are the core of the time-dependent network, not only for ACS but for the entire spectrum of cardiological emergencies. They serve as a reference for Level-1 ICCUs and are connected through shared diagnostic and care protocols with Level-3 ICCUs.

Level-3 ICCUs

These are located in hospitals with a Second-Level ED, which also have a Cardiac Surgery Unit, 24-hour coronary interventional catheter laboratory with structural interventions, an EP lab, and all other specialties typically found in Second-Level ED hospitals. According to Ministerial Decree No. 70 of 2 April 2015, at least one Level-3 ICCU should be available for every 600 000–1 200 000 inhabitants. According to the ANMCO 2022 census, there are 82 Level-3 ICCUs (21%) located in hospitals with cardiac surgery. In line with the decree, there is one Level-3 ICCU for every 719 500 inhabitants.

Level-3 ICCUs manage the most complex cases, both due to the technologies used and the complexity of the patients. They can be considered reference centres for critically ill cardiac patients who need complex technologies and require specific advanced professional expertise (*Table 4*). The patient case load for Level-3 ICCUs includes patients with cardiogenic shock stages C-D-E of the SCAI classification, myocarditis with haemodynamic compromise, post-cardiac arrest syndrome, acute aortic syndromes, electrical storms, etc.

In addition to the devices typically found in a Level-2 ICCU, Level-3 ICCUs must be able to manage patients with invasive mechanical ventilation, short- to medium-term ventricular assist devices, and devices for multi-organ dysfunction support. Specifically, the hospital with a Second-Level ED should have a 24-hour cath lab for treating coronary disease, structural heart diseases, and valvulopathies; a vascular cath lab for treating aortic diseases and peripheral arterial diseases; an EP lab for treating atrial and ventricular arrhythmias, even in urgent conditions; cardiac surgery, vascular

surgery, interventional neuroradiology, and a stroke team. Level-3 ICCUs, when they do not have a heart transplant programme on-site, must work in close contact with the transplant/device implantation center through shared regional protocols and teleconsultation services with the transplant heart team available 24/7.

Level-3 ICCUs, in addition to sharing diagnostic-therapeutic protocols with referring centres, should coordinate clinical research registries and protocols shared with these centres.

For the management of Level-3 ICCUs, the proposed nurse-to-bed ratio is 1:2, while for physicians, it is recommended that there be 1 cardiologist for every four beds, six cardiac intensivists dedicated to ensuring continuity of care during the day, and where possible, the establishment of an on-call service during night-time hours and holidays (*Table 4*).

To better rationalize human resources, a Level-3 ICCU should have at least 8 beds and the ability to rapidly transfer more stable patients to less intensive beds, with a nurse-to-patient ratio of 1:4. Additionally, protocols should be in place for transferring patients back to the referring cardiology unit once the acute phase is resolved or when palliative care is required.

The professional team supporting the cardiac intensivists should also include other specialized professionals such as physiotherapists, infectious disease specialists, nutritionists, perfusionists, biomedical engineers, palliative care specialists, psychologists, etc., all experts in managing critically ill patients (*Table 4*).

The head of a Level-3 ICCU should be a certified cardiac intensivist who has completed a specific and documented training programme, such as a second-level master's degree or ANMCO/ACVC certification, and has gained at least 5 years of experience in a Level-2 or Level-3 ICCU.

In summary, Level-3 ICCUs are equivalent to specialized intensive care units for critically ill cardiac patients who need invasive monitoring and circulatory and organ support with high-tech devices. Cardiac Intensivists must work closely with cardiac surgeons, cardioanesthesiologists, and all other specialists in the multidisciplinary team managing very complex patients. Level-3 ICCUs must ensure 24/7 teleconsultation services for discussing, sharing, and managing critically ill patients and should have a 24/7 teleconsultation service with the reference centre for cardiac replacement therapy (heart transplant/left ventricular assist device implantation) if not on-site.

Discussion

The functional reorganization of ICCUs is an essential goal for Italian cardiology, representing the starting point to rethink and redesign the cardiology landscape of our country. *Table 5* summarizes the bed and staff allocations based on the level of ICCU.

Over the past 60 years, ICCUs have played a central role in the growth of Italian cardiology and have contributed to ensuring widespread cardiology excellence across the country, without discrepancies between the North, Central, and South regions. In the 1980s, the largest clinical research on the pharmacological treatment of AMI, the Gruppo Italiano per lo Studio della Streptochinasi nell'Infarto Miocardico (GISSI) study, was initiated by Italian ICCUs and the ANMCO, enrolling over 11 000 patients in more than 90% of Italian ICCUs. This resulted in a strong and solid scientific outcome with significant implications for clinical practice.[18,22] Even today, the large number of Italian ICCUs that participated in the EYESHOT study has shown their ability to achieve excellent levels of treatment for AMI patients, with high adherence to international recommendations and mortality rates of 2.8% for STEMI and 1.8% for NSTEMI, better than international standards (De Luca L., unpublished data).

Currently, there is a perception that the role of the cardiologist within hospitals is changing. Faced with increasing demand for both non-invasive and invasive cardiological services, there is a limited capacity to take care of patients, especially critical ones, due to a lack of resources and adequate facilities. This document proposes a reorganization of the ICCUs, intended as the reorganization of the critical cardiology area; the proposed model is based on a network of ICCUs that not only transfers patients according to their level of severity and need for organ support but also ensures continuous information exchange and training among critical care professionals. To assess the needs for medical and nursing staff, we referred to documents from international scientific societies[5,6] and to the AGENAS document 'Method for Determining the Staffing Requirements of the National Health Service—Protocol No. 2022/0005733 of 10/06/2022'.[23] This document highlights that the ICCU is part of the intensive care area and, as such, requires an active divisional on-call (Cardiology/ICCU) during the night and on holidays. For ICCU beds, at least one cardiac intensivist must be provided for every eight beds; the staffing requirements

Table 5 Bed and staff allocation based on the level of intensive cardiac care units (ICCUs)

	LEVEL-1 ICCUs	LEVEL-2 ICCUs	LEVEL-3 ICCUs
ICCU beds	Eight beds for 150 000–300 000 inhabitants	Eight–twelve beds for 300 000–600 000 inhabitants	8–12 beds for 600 000–1 200 000 inhabitants
Nurse/bed ratio	1:4	1:3	1:2
Doctor/bed ratio	1:8	1:6	1:4
ICCU Medical staff	2 dedicated cardiac intensivists	4 dedicated cardiac intensivists	6 dedicated cardiac intensivists

should be adjusted based on the cases treated, patient turnover, and the support of any medical staff in specialist training.

The minimum number of nurses required in an ICCU should be calculated based on bed occupancy rates and the caseload. In intensive care, a minimum of 700 min/day/patient (equivalent to 11.6 h/day/patient) of nursing care is expected. In the descriptive tables of the three levels of ICCU, we have not included the staffing needs of Health Care Assistants (HCA), whose presence in critical care is essential. The minimum daily assistance from HCA is expected to be 90 min/day/patient.

For the staffing needs of ICCU beds, we believe that the result of the 2022 ANMCO census—one ICCU bed per 23 635 inhabitants—can cover the actual needs for intensive cardiology beds in our country. However, it is necessary to formalize, at a regional level, the most functional ICCU network model for the territory, so as to provide the appropriate context for patient hospitalization, regardless of the first access hospital.

The ICCU network should also include standardized data collection systems, through electronic medical records or permanent registries capable of extracting the necessary data for self-assessment and clinical research. Finally, a training network for cardiac intensivists should be established[24] through various initiatives, including university master's programs, certifications from national and international scientific societies, and educational programs such as those from the 'ANMCO ICCU Club'.

Summary

Intensive Cardiac Care Units (ICCUs) have undergone a profound transformation related to the evolution of acute coronary syndrome treatment and other more general and universal factors, such as the epidemiological transition, the increasing complexity of patient cases, the evolution of technologies, and the expansion of clinical-scientific expertise of the cardiologist. In Italy, a functional reorganization of the ICCUs reflecting these significant changes has not yet been implemented. Through this position paper, the Italian Association of Hospital Cardiologists (ANMCO) proposes a reorganization of the ICCUs into three levels, with increasing functional complexity based on the hospital in which they are located, the technological resources available, and the caseload treated. These units will be interconnected within a regional ICCU network, modelled on time-dependent networks. The ICCU network should also ensure shared diagnostic-therapeutic protocols and standardized data collection registries for self-assessment and clinical research purposes. This document outlines the requirements that characterize each level of ICCU based on the patient caseload, cardiac intensivist competencies, equipment, and medical and nursing staffing needs.

Funding

This paper was published as part of a supplement financially supported by Centro Servizi ANMCO SrL - Società Benefit.

Conflict of interest: none declared.

Data availability

There are no new data associated with this article.

Disclaimer

This Position Paper was originally published in the Italian language as 'Position paper ANMCO: Riorganizzazione funzionale delle unità di terapia intensiva cardiologica (UTIC) in Italia', in the official journal of the Italian Federation of Cardiology (IFC) 'Giornale Italiano di Cardiologia', published by Il Pensiero Scientifico Editore. This paper was translated by a representative of the Italian Association of Hospital Cardiologists (ANMCO) and reprinted with permission of IFC and Il Pensiero Scientifico Editore.

References

1. Julian DG. Treatment of cardiac arrest in acute myocardial ischaemia and infarction. *Lancet* 1961;**2**:840–844.
2. Morrow DA, Fang JC, Fintel DJ, Granger CB, Katz JN, Kushner FG *et al.* American Heart Association council on cardiopulmonary, critical care, perioperative and resuscitation, council on clinical cardiology, council on cardiovascular nursing, and council on quality of care and outcomes research. Evolution of critical care cardiology: transformation of the cardiovascular intensive care unit and the emerging need for new medical staffing and training models: a scientific statement from the American Heart Association. *Circulation* 2012;**126**:1408–1428.
3. Pirelli S, Ferratini M. Prof. Fausto Rovelli. *G Ital Cardiol* 2018;**19**:530–531.
4. Bouchlarhem A, Bazid Z, Ismaili N, El Ouafi N. Cardiac intensive care unit: where we are in 2023. *Front Cardiovasc Med* 2023;**10**:1201414.
5. van Diepen S, Fordyce CB, Wegermann ZK, Granger CB, Stebbins A, Morrow DA *et al.* Organizational structure, staffing, resources, and educational initiatives in cardiac intensive care units in the United States: an American Heart Association Acute Cardiac Care Committee and American College of Cardiology Critical Care Cardiology Working Group cross-sectional survey. *Circ Cardiovasc Qual Outcomes* 2017;**10**:e003864.
6. Bonnefoy-Cudraz E, Bueno H, Casella G. Editor's Choice - Acute Cardiovascular Care Association position paper on intensive cardiovascular care units: an update on their definition, structure, organisation and function. *Eur Heart J Acute Cardiovasc Care* 2018;**7**:80–95.
7. Casella G, Cassin M, Chiarella F, Chinaglia A, Conte MR, Fradella G *et al.* Epidemiology and patterns of care of patients admitted to Italian intensive cardiac care units: the BLITZ-3 registry. *J Cardiovasc Med (Hagerstown)* 2010;**11**:450–461.
8. Valente S, Lazzeri C, Sori A, Giglioli C, Bernardo P, Gensini GF. The recent evolution of coronary care units into intensive cardiac care units: the experience of a tertiary center in florence. *J Cardiovasc Med (Hager- stown)* 2007;**8**:181–187.
9. Oliva F, Di Pasquale G, Lucci D, De Luca L, Navazio A, Crialesi R *et al.* 8° Censimento delle strutture cardiologiche in Italia. Associazione Nazionale Medici Cardiologi Ospedalieri (ANMCO). Anno 2022. *G Ital Cardiol* 2024;**25**:19S–103S.
10. Agenzia Nazionale per i Sevizi Sanitari Regionali (AGENAS). Gruppo Tecnico per l'elaborazione di proposte per l'attuazione e l'evoluzione della rete cardiologica per l'emergenza. https://www.agenas.gov.it/images/agenas/RETI/cardio/rete_cardio_relazione_finale.pdf.
11. Tehrani BN, Sherwood MW, Rosner C, Truesdell AG, Ben Lee S, Damluji AA *et al.* A standardized and regionalized network of care for cardiogenic shock. *JACC Heart Fail* 2022;**10**:768–781.
12. Moghaddam N, van Diepen S, So D, Lawler PR, Fordyce CB. Cardiogenic shock teams and centres: a contemporary review of multidisciplinary care for cardiogenic shock. *ESC Heart Fail* 2021;**8**:988–998.
13. Senman B, Jentzer JC, Barnett CF, Bartos JA, Berg DD, Chih S *et al.* Need for a cardiogenic shock team collaborative—promoting a team-based model of care to improve outcomes and identify best practices. *J Am Heart Assoc* 2024;**13**:e031979.

14. GiViTI—Gruppo Italiano per la Valutazione degli Interventi in Terapia Intensiva. Rapporto Progetto PROSAFE. Anno 2022—Rapporto nazionale TI polivalenti—Italia. https://giviti.marionegri.it/wp-content/uploads/download/Reportistica/prosafe/2022/generali/Report PROSAFE_Polivalenti_Italia_IT_2022.pdf (11 December 2024).
15. GiViTI—Gruppo Italiano per la Valutazione degli Interventi in Terapia Intensiva. Rapporto Progetto PROSAFE. Anno 2022—Rapporto nazionale TI cardiochirurgiche—Italia. https://giviti.marionegri.it/wp-content/uploads/download/Reportistica/prosafe/2022/generali/Report-PROSAFE_Cardiochirurgiche_2022.pdf (11 December 2024).
16. Tavazzi G, Tricella G, Garbero E, Zamperoni A, Zanetti M, Finazzi S. Cardiogenic shock in general intensive care unit: a nationwide prospective analysis of epidemiology and outcome. *Eur Heart J Acute Cardiovasc Care* 2024;**13**:768–778.
17. Decreto Ministeriale 2 aprile 2015 n. 70. Regolamento recante definizione degli standard qualitativi, strutturali, tecnologici e quantitativi relativi all'assistenza ospedaliera. GU Serie Generale, n. 127 del 04-06- 2015. https://www.gazzettaufficiale.it/eli/id/2015/06/04/15G00084/sg (11 December 2024).
18. Regione Toscana. Delibera n. 717 del 17- 06-2024 Linee di indirizzo regionali per le reti cliniche tempo-dipendenti—Rete Emergenza Cardiologica. https://www301.regione.toscana.it/bancadati/atti/DettaglioAttiG.xml?cod-prat=2024DG00000000870 (11 December 2024).
19. Di Fusco SA, Di Pasquale G, Mistrulli R, Sorini Dini C, Gasparetto N, De Luca L *et al*. La rete per l'infarto in italia: il ruolo dell'ANMCO in 20 anni di progressi e prospettive future. *G Ital Cardiol* 2022;**23**:821–825.
20. Papolos AI, Kenigsberg BB, Berg DD, Alviar CL, Bohula E, Burke JA *et al*. Management and outcomes of cardiogenic shock in cardiac ICUs with versus without shock teams. *J Am Coll Cardiol* 2021;**78**:1309–1317.
21. Sánchez-Salado JC, Burgos V, Ariza-Solé A, Sionis A, Canteli A, Bernal JL *et al*. Trends in cardiogenic shock management and prognostic impact of type of treating center. *Rev Esp Cardiol (Engl Ed)* 2020;**73**:546–553.
22. Effectiveness of intravenous thrombolytic treatment in acute myocardial infarction. Gruppo Italiano per lo Studio della Streptochinasi nell'Infarto Miocardico (GISSI). *Lancet* 1986;**1**:397–402.
23. Agenzia Nazionale per i Sevizi Sanitari Regionali (AGENAS). Protocollo n. 2022/0005733 del 10/06/2022. Metodo per la determinazione del fabbisogno di personale del SSN. https://www.quotidianosanita.it/allegati/allega- to1670929933.pdf (11 December 2024).
24. Elliott AM, Bartos JA, Barnett CF, Miller PE, Roswell RO, Alviar C *et al*. Contemporary training in American critical care cardiology: Minnesota critical care cardiology education summit JACC scientific expert panel. *J Am Coll Cardiol* 2024;**84**:1436–1454.