



Role and Characteristic of Multidisciplinary in Hepatocellular Carcinoma Management and Care Pathway Certification: Bottom-Up Approach of the MDT Project in Italy

Giuseppe Cabibbo[✉] · Caterina Cocuzza · Ciro Celsa · Maria Rosaria Attanasio · Antonio Avallone · Rossana Berardi · Roberto Bordonaro · Mariafiorella Brangi · Fabio Cartabellotta · Desiree Lucy Anna Rita Caudullo · Bruno Daniele · Giovan Giuseppe Di Costanzo · Piera Federico · Giovanni Galati · Salvatore Gruttadauria · Francesco Izzo · Anna Nappi · Giuseppina Pacella · Mauro Piccirillo · Ferdinando Riccardi · Laura Schiada · Marta Schirripa · Marianna Silletta · Gianluca Svegliati Baroni · Emiliano Tamburini · Raffaella Tortora · Martina Assanti · Francesco Deligios · Giada Lodolo · Luca Pinto · Maurizio Russello · on behalf of the M. D. T. Project Working Group

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ABSTRACT

Introduction: Hepatocellular carcinoma (HCC) is a leading cause of cancer-related

mortality worldwide, requiring a multidisciplinary approach for effective management. The MDT Project aimed to define and pilot a structured care model for HCC management in Italy, supported by the implementation of integrated care pathways (ICPs), to standardize organizational processes and ensure the organizational

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G. Cabibbo (✉) · C. Celsa
Section of Gastroenterology and Hepatology,
Department of Health Promotion, Mother
and Child Care, Internal Medicine and Medical
Specialties (PROMISE), University of Palermo,
Palermo, Italy
e-mail: giuseppe.cabibbo@unipa.it

C. Cocuzza · M. Russello
UOC Internal Medicine and Hepatology, ARNAS
Garibaldi-Nesima Catania, Catania, Italy

M. R. Attanasio
U.O.C. Di Gastroenterologia - AORN Cardarelli,
Naples, Italy

A. Avallone · A. Nappi
Experimental Clinical Abdominal Oncology Unit,
Istituto Nazionale Tumori-IRCCS-Fondazione G.
Pascale, Naples, Italy

R. Berardi
Oncological Clinic, Università Politecnica delle
Marche, AOU delle Marche, Ancona, Italy

R. Bordonaro · D. L. A. R. Caudullo
U.O.C. Medical Oncology, ARNAS Garibaldi-Nesima,
Catania, Italy

M. Brangi · F. Riccardi
UOC Oncology, AORN Cardarelli, Naples, Italy

F. Cartabellotta
UOC Internal Medicine and Pneumology, Hospital
Buccheri La Ferla, Fatebenefratelli, Palermo, Italy

B. Daniele · P. Federico
UOC Oncology, Ospedale del Mare, Naples, Italy

G. G. Di Costanzo · R. Tortora
Liver Unit, AORN Cardarelli, Naples, Italy

G. Galati
Internal Medicine and Hepatology, Fondazione
Policlinico Universitario Campus Bio-Medico, Rome,
Italy

S. Gruttadauria

requirements needed for appropriate patient management.

Methods: A multi-phase approach included a narrative review, semi-structured interviews with national experts, and the development of an optimal care model operationalized through a maturity model with 15 organizational elements. A total of 13 hospitals, selected to reflect national heterogeneity, participated in a pilot phase involving tailored action plans and hospital-specific ICPs. In total, ten hospitals proceeded to ICP implementation, and eight achieved certification by an external accreditation body. An expert consensus meeting subsequently validated the care model, key performance indicator (KPI) panel, and assessment tools. Organizational changes were assessed pre- and post intervention through the maturity model evaluation and a survey capturing clinicians' perceptions.

Results: Organizational improvements were observed primarily in areas directly targeted by the action plans, including the formalization of care-flow processes, multidisciplinary team

structuring, case management, and coordination processes. More limited progress was seen in information systems and KPI monitoring, which require structural investments. Clinicians perceived the certification process as helpful in consolidating procedural standardization and documentation quality.

Conclusions: The MDT Project piloted an organizational model for HCC management in Italy, focusing on care-pathway governance, multidisciplinary coordination, and center readiness. These findings represent an initial step toward broader implementation; future phases should incorporate clinical outcomes and patient-reported measures to evaluate the model's long-term impact.

Keywords: Case management; Hepatocellular carcinoma; Integrated Care Pathway Certification; Multidisciplinary approach; Oncology; Organizational improvement

Department Abdominal Center, UPMC (University of Pittsburgh Medical Center), Palermo, Italy

S. Gruttadauria

Department of Surgery and Medical and Surgical Specialties, University of Catania, Catania, Italy

F. Izzo · M. Piccirillo

S.C. Hepatobiliary Oncological Surgery - Istituto Tumori of Naples, IRCCS Fondazione "G.Pascale", Naples, Italy

G. Pacella

Operative Research Unit of Radiology and Interventional Radiology, Fondazione Policlinico Universitario Campus Bio-Medico, Rome, Italy

G. Pacella

Research Unit of Radiology and Interventional Radiology, Department of Medicine and Surgery, Università Campus Bio-Medico, Rome, Italy

L. Schiada · G. S. Baroni

SOSD Liver Damage and Transplants - AOU Delle Marche, Ancona, Italy

M. Schirripa

UOC Oncology, Ospedale Belcolle, Asl Viterbo, Viterbo, Italy

M. Silletta

Operative Research Unit of Medical Oncology, Fondazione Policlinico Universitario Campus Bio-Medico, Rome, Italy

E. Tamburini

Department of Oncology and Palliative Care, Hospital C. Panico, Tricase, Italy

M. Assanti · F. Deligios · G. Lodolo · L. Pinto
IQVIA, Milano, Italy

Key Summary Points

Why carry out this study?

Hepatocellular carcinoma (HCC) is a highly complex disease with an expanding therapeutic landscape, requiring coordinated multidisciplinary management; however, in Italy, organizational approaches to HCC care remain heterogeneous owing to the decentralized healthcare system and the absence of shared organizational guidelines for disease management.

This study aimed to explore whether a structured, guideline-aligned multidisciplinary care model, operationalized through Integrated Care Pathways (ICPs), could be implemented across pilot hospitals to support organizational improvement in HCC management.

What was learned from the study?

A structured organizational care model for HCC management was developed and implemented in ten Italian hospitals. Successful implementation of the care model was supported by two key factors: the active involvement of clinicians and hospital management in the development of the ICP and the use of locally adapted action plans that allowed the model to be tailored to the organizational characteristics of each hospital.

Combining a qualitative survey capturing clinicians' perceptions with a structured maturity model enabled a pre-post evaluation of organizational change. Improvements were mainly observed in care management, multidisciplinary team governance, and patient pathway organization.

The findings suggest that a structured organizational framework for HCC management can be adapted to heterogeneous hospital settings while retaining its core structure. Early results indicate potential benefits of the model in enhancing operational clarity, process standardization, and multidisciplinary coordination. They also provide a basis for subsequent investigations into long-term clinical outcomes and patient-reported measures.

INTRODUCTION

Hepatocellular carcinoma (HCC) is the most common type of primary liver cancer and is among the leading causes of cancer-related mortality worldwide, with approximately 854,000 new cases and 810,000 deaths annually [1]. This aggressive tumor is often linked to liver cirrhosis, and its nonspecific early symptoms make early detection challenging [1]. Globally, HCC incidence is increasing, particularly in Southern Europe, with projections indicating that liver cancer cases and deaths may rise by over 55% by 2040 [2].

Although there have been major advancements in HCC management in recent years, there remains room for improvement. Prior to 2007, effective systemic therapies for advanced stages were lacking. Today, the therapeutic landscape includes second- and third-line treatment [3]. The transition from monotherapy with multikinase inhibitors to combinations with immunotherapy has expanded therapeutic options, ranging from resections and liver transplants to percutaneous locoregional treatments, transarterial therapies, and, in some cases, external radiotherapy. Surgery has also advanced through minimally invasive laparoscopic techniques. While these developments have broadened treatment possibilities, they have also added complexity, requiring careful evaluation to optimize treatment sequencing. HCC exhibits considerable biological and clinical heterogeneity, resulting in widely varying prognoses based on individual patient and tumor characteristics [4–6]. Treatment decisions are further complicated by factors such as disease stage, liver function (often impaired by cirrhosis), and other comorbidities [7]. Consequently, managing HCC increasingly requires a multidisciplinary approach, involving hepatologists, oncologists, surgeons, and radiologists working together to design appropriate treatment strategies. This collaboration is essential for adapting treatment plans to disease progression and patient condition, ultimately improving outcomes and quality of life [7–10].

In this context, the most recent guidelines on hepatocellular carcinoma have played a pivotal role in shaping the approach to HCC

management in Italy [11], with particular emphasis on the multidisciplinary management of hepatocellular carcinoma emerging from the latest recommendations [12–14]. The guidelines aim to establish an integrated care pathway that ensures uniform access to diagnostic and therapeutic services for patients with HCC across the country. Italy's National Health System (NHS) is highly decentralized, with each region adopting its own organizational care model for healthcare delivery. While this governance structure is intended to improve efficiency and management effectiveness, it often leads to significant regional disparities. Therefore, the guidelines serve as a general reference to be adapted to the regional context. To ensure continuity of care, close collaboration between HCC reference hospitals and local healthcare providers is essential, along with the optimization of human, structural, and economic resources. In addition to defining the patient care pathway, the multisocietal guidelines promote continuous improvement through the monitoring of key performance indicators (KPIs) [12].

Currently, no comprehensive care model fully addresses the organizational implications of the evolving HCC management landscape. Strengthening these organizational foundations is essential to support consistent multidisciplinary collaboration and equitable access to appropriate diagnostic and therapeutic services. The MDT Project represents a first step toward addressing this gap by defining a structured care model aligned with national guidelines and supported by the development of tools to guide care pathway implementation across hospitals, such as the integrated care pathways (ICPs). This article presents preliminary organizational outcomes from the pilot phase, which reflect early changes associated with the adoption of a standardized care pathway. These findings lay the groundwork for future evaluations of the care model's replicability and its potential implications for clinical and patient-reported outcomes, as already documented in pathway-based initiatives in other clinical areas.

METHODS

Study Design and Participants

The primary objective of the MDT Project was to develop a care model for the management of HCC that could be adapted to the different organizational structures of the Italy's NHS. Figure 1 summarizes the methodological approach adopted for the definition, implementation, and validation of the care model. All project activities were carried out between 2021 and 2024.

A steering committee composed of five key opinion leaders (KOLs) in hepatology and oncology from different regions guided the methodological process, from the initial definition phase through to validation, in collaboration with IQVIA's Implementation Science (IS) team.

IQVIA's IS team, with extensive experience in optimizing care pathways and healthcare processes, has driven initiatives that improved healthcare delivery and outcomes at local and regional levels across Italy. The project adhered to the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines to report insights on healthcare quality improvement [15].

HCC preliminary care model definition

The first phase involved a narrative review of scientific and gray literature, best practices, national and international guidelines, Italian multisociety recommendations, and already adopted ICPs. These were identified through searches on PubMed, SCOPUS, and the websites of major national scientific associations [16, 17]. By applying the “care delivery value chain” methodology, grounded in the principles of value-based healthcare, a preliminary care model for the management of HCC was defined [18–20]. The review also enabled the identification of a preliminary set of KPIs related to outcomes, processes, volumes, and patient experience, derived from Italian guidelines and clinical recommendations [21].

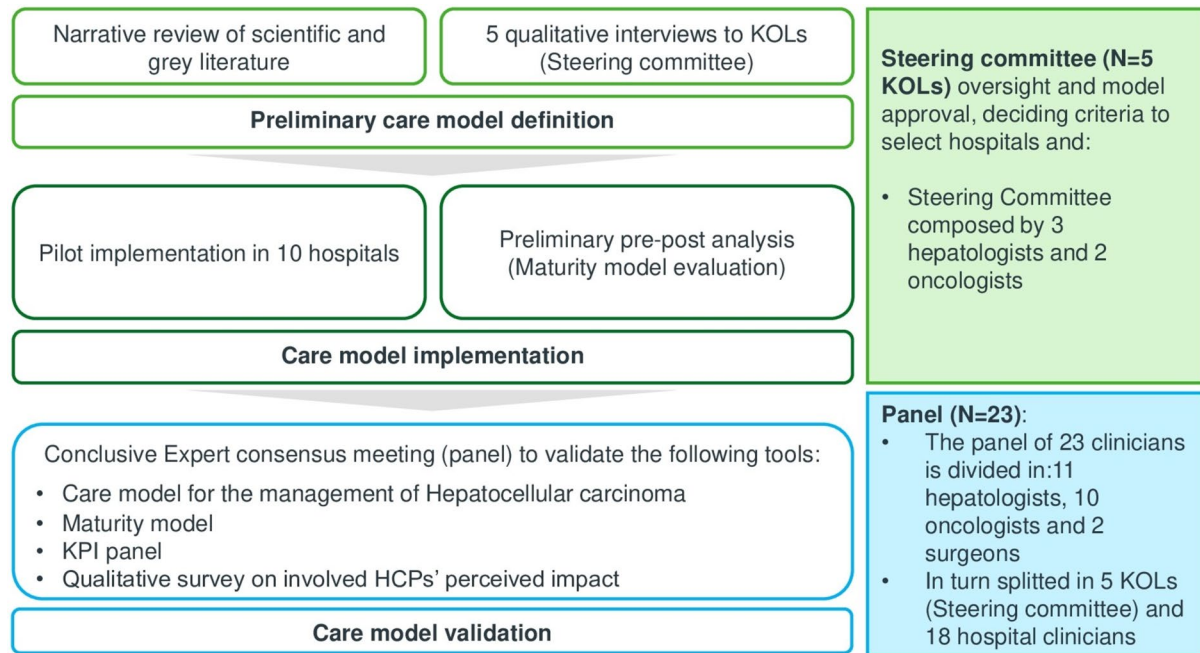


Fig. 1 Illustrates the overall methodological workflow of the MDT Project, including care model definition, pilot implementation, and validation phases, as well as the com-

position and roles of the steering committee and the clinicians' panel. *KOL(s)* key opinion leader(s), *KPI* key performance indicator, *HCP* healthcare professional

In parallel, semi-structured interviews (see Supplement 1 in the electronic Supplementary Material) were conducted with the KOLs from the steering committee to support the definition of the care model, the selection of an initial panel of KPIs for pathway monitoring, and the identification of the criteria for selecting the hospitals to be included in the pilot phase. These criteria were designed to ensure an accurate representation of the heterogeneity of Italian hospitals, including variability in patient volumes, institutional types (University Hospitals, Scientific Institute for Research, Hospitalization and Healthcare, Hospital Trusts), the presence of specialists required for HCC management, and different levels of structuring of multidisciplinary teams (Fig. 2). By integrating evidence from the document review with insights from the interviews, the preliminary care model for HCC management was developed. Moreover, under the guidance of the KOLs, IQVIA's IS team developed a maturity model that allows us to quantitatively and qualitatively assess the

organizational maturity of hospitals in HCC management structured around five pillars, each comprising 3 specific elements, for a total of 15 elements (Table 1, Fig. 3). Each element is described through four progressive development levels, from level 1 (basic) to level 4 (optimal) (see Supplement 2 in the electronic Supplementary Material).

Pilot Implementation

Before proceeding with the validation of the preliminary model, a pilot phase was planned in a sample of national hospitals. The project was presented to hospitals across the country; 18 expressed interest, and 13 were selected on the basis of the predefined criteria and their representativeness of national organizational variability (Fig. 4).

This study focused exclusively on organizational processes and the perspectives of healthcare professionals. All participants were members of the MDT Project working group, whose

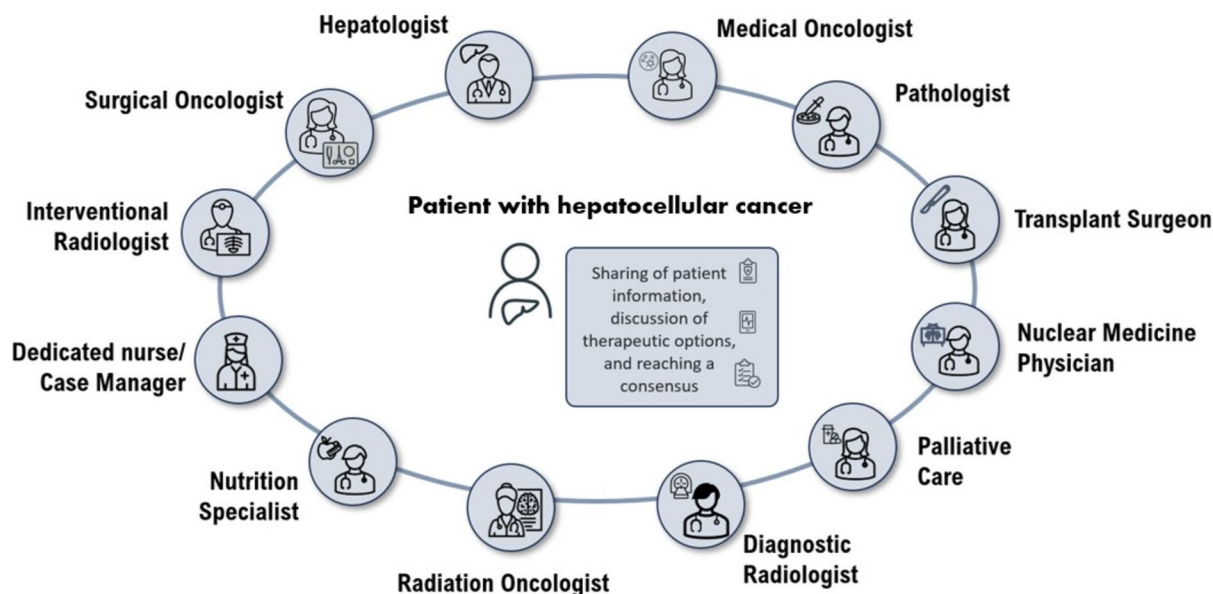


Fig. 2 Illustrates the specialists who are part of the multi-disciplinary team, representing members who, in different hospital settings, can belong to both the core team and the

noncore team, reflecting the diversity found in the Italian healthcare system

involvement was formally established through a collaboration agreement between IQVIA and each hospital's general management. Participants were informed that findings would be disseminated through scientific publications. As the project did not collect patient-level data or personal health information but focused exclusively on organizational processes and professionals' perspectives, participating institutions deemed ethics approval not required.

To comprehensively reconstruct the real-world care pathways of each hospital, a standardized and adaptable semi-structured interview framework was adopted (see Supplement 3 in the electronic Supplementary Material). A total of 70 interviews were conducted in the 13 selected hospitals, enabling detailed mapping of care pathways [22, 23]. Comparing these care pathways with the preliminary care model allowed the identification of gaps and improvement opportunities, which informed the development of a tailored action plan for each hospital (Table 2) based on the elements defined in the maturity model. Each tailored action plan

was validated with local working groups and hospital management.

The pilot phase also included the drafting of the HCC-specific ICP and its certification by an external accreditation body, Bureau Veritas (BV). The ICP serves as the formal instrument through which the care model is incorporated into clinical and organizational processes, ensuring operational consistency and fulfilling the requirements necessary to initiate the certification process. A total of 3 of the 13 hospitals were unable to proceed with drafting the ICP owing to insufficient time and/or resources to complete the document within the project timeline, also related to internal reorganizations or changes in strategic leadership. The remaining ten hospitals initiated the development of the ICP in alignment with the care model and certification requirements.

ICP Certification

The project involved BV as an external and independent certification body, which developed

Table 1 Structure of the maturity model used to assess hospitals' organizational maturity in HCC management, with a description of the scope assessed within each element

Pillar	Element	Description
Dedicated pathways	Referral and dedicated pathways	Evaluates the degree to which referral mechanisms from primary care and hospital specialists to dedicated HCC outpatient clinics are formalized, including the availability of shared pathways with GPs
	Intake modalities	Evaluates how patients with suspected or confirmed HCC are received and managed upon entry to the care pathway, including the degree of multidisciplinary involvement and the presence of dedicated care coordination
	Diagnostic and therapeutic availability	Examines the availability of dedicated diagnostic slots (ultrasound, magnetic resonance imaging (MRI)) for surveillance, diagnosis, and follow-up and patients' access to the full range of HCC therapeutic options, either within the facility or through formalized agreements
Expertise	Case management	Evaluates whether a dedicated figure is responsible for coordinating patient care across the pathway, including scheduling, multidisciplinary team communication, and monitoring of adherence to surveillance and follow-up
	Internal and territorial actors training	Assesses the scope and formalization of training initiatives for hospital specialists and GPs on the clinical and organizational aspects of HCC management
	Dedicated and experienced staff	Evaluates the availability of experienced clinical and nursing personnel, the presence of a dedicated multidisciplinary team, and the availability of expert HCC sonographers within the facility and in the community

Table 1 continued

Pillar	Element	Description
Multidisciplinary team	Professionals involved	Evaluates the composition of the HCC multidisciplinary team, from informal specialist consultations to a fully formalized team comprising core and noncore specialists coordinated by a dedicated case manager
	Objectives and areas of intervention	Evaluates the scope of multidisciplinary team activity, from occasional specialist consultations to structured periodic discussions of all HCC cases, encompassing staging and therapeutic pathway definition
	Organization	Evaluates the procedural aspects of multidisciplinary team functioning, including meeting scheduling, case submission processes, documentation of clinical decisions, and patient communication modalities
Network and territorial integration	Coordination of involved actors	Evaluates the degree of formalized integration between the hospital HCC team and GPs, including referral criteria, dedicated communication channels, and GP involvement in post-treatment follow-up management
	Integration of territorial care settings	Evaluates the extent to which care activities (surveillance, diagnostics, follow-up, therapeutic treatments) are conducted within the hospital or outsourced to territorial facilities through formal agreements, ensuring continuity and equity of access
	ICP and regional network	Evaluates the formalization of a corporate ICP for HCC management and the establishment of a regional HCC network defining roles and responsibilities across participating institutions

Table 1 continued

Pillar	Element	Description
Organization and IT tools	Clinical and healthcare support systems	Evaluates the degree of digitization of clinical records and outpatient scheduling systems and the availability of institutional databases for monitoring adherence among HCC surveillance patients
	Collaboration tools	Evaluates the availability of institutional platforms supporting data sharing, remote multidisciplinary meetings, and structured communication between specialists, GPs, and patients
	KPI monitoring	Evaluates whether process, volume, and outcome indicators for the HCC pathway are defined, systematically monitored through a shared corporate database, monitored through a shared institutional database, and periodically reported to hospital management and GPs

HCC hepatocellular carcinoma, *GP* general practitioner, *MRI* magnetic resonance imaging, *ICP* integrated care pathway, *IT* information technology, *KPI* key performance indicator

a specific scheme for the implementation of ICPs to ensure alignment with the requirements needed for certification. BV is accredited by Accredia, the Italian national accreditation body [24], for the certification of ICPs. Alongside the two audit phases, the certification process is guided by the national guidelines and by the technical specification developed by BV, which defines the minimum organizational and clinical requirements that an ICP must meet. These requirements include the formal recognition of the multidisciplinary team, through an official hospital resolution distinguishing core and extended members, the complete and documented description of the pathway with its procedures, timelines, decision criteria, and responsibility matrix, the internal dissemination of the ICP to all involved professionals, the provision of specific training programs for the multidisciplinary team, and the identification and monitoring of pathway KPIs. Compliance with these elements is assessed during both the document review and the on-site inspection, forming the

basis for the final certification decision. The BV certification process consists of two phases:

- Phase 1: a document review to verify compliance with ICP requirements and guidelines.
- Phase 2: on-site inspections to examine the settings involved in the pathway and review patient records to ensure clinical and organizational alignment with the ICP.

At the conclusion of both phases, the auditor issues a report identifying any nonconformities and observations. The hospital must address all nonconformities by providing justifications and proposing corrective actions to be implemented. If positively evaluated, the hospital receives the certification, followed by biennial surveillance audits. Of the ten hospitals that developed the ICP, eight completed the certification process, while two hospitals, already affiliated with a different certification body within their organization, chose not to undergo the BV certification process and opted to conduct it independently. Given the breadth of

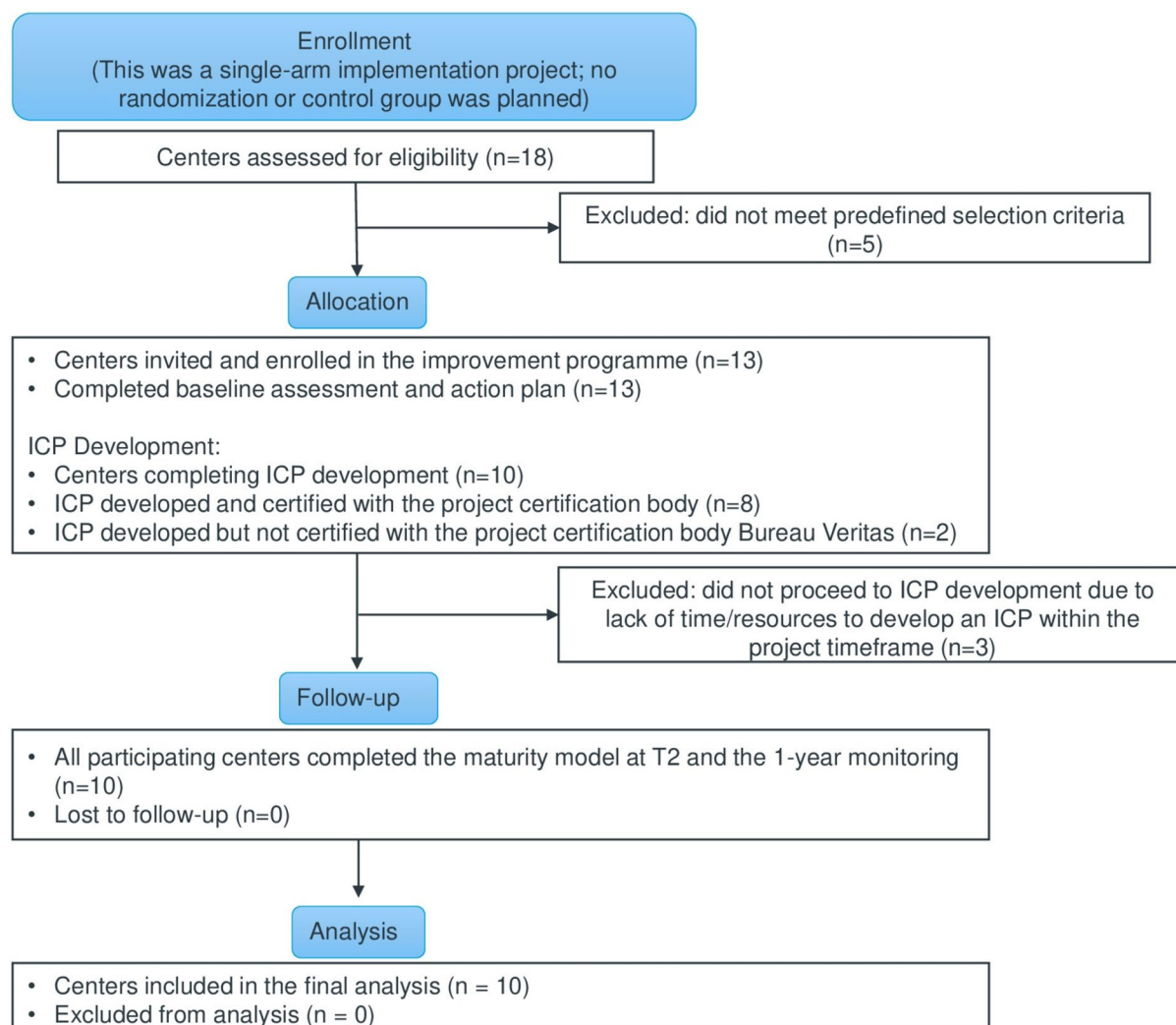


Fig. 3 Illustrates the structure of the maturity model, organized into five pillars, each comprising three essential elements used to assess hospitals' organizational maturity

in HCC management. *ICP* integrated care pathway, *IT* information technology, *KPI* key performance indicator

these requirements and the depth of verification steps, the overall process, from the initial assessment activities to the achievement of certification, typically required approximately 12–14 months in participating hospitals.

Validation of the Care Model

Thereafter, an expert consensus meeting was conducted involving the five KOLs and 18 clinicians from the ten hospitals participating in the implementation phase. The objective was to validate

the care model, the KPI panel, and the assessment tools. IQVIA presented each element under discussion: if no objections emerged during the discussion, agreement was considered achieved; in cases of disagreement, a formal vote was conducted, and consensus was accepted when at least 75% of participants expressed concordant opinions.

Pre- and Post-Intervention Analysis

To assess the impact of the project, each hospital conducted an initial self-assessment (T0) using

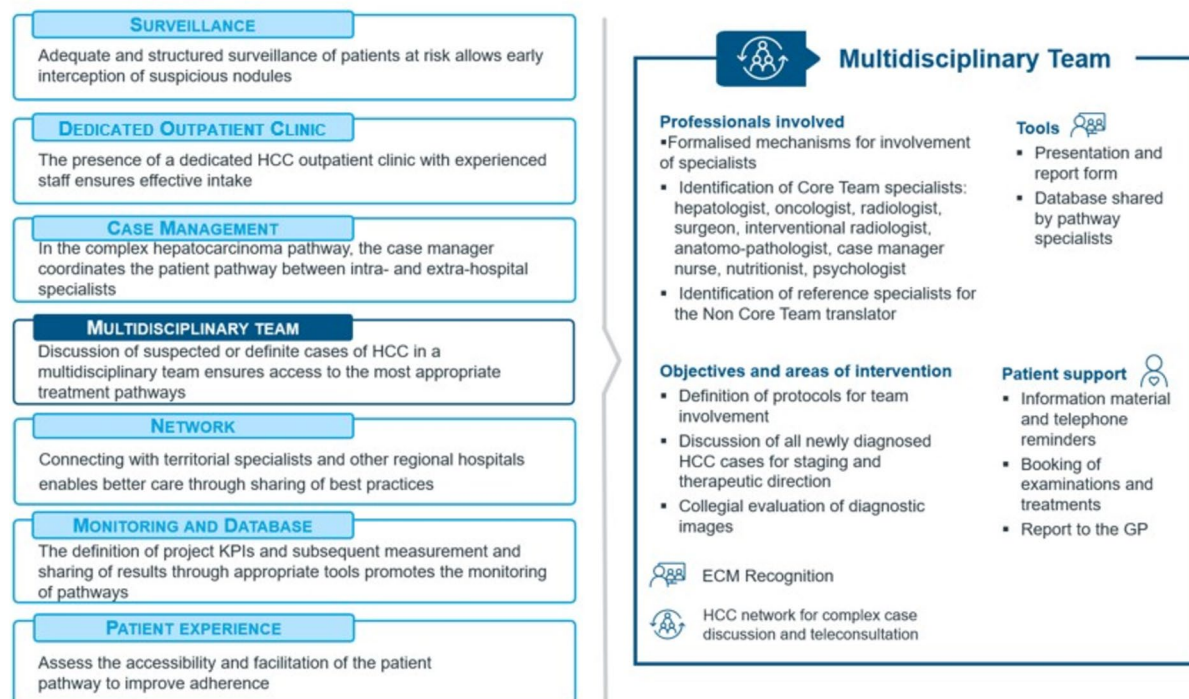


Fig. 4 Consolidated Standards of Reporting Trials (CONSORT)-style diagram summarizing hospital eligibility assessment, reasons for exclusion, progression through

ICP development and certification, completion of follow-up activities, and inclusion in the final analysis. *ICP* integrated care pathway

the maturity model and, after at least 12 months following ICP adoption and its eventual certification (T1), repeated the assessment using the same framework. The self-assessment was conducted by a local multidisciplinary working group, coordinated by a designated pathway lead; any divergences were resolved through shared consensus. In parallel, clinicians completed a qualitative survey (see Supplement 4 in the electronic Supplementary Material) to capture the perceived impact at the conclusion of the project.

For the two hospitals that did not follow the certification process with BV, and for their affiliated clinicians, a short version of the survey was used. This version retained the elements related to the project's impact and the development of the ICP but excluded questions specifically referring to the effects of the certification process, thus ensuring an evaluation consistent with the actual care pathway undertaken in those hospitals.

RESULTS

Definition of the Optimal Care Model

The project enabled the definition and validation, through a literature review, a pilot phase conducted in ten hospitals, and a consensus-meeting process, of a structured care model for the management of HCC. The resulting care model consists of seven pillars representing the elements considered fundamental for optimal HCC management. Specifically, these pillars include: surveillance of patients at risk of developing HCC, the establishment of dedicated outpatient clinics, case management, the role of a multidisciplinary team, networking with various care settings, the use of monitoring indicators and appropriate databases, and, eventually, the assessment of patient experience. For each pillar, the main key elements were detailed, as exemplified in Fig. 5 with regard

Table 2 Summary, for each hospital, of the three priority improvement element identified in the personalized action plan, together with the preliminary care-model pillarsanticipated to register the greatest impact from the proposed actions. *ICP* integrated care pathway, *KPI* key performance indicator

Hospital	Element 1	Element 2	Element 3	Pillar from preliminary care model expected to be impacted
A	Case Management	Organization	Collaboration tools	Case management and multidisciplinary team
B	Case management	Organization	Intake modalities	Dedicated outpatient clinic and case management
C	Dedicated and experienced staff	Organization	Objectives and areas of intervention	Network and multidisciplinary team
D	Referral and dedicated pathways	Diagnostic and therapeutic	Internal and territorial actors training	Dedicated outpatient clinic and network
E	Case management	Intake modalities	KPI monitoring	Case management and monitoring and database
F	Case management	Organization	Intake modalities	Case management and multidisciplinary team
G	Objectives and areas of intervention	Organization	Intake modalities	Dedicated outpatient clinic and multidisciplinary team
H	Referral and dedicated pathways	Intake modalities	KPI monitoring	Dedicated outpatient clinic and monitoring and database
I	Referral and dedicated pathways	Case management	Internal and territorial actors training	Case manager and surveillance
J	Case management	KPI monitoring	Internal and territorial actors training	Case manager and network

All hospitals also worked within their action plans on the ICP and the regional network element of the maturity model, as it is intrinsically linked to the realization of the ICP. Therefore, this has been excluded from the table as an improvement element to avoid redundancy but should be considered as a primary common element

The improvement elements reported for each hospital are all regarded as priority actions; the order of display is not intended to reflect importance ranking

to the multidisciplinary team pillar. The seven pillars of the care model find their operational translation in the 15 elements of the maturity model (Fig. 3 and Supplement 2 in the electronic Supplementary Material), which convert their content into observable criteria organized

across progressive levels of development. In the transition from the care model to the maturity model, several components of the seven pillars were found to be closely interrelated or conceptually overlapping. For assessment purposes, these contents were therefore consolidated

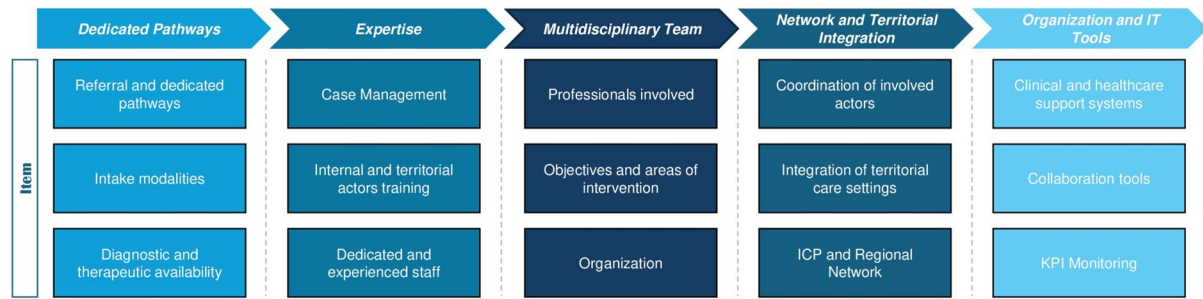


Fig. 5 Illustrates the seven pillars of the HCC model, illustratively showing the pillar detail related to the multidisciplinary team. *HCC* hepatocellular carcinoma, *KPI(s)*

key performance indicator(s), *GP* general practitioner, *ECM* continuing medical education

into five broader domains, each articulated into three elements. This structure provides a more streamlined and operational representation of the care model's requirements, allowing the maturity model to serve as a practical and comparable self-assessment tool across hospitals with different organizational settings. The tools provided by the maturity model and the survey made it possible to assess hospitals' organizational progress from the initial phase (T0) to the post-implementation and, where applicable, post-certification phase (T1), thereby enabling measurement of the project's organizational impact (see Supplement 5 in the electronic Supplementary Material).

Maturity Model Results

The maturity models analysis enabled a description of how the organization of the centers evolved between the initial phase (T0) and the post-implementation phase (T1). This evolution also reflects an increased focus on, and a more structured approach to, monitoring processes. A two-sided paired *t*-test was conducted to assess the statistical significance of pre-post differences in each hospital (see Supplement 6 in the electronic Supplementary Material). Table 3 and Fig. 6 present the details of the variations observed across the different pillars of the care model, highlighting heterogeneous trends between hospitals and assessment areas.

Within the "dedicated pathways" pillar, increases were observed in the "admission processes" (+58%) and "referral and dedicated pathways" (+50%) elements. These improvements are associated with the formalization of care-flow processes, the definition of dedicated slots, and the reorganization of outpatient clinics as part of the ICPs developed.

One of the most impacted areas was "case management," which saw a substantial increase (+123%; $p < 0.001$) owing to the introduction of dedicated case managers in six hospitals and a case manager not exclusively assigned to the HCC pathway in a seventh hospital. In the initial phase, the case manager supported the multidisciplinary team by coordinating meetings (e.g., preparing case summaries in advance, ensuring the presence of core team specialists, supporting the drafting and standardization of meeting minutes) and managing the care pathway, gradually expanding their role over time to include patient-related activities, such as providing disease related education when appropriate.

Lastly, in the pillar of "network and territorial integration", a significant increase was observed in the "ICP and regional network" element (+84%; $p < 0.001$). In total, ten hospitals developed an ICP dedicated to HCC, and eight of them also obtained certification, contributing to a more formal definition of interactions with regional organizational levels and other care settings. By contrast, the element "integration of territorial care settings" did not

Table 3 Pre- and post-intervention maturity model scores across the 15 assessed elements, grouped by pillar

Pillar	Element	T0 Mean	T1 Mean	Δ%	Mean Δ (T1 – T0)	95% CI [Lower–upper]	t (df = 9)	p-Value (Two-sided)
Dedicated pathways	Referral and dedicated pathways	2.20	3.30	+50%	+1.10	[0.47–1.73]	3.56	0.006**
	Intake modalities	2.25	3.55	+58%	+1.30	[0.85–1.75]	6.50	0.001***
	Diagnostic and therapeutic availability	2.70	3.00	+11%	+0.30	[0.05–0.55]	2.42	0.031*
Expertise	Case management	1.30	2.90	+123%	+1.60	[1.00–2.20]	5.99	0.001***
	Internal and territorial actors training	1.40	2.90	+107%	+1.50	[0.92–2.08]	5.78	0.001***
	Dedicated and experienced staff	3.10	3.55	+15%	+0.45	[–0.10–1.00]	1.66	0.125
Multidisciplinary team	Professionals involved	2.70	3.50	+30%	+0.80	[0.42–1.18]	4.72	0.001***
	Objectives and areas of intervention	2.60	3.70	+42%	+1.10	[0.66–1.54]	5.56	0.001***
	Organization	2.50	3.55	+42%	+1.05	[0.62–1.48]	5.40	0.001***
Network and territorial integration	Coordination of involved actors	1.80	2.40	+33%	+0.60	[0.19–1.01]	3.56	0.006**
	Integration of territorial care settings	1.90	1.95	+3%	+0.05	[–0.21–0.31]	0.43	0.674
	ICP and regional network	1.55	2.85	+84%	+1.30	[0.88–1.72]	6.93	< 0.001***
Organization and IT tools	Clinical and healthcare support systems	2.40	2.74	+15%	+0.35	[–0.07–0.77]	1.86	0.096
	Collaboration tools	1.65	1.85	+12%	+0.20	[–0.15–0.55]	1.23	0.250
	KPI monitoring	1.40	3.00	+114%	+1.60	[0.81–2.39]	4.41	0.002**

CI confidence interval, df degrees of freedom, t *t*-statistic (paired *t*-test), p *p*-value, ICP integrated care pathway, KPI key performance indicator, IT information technology

T0 denotes hospitals' average scores at baseline; T1 reflects average scores recorded after a minimum of 12 months following the establishment of the action plan. Δ% represents the percentage change between T0 and T1. Mean Δ is the absolute mean difference (T1 – T0) across the 10 hospitals. Statistical significance was assessed using a two-sided paired *t*-test (*n* = 10 hospitals, df = 9); the 95% confidence interval refers to the mean difference. Significance levels: **p* < 0.05, ***p* < 0.01, ****p* < 0.001

register a statistically significant improvement (+3%; *p* = 0.674), reflecting the fact that meaningful progress in this area requires multi-stakeholder coordination and structural adjustments that extend beyond the scope of individual

hospital-level interventions and are unlikely to be captured within the project timeframe.

Similarly, the pillar showing the lowest overall increase, excluding the KPI element, was “organization and IT tools,” in which no statistically

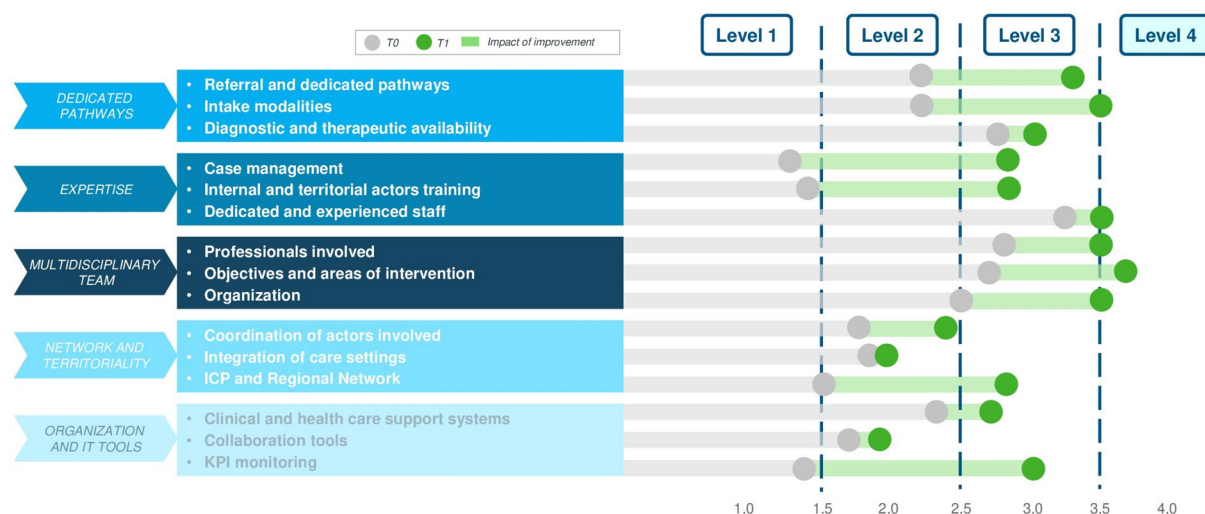


Fig. 6 A graphical representation of the average hospital evolution of each pillar element between T0 and T1. *ICP* integrated care pathway, *KPI* key performance indicator

significant improvement was observed for “clinical and healthcare support systems” (+15%; $p=0.096$) or “Collaboration Tools” (+12%; $p=0.250$). The observed increase was primarily attributed to initiatives already planned before the project, such as the integration of an electronic medical record with the corporate repository in one hospital.

Survey Results

The survey allowed to gather professionals’ perceptions of the organizational effects associated with the definition, implementation, and certification of the ICP for HCC management. The involvement of hospital management and support functions (e.g., quality, risk management, clinical engineering), required during the development of the ICP, was perceived as helpful in increasing the visibility of the care pathway and facilitating the implementation of the actions outlined in the action plan, with an average rating of 3.5/5. In parallel, multidisciplinary collaboration during the drafting of the ICP was considered important in fostering a shared understanding of the care pathway and greater

consistency in the application of procedures, with average scores around 4/5.

The formalization of the multidisciplinary team—defined in terms of composition, roles, responsibilities, and meeting frequency—received ratings of 4.1/5, particularly owing to its impact on the appropriateness of care processes, internal communication, and coordination. The perceived effect on overall process control was more limited (approximately 3.7/5), suggesting that standardization requires time to translate into more stable operational governance. Clear identification of roles and responsibilities within the pathway was judged useful for improving internal organization, with an average of 4.4/5, although differences across centers reflected varying baseline levels of maturity.

The case manager role received high ratings: approximately 4.5/5 for its impact on multidisciplinary collaboration and organizational processes. Effects on treatment adherence (approximately 3/5) and compliance with timelines, perceived as neutral, appeared more limited in the initial phase, consistent with a role primarily focused on organizational aspects.

The definition of the KPI set generated heterogeneous responses. The perceived impact

on process control (3.3/5) and staff awareness (3.1/5) was partial, reflecting differences in the availability of information systems. Data collection and processing also received a moderate average score of 3.3/5, indicating a certain degree of operational complexity.

Internal and external clinical audits conducted as part of the certification process were among the most highly valued elements: 4.9/5 for internal audits and 4.6/5 for external audits, recognized for their educational value. The framework used for certification received an average rating of 4.4/5, contributing to strengthened awareness and adherence to procedures, with a perceived improvement in the quality of clinical documentation (from 2.4 to 3.7 between pre- and post-audit).

DISCUSSION

Over the last few decades, the landscape of hepatocellular carcinoma management and treatment has witnessed a rise in both case numbers and therapeutic complexity, with projections indicating a continued increase. In Italy, estimates suggest that new cases and deaths from HCC will rise by more than 55% by 2040 [2]. Moreover, the evolving HCC scenario and the expansion of therapeutic options across various stages of the disease indicate that HCC is in a state of constant change [4, 5, 25].

HCC primarily arises in cirrhotic livers [26], where progressive hepatic deterioration significantly impacts outcomes, irrespective of tumor burden. The liver functional status plays a central role in therapeutic decisions [14], influencing both curative and palliative treatments [9, 27]. Notably, liver decompensation is a leading cause of mortality in both early-stage HCC [28] and advanced disease treated with systemic agents [29, 30].

All these conditions emphasize the complex nature of HCC, which is fundamentally characterized by the intricate interplay between tumor progression and underlying liver disease. This dual pathological process creates a unique clinical scenario where therapeutic decisions must carefully balance oncological effectiveness with

liver function preservation. The complexity is further magnified by the expanding therapeutic arsenal now available, encompassing surgical, locoregional, and systemic treatment options. This multilayered clinical landscape makes the multidisciplinary approach particularly crucial in HCC management, arguably more so than in other oncological settings, where the underlying organ function may be less critical in treatment selection and during follow-up. In this context, while guidelines offer clear indications for certain cases, many patients could benefit from multiple therapies, necessitating input from various specialties and making a multidisciplinary approach crucial and essential for optimal HCC management [31].

The Italian NHS is regionally decentralized, leading to varied organizational approaches in HCC management. In this context, it is important to acknowledge the organizational heterogeneity that characterizes HCC management across Italy. Hospitals differ in patient volumes, available resources, and the operating models of their multidisciplinary teams, ranging from the systematic discussion of all cases to a focus on only the most complex ones. Leadership of the pathway also varies, being assumed by hepatologists in several hospitals and by oncologists in others. Despite these differences, multidisciplinary care remains a central element, although its formalization and structuring are still heterogeneous and not always optimal across settings. The MDT Project fits within this complex landscape with the aim of establishing the foundations for a structured and scalable care model capable of supporting hospitals in the multidisciplinary and organizational management of HCC. The initiative represents a first step toward consolidating process standardization, strengthening hospitals' organizational readiness, and creating favorable conditions for a more coherent and coordinated patient care pathway. In this regard, the project's approach is consistent with literature highlighting the potential of external ICP certification to improve organizational quality and promote more uniform access to care [32, 33].

In this pilot phase, 13 Italian hospitals contributed to assessing the feasibility and applicability of the care model across settings

characterized by heterogeneous structures, resources, volumes, and organizational maturity. These preliminary findings mainly describe organizational changes observed during the implementation of the care model and the ICPs, while clinical outcomes will require more time and will be addressed in future studies.

The application of the care model revealed progress particularly within the pillars related to clinical–organizational pathways and multidisciplinary areas in which targeted interventions tend to translate more rapidly into perceptible changes in daily practice. The alignment between these early improvements and the domains most directly addressed, such as the formalization of organizational flows, the definition of roles, and the coordination of decision-making moments, suggests that the tools introduced contributed to greater operational clarity and the adoption of more standardized practices. These aspects are typically the first to respond to the introduction of a shared organizational care model, as they require mainly internal adjustments that are more easily integrated into routine clinical activity compared with more structural changes, such as those related to information systems or systematic KPI monitoring. Among the interventions implemented through the action plans, the revision of admission processes was one of the most evident elements: the formalization of intake workflows, the introduction of reserved slots for specific phases of the pathway, and the reorganization of dedicated outpatient clinics contributed, where implemented, to a smoother management of the diagnostic–therapeutic process. In several hospitals, clinicians reported that, where implemented, these interventions appeared to support a smoother management of the care pathway, with a perceived reduction in waiting times for certain procedures and improved adherence to treatment timelines, a factor recognized as critical for optimizing HCC care [34]. Key facilitators included the active involvement of hospital management and quality offices, whose engagement in the project enabled the refinement of several activities proposed in the action plans for individual hospitals. Conversely, the most significant barriers concerned the limited availability of dedicated personnel,

the high clinical workload, and the challenges associated with reallocating resources within complex healthcare structures, where coherence with multiple clinical–organizational governance needs must be ensured. The formalization of multidisciplinary team activities, including team composition, roles and responsibilities, meeting frequency, advance case preparation, shared evaluation criteria, and standardized post-meeting documentation, was considered particularly useful for improving decision-making consistency and communication among specialists. These elements are consistent with international literature, which highlights the importance of solid organizational structures to support multidisciplinary team governance [12–14, 35, 36]. In particular, Abuelgasim et al. emphasize the value of institutionalizing multidisciplinary teams at the corporate level, with regular meetings, standardized processes, and early sharing of clinical information [37]. In this regard, several clinicians reported, on the basis of information gathered from the newly introduced standardized post-multidisciplinary meeting documentation, a greater participation of core-team members and a more frequent discussion of newly diagnosed cases, which were interpreted as early signals of a more systematic and shared use of the collegial decision-making setting.

At the same time, it is important to acknowledge the intrinsic complexities of multidisciplinary work. As observed by Colli and Prati, even in highly structured contexts, group work may be influenced by dynamics such as conformity to dominant opinions or decision-making polarization, which can limit critical thinking and sometimes cause treatment delays owing to divergent viewpoints [38]. These reflections offer useful insight into why tools such as shared protocols, standardized case-presentation formats, and periodic audits represent essential components to support transparent and robust decision-making processes. In this sense, the interventions introduced by the project, including the development and certification of ICPs, shared case-discussion criteria, structured documentation of multidisciplinary team discussions, and the strengthening of audit activities, including proactive internal clinical audits of

medical records for ex-post case evaluation, may help mitigate these risks, supporting a more consistent functioning of multidisciplinary teams over time.

In the hospitals where a case manager was introduced, the role provided support for operational coordination. Clinicians perceived the case manager as a facilitator, particularly in activities related to multidisciplinary meetings and in ensuring continuity across the different phases of the care pathway. This is consistent with the content of the action plans provided to hospitals, which in the initial phase were primarily oriented toward care pathway governance and support to the multidisciplinary team, rather than towards activities directly involving patients. Among the main facilitators, clinical teams highlighted the role of hospital management, which acknowledged the value of this function and enabled its implementation; conversely, the primary barriers included the need for dedicated personnel, the availability of specific training pathways, and the economic sustainability associated with introducing or re-allocating staff. According to the survey findings, professionals also reported that the introduction of the case manager may have generated positive effects on patient-related aspects, as perceived by clinicians, although a direct evaluation from patients is not yet available. This perception is supported by the international literature, including the meta-analysis by Ahmed et al. (2024) [39], which demonstrates that multidisciplinary models with structured nurse-coordinated interventions result in tangible clinical benefits, including a significant reduction in all-cause mortality and hospitalizations. These findings suggest that organizational interventions may, over time, translate into measurable improvements in clinical outcomes and patient experience. However, such potential effects require confirmation through future studies specifically designed to capture patient-reported outcomes.

In contrast with the progress observed for more organizational aspects, advancements related to information systems were more limited, as reflected in the absence of statistical significance for the clinical and healthcare

support systems and collaboration tools elements ($p=0.096$ and $p=0.250$, respectively). These areas require structural interventions and longer implementation horizons, often incompatible with the timeframe of projects of this type. Major barriers include the extended timelines needed to implement or update digital solutions, the complexity of harmonizing heterogeneous information systems, and the dependence on strategic decisions at institutional or national level. Similarly, challenges also emerged in the area of KPIs. As reported by healthcare professionals and already highlighted in prior studies on pathway governance and quality monitoring, there is still variability in the recognition of the importance of systematic data collection for effective process control [32, 37, 40], and clinicians often lack both adequate digital tools and dedicated personnel to support monitoring activities. Moreover, because KPI definition and monitoring are required for both the certification and maintenance of the ICP, these activities generate an additional workload for clinicians, particularly in settings where digital infrastructures do not adequately support such functions. It is therefore plausible that substantial improvements in this area will require planned medium- to long-term investments and strengthened technical capacities.

Within this framework, the development and certification of the ICP represented, for most hospitals, an important element in consolidating the care pathway. Internal and external audits, already recognized in the oncological literature as effective tools to monitor adherence to guidelines and improve care pathway quality [32, 41], were perceived as relevant educational opportunities. According to clinicians, these audits contributed to increasing awareness of clinical documentation, standardizing procedures, and enhancing overall consistency in care processes. The presence of clear reference standards and external validation, such as that provided through BV certification, was appreciated as it fostered the adoption of more uniform practices and reinforced organizational accountability. Moreover, since ICPs are formally approved by hospital management, they acquire the

status of institutional policies, which can facilitate greater adherence among the professionals involved. The early engagement of administrative and quality offices strengthened their competencies and visibility, creating the conditions for these teams to autonomously update the ICPs or conduct internal audits in the future. Finally, the action plans developed within the project provide a structured framework that can support organizational improvements beyond the implementation period.

Finally, the limited improvement observed in the “integration of territorial care settings” element may reflect the broader policy context in which the project was conducted. Ministerial Decree 77, issued in 2022, introduced a national framework for the reorganization of territorial and community-based healthcare services, with implementation required by 2026. During the project period (2021–2024), hospitals were therefore operating in a transitional phase, still adapting to the Decree’s requirements, with limited operational guidance available on how to restructure referral pathways and integrate community care structures into existing clinical workflows. This context may partly explain the limited progress observed in this area. As implementation of the Decree progresses, conditions may become more favorable for strengthening coordination beyond the hospital setting and supporting full integration of the HCC pathway within regional care networks.

Limitations

This study has several limitations that should be considered when interpreting the findings. The MDT project was primarily designed to optimize organizational models for hepatocellular carcinoma management through governance-oriented interventions and tools (action plans, organizational maturity assessment, and development/certification of ICPs). As a result, it focused on strengthening organizational processes and hospital readiness rather than directly measuring clinical outcomes. Owing to time constraints, the study did not include systematic collection of clinical, economic, or patient-reported outcomes (PROs), and no structured

cost analysis was performed. This reflects an iso-resource optimization strategy within participating hospitals, with the sole exception of introducing a case manager role in selected contexts. Future research should incorporate pre–post evaluations that include clinical, economic, and patient experience outcomes to allow a more comprehensive assessment of impact. Additionally, participating hospitals joined the project on a voluntary basis, potentially representing institutions already more attentive to organizational improvement. This may limit the generalizability of the findings to contexts with lower baseline engagement in governance and process optimization.

The pre–post, single-arm design without a control group limits causal inference: observed changes cannot be attributed exclusively to the intervention and may reflect secular trends or other external factors. Evaluation relied on a maturity model providing structured qualitative assessment based on predefined criteria and progressive levels of development and an exploratory survey of healthcare professionals’ perceptions. While informative for organizational change, these instruments do not yield quantitative estimates of clinical or economic impact and are susceptible to perception and response biases. Finally, the project was funded by a pharmaceutical company, which represents a potential source of bias. Mitigating measures included independent operations of the IQVIA implementation science team with direct interactions with participating hospitals and the development of ICP clinical components exclusively according to nationally endorsed guidelines, ensuring alignment with institutional recommendations.

CONCLUSIONS

The MDT Project proposed and piloted an organizational model for the management of hepatocellular carcinoma in Italy. By emphasizing care-pathway governance, multidisciplinary coordination, and hospitals readiness, the initiative aimed to support more consistent organizational practices across heterogeneous settings. Pilot activities suggest that the approach is

adaptable to real-world contexts and may facilitate organizational alignment and collaboration. However, in light of the methodological and scope limitations described, these observations should be considered preliminary and hypothesis-generating rather than evidence of a finalized or nationally generalizable model. The proposed framework provides a basis for iterative refinement and prospective evaluation; future studies should incorporate pre-post assessment with clinical outcomes, patient-reported measures, economic analyses, and sustainability evaluations to characterize long-term impact and determine scalability.

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Data Availability. All data generated or analyzed during the current study are included in this published article, as supplementary information files.

Declarations

Conflict of Interest. Giuseppe Cabibbo participated in advisory boards and received speaker fees from Bayer, Eisai, Ipsen, MSD, AstraZeneca, Roche, and Gilead. Ciro Celsa received speaker fees from Eisai, Ipsen, MSD, and AstraZeneca and travel support from Roche. Rossana Berardi has financial interests with AstraZeneca (advisory board), Bayer (advisory board), Boehringer Ingelheim (advisory board), EISAI (advisory board), Gilead (Invited Speaker), Incyte (advisory board), Eli Lilly (advisory board), Menarini (advisory board), Merck (advisory board), and MSD (advisory board); institutional funding was received from AstraZeneca, Pfizer, and Roche. Rossana Berardi is an Editorial Board member of *Oncology and Therapy*; she was not involved in the selection of peer reviewers for this manuscript nor in any of the subsequent editorial decisions. Roberto Bordonaro received fees from Bayer, AstraZeneca, Novartis, Amgen, Roche, Pfizer, Janssen Cilag, and Bristol Myers

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Ethical Approval. This study focused exclusively on organizational processes and the perspectives of healthcare professionals. All participants were members of the MDT Project working group, whose involvement was formally established through a collaboration agreement between IQVIA and each hospital's general management. Participants were informed that findings would be disseminated through scientific publications. As the project did not collect patient-level data or personal health information but focused exclusively on organizational processes and professionals' perspectives, participating institutions deemed ethics approval not required.

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