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Revealing the role of intellectual capital in digitalized health networks. A meso-level analysis for building and monitoring a KPI dashboard

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ABSTRACT

Purpose: We aim to provide a conceptual analysis about the role of intellectual capital in driving construction of a reliable measurement system in order to increase the effectiveness of healthcare policies. Specifically, we explore the building of a dashboard to monitor key performance indicators (KPIs) in the digitalized health networks. The study seeks to improve healthcare policies by developing an integrated meso-level framework based on the centrality of intellectual capital components (structural, relational, human).
Design/methodology/approach: To tackle the research question, we follow a conceptual approach supported by direct observation of a cancer network in the Southern Italy. First, we performed an integrative literature review in order to reveal the role of intellectual capital in driving digital transition for healthcare networks. Second, we started from theoretical speculations in order to build up a reliable dashboard formed by a set of KPIs, aimed at monitoring the crucial operation of a digitalized cancer network.
Findings: The conceptual model outlines an inductive process model by which the managers of the healthcare network can develop a comprehensive multi criteria group decision making (MCGDM) dashboard of KPIs, automatically extracting most of the information about the network from the digital platform. We have chosen three main dimensions that drive the digital transition: technological, referring to human capital, organizational, referring to structural capital, and environmental, referring to relational capital.
Originality/value: The originality of the model lies in its specific focus on confronting the complexity and heterogeneity that irremediably affects the decision-making process. An intellectual capital-driven dashboard allows cancer network policy makers and practitioners to deal with digitalization in a very broad and successful way. This paper seeks to gain an overall understanding by merging different fields of research and providing a reliable baseline to set up further quantitative academic research, centered on the dashboard. Due to its standardized approach, the dashboard may improve comparability between different healthcare networks and open the way for comparative studies between different healthcare structures; it might represent an opportunity for practitioners and academics.

1. Introduction

Evaluation and performance measurements have long been crucial topics for healthcare organizations (Pirozzi and Ferulano, 2016; Voelker et al., 2001). Managed clinical networks have become a relevant subject within healthcare management theory within the last 20 years. A managed clinical network is "a linked group of health professionals and organizations from primary, secondary, and tertiary care, working in a coordinated way that is not constrained by existing organizational or professional boundaries to ensure equitable provision of high quality, clinically effective care" (Baker and Lorimer, 2000). The exchange of knowledge has become fundamental in the development processes of this sector; indeed, the use of open innovation models and digital technologies guaranteed the fluidity of data and knowledge involving public and private actors (Ancker et al., 2017; Barham et al., 2020; Lavoie et al., 2020). Berler et al. (2005) proposed an important knowledge management (KM) tool that enables knowledge sharing among various health-care stakeholders and between different health-care groups. Boschma (2007) indicated that geographical distance was a less important element when innovative technologies are used in the

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process of sharing knowledge within a context. On the other hand, Freeman (2002) identified technical problems in measuring the performance of healthcare in the public sector, including indicator selection; the availability, validity and reliability of data and problems with robustness, sensitivity, and specificity.

Despite the centrality of such a subject, very few studies tried to analyze the issues of the performance and evaluation of these networks (e.g. Khare et al., 2016). Most of these studies focused on the identification of effective key performance indicators (KPI). A KPI refers to "quantifiable performance measurements used to define success factors and measure progress toward the achievement of business goals" (Grigoroudis et al., 2012, p. 109). A study by T.J.A. Peng et al. (2007) aimed to analyze how hospitals view the role of intellectual capital and performance indicators in the healthcare sector. Elg et al. (2013) suggested that performance measurement may be a versatile method for driving improvements in healthcare organizations. Thus, improving performance means being able to measure them. The integration of more KPI from different organizational domains allows the building of useful dashboards, such as the well-known "Balanced Scorecard" (Kaplan and Norton, 1992), to understand the value and performance of organizations. Furthermore, other intellectual capital models have been just provided by scholars, as an instance the Skandia Navigator model has been conceived for specifically focusing on human factors (Edvinsson and Sullivan, 1996). To the other hands, the technology broker model frames the evaluation process by emphasizing the relevance of intellectual property. Although this model presents a great point of weakness concerning the inability to evaluate the synergies among the company's capabilities (Brooking, 1998).

The intellectus model is the closest one to our conceptual idea, in short, the model states that the evaluation of organizational performance is driven by intellectual, relational and structural part, and the assessment takes place in five main parts: structure, principles, internal logic, development of model and table of indicators. The most relevant point of matching with our model is the idea of developing the model drawing from intellectual capital for efficiently creating performance indicators. Although, the models above mentioned, are not able to fully address to main issues: (1) the lack of modularity and adaptability in relation to healthcare networks; (2) the weakness in dealing with complexity and heterogeneity of new digital systems such as the healthcare networks. To date there are no conceptual model that can drive a monitoring dashboard construction for a healthcare networks.

Our study aims to highlight the importance of intellectual capital (M. Subramaniam and Youndt, 2005; Nahapiet and Ghoshal, 1998) as a driver during the building of a dashboard to monitor KPI in the health networks. Thus, the research question of the study is: how does intellectual capital drive the construction of a reliable monitoring system and increase the effectiveness of healthcare policies? In order to answer such a research question, we follow a conceptual approach (Doty and Glick, 1994; Jabareen, 2009). First, we performed an integrative literature review in order to identify the importance of knowledge in the health networks Second, we started from theoretical speculations (King and Walsh, 1993) in order to develop a conceptual framework to build up a reliable MGCDM dashboard formed by a set of KPIs, aimed at monitoring the crucial operation of a digital cancer network.

Our research supports the fact that two crucial obstacle problems of digitalization may be overcome due to a better exploitation of intellectual capital components (relational, structural, and human). Specifically, two main problems are addressed in-depth, thanks to the perspective of intellectual capital: the complexity of the system and the heterogeneity of actors and resources. Indeed, the proposed conceptual model affirms the centrality of intellectual capital in setting a multi group criteria decision-making (MGCDM) dashboard to tidy up a very indistinct decision-making process in the cancer network. We show the complexity of the healthcare network by referring to the selection, prioritization, and adoption of preferences and criteria in order to efficiently adopt decisions and implement changes successfully. On the other hand, heterogeneity is generated by the simultaneous convergence of different stakeholders and by the need to select, exploit and capture the most suitable and reliable data coming from the very fragmented actors and resources involved.

For these reasons, our conceptual framework can handle the complexity and heterogeneity of the decision-making process by exploiting the above quoted lines of intellectual capital literature. In other words, the performance measurement problem in the digitalized healthcare network is not only a problem of data but rather an issue of the selection of criteria behind the measurement toolkits in order to improve healthcare policies.

The paper is organized as follows: after this introduction, Section 2 contains the theoretical background and Section 3 defines the methodology. Section 4 shows a conceptual proposal to highlight the role of intellectual capital as a driver during the building of a dashboard to monitor KPIs in the health networks. Section 5 discusses the findings and the main implications for policy makers, practitioners, and scholars. Section 6 illustrates the conclusions.

2. Theoretical background

2.1. Exploring the role of intellectual capital in driving digital transition for healthcare networks

Health networks are "self-supporting groups of professionals working together to ensure cross-speciality sharing of patients and expertise" (Skipper, 2010). Scotland is a pioneer country in the setting up and management of this type of network. Managed clinical networks are usually organized at regional level, since one of the key expected benefits is the delivery of timely care for patients from the most suitable professionals and institutions in the network area (Skipper, 2010). Thanks to these clinical networks it is always easier to create innovative practices to improve the efficiency of the health system. However, these few studies did not consider the impact of intellectual capital and knowledge on the performance of these networks.

Thus, a more profound debate on the role of intellectual capital and its exploitation during the digitalization of the healthcare network is urgently needed. To extract the meaning of intellectual capital, we used the classification of intellectual capital as the result of three dimensions: human capital, structural capital, and relational capital (M. Subramaniam and Youndt, 2005; Nahapiet and Ghoshal, 1998). Human capital within healthcare networks may be defined as the sum of workforce features; more specifically, they concern knowledge, skills, experience, competence, attitude, commitment, and individual personal characteristics (Kang et al., 2007; Yang and Lin, 2009).

According to Yang and Lin (2009) the three components of intellectual capital impact on the relationship between healthcare system stakeholders and organizational performance. The authors argue that an efficient human resources management may foster the organizational level. Such a phenomenon is even more evident in knowledge-intensive industries like healthcare, where added value corresponds fundamentally to the level of intangible resources provided, for example, by specialists or a skilled healthcare workforce in the form of collective human performance (Y. Wang et al., 2018). The authors claim that intellectual capital is a crucial factor in determining a successful knowledge-intensive healthcare system (Yang and Lin, 2009). Relational capital is an intangible resource at the heart of relationships in all kinds of organizations (Mom et al., 2015). The relationships are both internal (among the components of organization) and external (members, actors, stakeholders outside organizations). The role of relational capital has become decisive since the healthcare institutions have adopted the network model and have undertaken a multidisciplinary approach (Dal Mas et al. 2020). Indeed, the mediator effect of relational capital plays a tactical role in orchestrating the heterogeneous high-quality healthcare resource and narrowing the systemic level of complexity (Evans et al., 2015; Huang et al., 2020) Structural capital has a connection with the

environmental features of an organization (Benevene and Cortini, 2010). It concerns new procedures, technological implementation, innovation development, and new knowledge codification within the healthcare network, which has a crucial role when digitalization occurs. Indeed, a new range of medical procedures, therapeutic technologies (Aramburu and Sáenz, 2011), or diagnostic teams are provided to enhance performance and adopt a higher level of connectivity within the healthcare network (E. Rojas et al., 2016).

Growing data intelligence availability is obviously a new source for better healthcare system management although the establishment of a performance dashboard is more related to practical aspects, instead investigating the long-term capacity to suggest and provide new efficient policies. The overproduction of data, due to digitalization in the healthcare systems, is bound to make the intellectual capital diffusion and measurement very indistinct. However, in networks, more levels of knowledge can co-exist in order to improve business processes. Knowledge impacting business performances can come at individual, inter-firm, and network level (Schiavone, 2008; Schiavone et al., 2014). These ideas could escape their initial business contexts to extend to a larger system (Narteh, 2008; Williams, 2007). As affirmed by Khare et al. (2016), the performance improvement programs aimed at ensuring high quality-of-care standards are a fundamental component of health care delivery.

In response to the growing need for data mining control and a data exploitation platform, this paper has reviewed the main studies (see Table 1) concerning the adoption of digital technology within the healthcare system. To date, research on digitalization in healthcare has been polarized between the technological evolutionist perspective, the structuralist network approach, and quantitative measurement studies. The following table recapitulates the types of intellectual capital by creating a link from the research propositions of the analyzed studies to the future research directions.

2.2. A multidisciplinary approach for managing digitalized health networks

The development of a multidisciplinary approach within the healthcare process is considered to be useful when it is exposed to a technological deployment. Some scholars bolster the argument for creating a health team of different experts to harness the real potential in the value of a disruptive technological innovation (Jimmison, 1999; M. Subramaniam and Youndt, 2005; Mans et al., 2015). The reasons why a multidisciplinary approach is fundamental are anchored to the involvement of very heterogeneous stakeholders that may contribute to aligning the actors' efforts around the new technological innovation (Narkevar and Jain, 2006; Carayannis et al., 2014). Recent scholars seem to be reluctant to adopt a very multidisciplinary approach by taking into account the end user approach. In other words, such a perspective influences technological development without reshaping the boundaries of patient mission and failing to encompass important new actors (e.g. social organizations, medical technicians). This lack of breadth of perspective will even hinder the same patients.

On the other hand, Pagliari (2007) stated that a multidisciplinary team of experts is irreplaceable in order to capture the potential of digital innovation. Dansky et al. (2006) argued that multidisciplinary elements and skills are aimed at developing, organizing, monitoring, and reshaping the digital healthcare system. Hamid and Skarmad (2008) shed light on the necessity to adopt a multiple perspective in the evaluation phase. In a nutshell, the authors affirmed that monitoring operations is a crucial phase to consider with the efforts of as many stakeholders as possible. According to such a thesis, the assessment may fit better, and the healthcare system may react more easily to external and internal solicitations.

Over the last few years widespread adoption of IT has taken place within the healthcare systems. The control of business processes by using digital platforms seems to have several advantages and also result in disruptive changes. Indeed, the proliferation of more responsive digital platforms has opened up the possibility of a large reconfiguration of business processes. Such reshaping is giving way to new process design by encompassing and connecting a greater number of actors. IT that fits very well acts as a natural partner within a fragmented and dispersed healthcare process. Nowadays it assumes a pivotal role in almost all the operations (Houy et al., 2010). IT takes part in the process, arguably as both the enabler and facilitator of new disruptive dynamics, innovative tools, and breakthrough mechanisms. The relationship between IT and healthcare process innovation is intended to be mutual because the process is sometimes able to reinforce and sustain technological advancements (Sarkis and Sundarraj, 2003; Žabjek et al., 2009).

Jimmison et al's study. (1999) argued that the multidisciplinary team for health technology adoption should consist of four main categories of stakeholders: (1) the consumer represented by the patient, but also their relatives and caregivers; (2) healthcare specialists, as the categories encompassed physicians, nurses, and all the other actors who were strictly related to the care service administrations; (3) developers, as the category referred to technical developers like IT developers or statisticians, or IT managers; and (4) the policy maker, which referred to all the public institutions aimed at financing and regulating the healthcare system.

2.3. Theoretical speculations inspired by TOE and HOT-fit frameworks

The literature review on the digitalization of healthcare networks and the exploration of intellectual capital as a facilitator of the knowledge-sharing process and conveyor of healthcare resources provides several conceptual drivers to set up an efficient theoretical framework to measure and assess healthcare system performance. In doing so, the efficient alignment of heterogeneous concepts has for a long time remained in a black box. In addressing this, this study is performed by harnessing two main frameworks: the Technology-Organization-Environment (TOE) framework (L. Tornatzky and Fleischer, 1990), and the Human-Organization-Technology fit (HOT-fit) model (M.M. Yusof et al., 2008). The reason why theoretical speculations are driven by the TOE framework is related to its capability to simultaneously analyze the technical threats without neglecting the features of context and highlighting the organizational changes that are an irreplaceable perspective for monitoring and managing the systemic and operational evolution. Besides, the TOE framework is applicable in a huge spectrum of organizations that are in the process of new breakthrough technological adoption, it fits effectively with the development of digital platform deployment. The HOT-fit framework is rather similar to TOE but it is configured just for the healthcare information system (M. M. Yusof et al., 2008). For these reasons, the exploitation of both frameworks may be suitable in order to capture the dynamics within a digital health network. The current literature does not show how managers of healthcare networks can exploit digitalization by avoiding an inconsistent and unreliable measurement system to achieve a more connected and successful healthcare network.

Drawing on these assumptions, we can develop some theoretical speculations (King and Walsh, 1993) about the role of intellectual capital components (M. Subramaniam and Youndt, 2005; Nahapiet and Ghoshal, 1998) as drivers during the building of a dashboard to monitor KPIs. Complex systems such as healthcare networks have a weakness when referring to the capacity to measure their performance. Several studies have adopted the perspective of complexity theory to investigate the role of intellectual capital in assessing systemic performance (Bueno et al., 2006; Jordão, 2017). For these reasons, the role of intellectual capital in the improvement of health policies in the health networks can be summarized in two ways.

First, we have speculated on the research fields of intellectual capital and decision support system management (Bergek et al., 2008; Cao et al., 2015). These theoretical fields provide us with theoretical frameworks for a better evaluation, prioritization, and selection over the

Table 1
Table of the most important previous studies about intellectual capital in healthcare.

Types of intellectual capital	Research proposition	Field of research	Key assumption	References	Research direction
Human capital	The human capital is an essential dimension in organizing heterogenous resources. It is even more evident within healthcare networks. Previous studies analyze how human capital enables of managing high-quality workforce, top specialists and user-innovation capabilities within digitalized healthcare network.	Organizational study	*"The three components of intellectual capital, namely, human capital, relational capital, and organizational capital, mediate the relationship between healthcare practices and organizational performance".*	(Z. Wang et al., 2018).	The digital coordination of intangible resources, skilled workers, users and assistance care providers might enhance the exploitation of healthcare network inputs for achieving R&D high quality-standards, breakthrough innovations, and successful healthcare technology deployment
		Healthcare innovation management	*"In knowledge-intensive industries, such as healthcare, added value accrues mainly from intangible services provided by medical professionals in the form of collective and synergetic human performance. Therefore, effective human resource management may facilitate the accumulation of an organizational-level intellectual capital in this competitive and knowledge-intensive era".*	(Yang and Lin 2009)	
		Knowledge management	*"knowledge plays a crucial role within healthcare industry by acting as a key element for every healthcare organization and institution."* *"…about the human capital injection, it adds skills, and competencies into healthcare industry also in a knowledge management perspective"*	(Addicott et al., 2006; Dal Mas et al., 2020; T.J. A. Peng et al., 2007)	
Relational capital	Relational capital within healthcare network is a determinant intangible resource for achieving a better coordination among heterogenous HealthCare actors	Organizational study	*"intangible resources influence healthcare organizations, and their mutually enhancing interactions on performance.* *It is an essential part of intellectual capital and is the value embedded in both internal relationships (among employees) and external relationships (those of customers, stakeholders, and partners)*	(Nahapiet and Ghoshal 1998; Evans et al., 2015)	Since healthcare institutions have adopted digital network configuration, the role of relational capital has become determinant for accomplishing a multidisciplinary approach. The mediator effect of relation capital plays a tactical role in: • orchestrating the heterogeneous high-quality healthcare resources • narrowing the systemic level of complexity; • enabling a much more effective performance measurement.
		Knowledge management	*"Healthcare Digital platform might create a much greater participation of patients in providing treatments and making diagnosis and medical procedures.*	(Piri and Asefzadeh 2006)	
		Healthcare innovation management	*"Intellectual Capital, defined by its major components of Human Capital, Structural Capital, and Relational Capital, is strongly linked to innovation as well as strategy, as Innovation Capital. Medical treatment in Healthcare is a sector that is mostly affected by new innovative technologies"*	(Dal Mas et al., 2020)	
Structural capital	Extant literature emphasizes the role of structural capital in supporting healthcare networks. Specifically, it provides contexts conditions that help the sharing of information and knowledge.	Organizational study	*Structural capital is defined as all of the features related to the organization design. Within healthcare systems, self-supporting groups of professionals working together to ensure cross-speciality sharing of patients and expertise*	(Skipper 2010; Aramburu and Saenz 2011)	Structural capital may drive the adoption of new procedures, more efficient technological implementation, innovation development, and new knowledge codification during the digital transition of a healthcare network. Indeed, the structural capital might play an essential role in assessing and measuring a new range of medical procedures, therapeutic technologies or diagnostic team collaboration.
		Knowledge management	*"The Knowledge management, in particular an efficient intellectual capital management, can build competitive advantage for company, especially in referring to patents"*	(Onumah and Duho 2019)	
		Business model innovation	*"Digital business model is mostly focalized on the structural traits of healthcare system. This stream of study is worried to capture the collaborative information and the relationships among the healthcare workers involved in their organizational units"*	(E. Rojas et al., 2016)	
		Digital innovation	*"Information technology (IT) as a means of making health-care systems*	(Agarwal et al., 2010)	

(*continued on next page*)

Table 1 (*continued*)

Types of intellectual capital	Research proposition	Field of research	Key assumption	References	Research direction
			safer, more affordable, and more accessible, a rare and remarkable opportunity has emerged for the information systems research community to leverage its in-depth knowledge to both advance theory and influence practice and policy".		

Source: Authors' research.

available alternatives, which are characterized by a large spectrum of conflicting criteria and decision-making preferences (Cao et al., 2015). Along with the decision-making criteria, there is another difficult problem, the heterogeneity of actors. This is the process of achieving a selection or a solution for a decision-making problem centered on the input or feedback of a multitude of actors in a multidisciplinary approach. For instance, a growing number of organizations are reconfiguring operations by creating a very articulated system of different healthcare actors, well known as the cancer network. It is formed by many resources coming from different branches of medicine endowed with extra expertise, because cancer treatment needs a huge spectrum of doctors and workers, from physicians to nurses or medical specialists.

Second, the process of healthcare efficiency matters not just from an organizational or managerial perspective, but it is also a crucial point in avoiding faulty medical procedures. The patient-centric approach adopted by the cancer network opens the route to a new way to provide care services by exploiting available resources as much as possible, breaking down spatial and temporal limitations. Healthcare digital platforms encourage a much greater participation of patients in providing treatment and making diagnoses and medical procedures (Piri and Asefzadeh, 2006). In other words, the cancer network should provide a more responsive and reachable patient service by encompassing more efficient resources or harnessing existing ones much better. In this scenario, the adoption of digital platform technologies should provide direct support for encouraging clinical and administrative processes and supply chain dynamics. The technology dimension concerns the technical issues that will affect the implementation, maintenance and remodulation of a technology within a system or a process. Chang et al. (2007) initiated the application of TOE to the healthcare industry. She claimed that the effectiveness of adoption in the hospital is subordinated to two sensitive features of technology: compatibility and complexity. Digitalization of the cancer network might overcome the lack of interoperability with other systems by favoring increased integration, although digitalization carries a higher degree of heterogeneity in healthcare processes, which troubles the business process analysis. The environmental dimension provided by the TOE framework is useful for handling heterogeneous and complex milieus. Indeed, this dimension is related to several traits, such as industry aspects, policy maker guidelines, and organizing committees. In the healthcare industry, external influences seem to play a crucial role in the dynamics, therefore it is of primary importance to pay great attention to environmental aspects. The patient organizing committee, or the government, frequently want to be involved in the decision-making process.

3. Methodology

In order to answer such research questions, we follow a conceptual approach (Doty and Glick, 1994; Jabareen, 2009) supported by direct observation (Mills et al., 2009) of a cancer network in Southern Italy. First, we performed an integrative literature review in order to identify the importance of knowledge in the health networks and the multidisciplinary strategies used when it is exposed to a technological deployment. In particular, the integrative literature review approach "reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated" (Torraco, 2005, p. 356). Second, we started from theoretical speculations (King and Walsh, 1993) in order to develop a conceptual framework to build up a reliable healthcare network dashboard formed by a set of KPIs aimed at monitoring the crucial operation of a digital cancer network that exploits intellectual capital components. In order to verify the consistency and the reliability of our conceptual model, we exposed the variables to the discussion and validation of the most pivotal actors of the cancer network. We collected their feedback during the debate to delineate the concept map. of the model. Indeed, to achieve a trustworthy conceptual model, the validation phase is needed to the high degree of specialization of the cancer network. Besides this confirmation step is performed in coherence to each functionality and each dimension of the cancer network: (1) economic; (2) clinical; (3) operational; (4) cognitive.

Finally, we directly observed the activities and the main documentation of a cancer network in the Campania region, the so-called "Rete Oncologica Campania" (ROC), in order to capture strengths and weaknesses for designing a monitoring dashboard and determine what is fundamental to better manage the healthcare operations. We used direct observation as evidence to highlight ROC everyday practices from an external view, indeed, direct observations provides to enter within an unfamiliar setting in order to show events that might go unobserved by those who are already participants in the setting (Mills et al., 2009).

3.1. Direct observation of a cancer network in Southern Italy

This study began after direct observation of a cancer network in the Campania region, the so-called "Rete Oncologica Campania" (ROC). Data collection took place between November 2019 and February 2020. Both primary information and secondary data were collected and analyzed. We reviewed and observed five institutional documents (see below) about the ROC in order to understand the key working mechanisms of this network and to obtain an initial picture of its supply chain:

- regional decree of ROC constitution (2016)
- regional decree of ROC divisional structure (2019)
- first official report about ROC of Istituto Nazionale Tumori Fondazione Pascale (2020)
- official archival documents of ROC performance monitoring (2020)
- national document of the Italian cancer networks progress (2020)

Drawing on the Gioia et al. (2013) method we referred to a qualitative analysis of the institutional documents of the ROC. We started from "first order quotes" described within the reports and regional decrees such as the first ROC objective "increased cancer survival and improved quality of life for cancer patients". After this observation, following Gioia et al. (2013), we grouped this first ROC aspects in "second emerging themes" as the complexity of the system etc. (see Fig. 1) with reference to our research question. Finally, basing on our theoretical background on intellectual capital, we linked these to the identified aggregate dimensions (es. performance of the network)

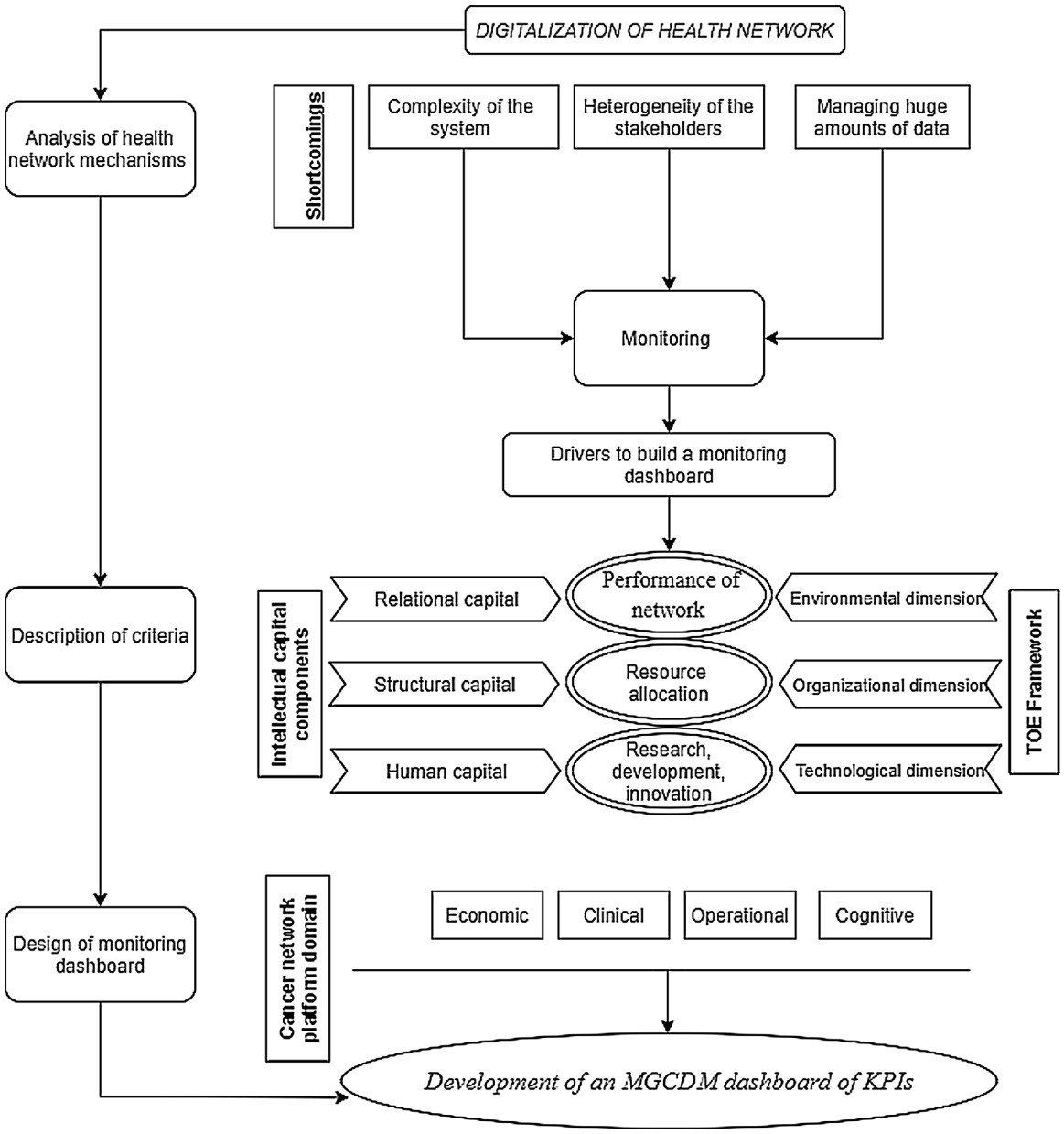

Fig. 1. The proposed conceptual framework.

related to the three intellectual capital components (relational, structural, human).

This investigation of the constitutive documentation of ROC has argued that the network is based on four organizational models: hub and spot; comprehensive cancer service; cancer care network, and comprehensive care network. The hub and spoke logic are centered on the "Istituto Nazionale Tumori Fondazione Pascale" of Naples, that is, the most important hospital for cancer treatment at regional level.

Over the last two years, this managed cancer network implemented a digital platform in order to facilitate communication and information-sharing among regional cancer hospitals about patient management and pathways by obtaining significant improvements in this direction. Digitalization of the relationship between different ROC stakeholders has on several occasions simplified the procedures by saving time and resources.

4. The proposed conceptual model

In order to go beyond the heterogeneity and complexity of digitalized networks, we provide a conceptualization about a standardized monitoring system based on intellectual capital components (Huang et al., 2020; M. Subramaniam and Youndt, 2005; Nahapiet and Ghoshal, 1998), driven by a multi-criteria structure. The conceptual model outlines an inductive process by which the managers of the healthcare network can support the development of a comprehensive Multi-Criteria-Group-Decision-Making (MCGDM) dashboard of KPIs, automatically extracting most of the information about the network from the digital platform. The stages of the model start from the analysis of health network mechanisms in order to define the criteria decision-making process. Furthermore, it is possible to design (or re-design) the digital platform and develop an MGCDM dashboard of KPIs for monitoring health networks. The dashboard includes a large set of KPIs focused on the performance of the overall cancer network. More specifically, we have considered the TOE framework (J. Baker, 2012; L. G. Tornatzky and Fleischer, 1990; Wu and Chen 2014) and HOT-fit (M. Nilashi et al., 2016; M.M. Yusof et al., 2008) to build a multistage measurement system by achieving an efficient dashboard, linking this to intellectual capital components (structural, relational, human).

As shown in Fig. 1, we derived a multi-criteria decision-making dashboard for the evaluation of the performance of cancer networks. Such a conceptual model shows four key domains of performance (each one consisting of a specific set of indicators): (1) economic; (2) clinical; (3) operational; (4) cognitive. Indeed, encompassing the four domains and driving performance monitoring by an intellectual capital approach ensures not only a high degree of effectiveness of resources but also a reduction in conflicts and the risk of escalating. In the case of the cancer care service, complexity and heterogeneity are even more accentuated, also due to the need to integrate a greater number of specialists and rare resources into patient care services.

Therefore, following both our theoretical background on intellectual capital and the direct observations of a cancer network in Southern Italy it is worth grouping together a spectrum of indicators consistent with the three pillars of intellectual capital (structural, relational, human). This kind of approach can provide a reliable and affordable monitoring result, which leads to the generation of a more consistent set of management policies. In order to enhance the reliability of the conceptual model, we exploited the skills and the experience of the pivotal specialists of the cancer network. We set up a validation phase, aimed at testing the consistency of the conceptual model. We received a confirmation feedback per each model dimension in accordance with the area of specialty. Specifically, we got an opinion from the coordinator of the ROC in order to test the main operational economic clinical and cognitive dimensions. Besides, we tested the consistency of dimensions by debating with the Head of Epidemiology of Istituto Nazionale Tumori Fondazione Pascale. In the Head's point of view, the conceptual model has made proof of ability in managing clinical data coming from healthcare procedures and treatments. In the end, we have debated with the ROC project manager that approved the dimensions that drive the conceptual model (Fig. 1).

The overlapping of the above-cited studies allows us to merge the concepts and explore some meso-drivers that may be helpful in managing cancer monitoring. More profoundly, the issues related to organizational aspects may be linked to the resource allocation driven by structural capital components. On the other hand, environmental aspects could be regulated by relational capital. To conclude, a final aspect to monitor is the technological aspect, which corresponds to the research, development and innovation of human capital components.

For each dimension we have proposed a dedicated set of KPIs that are interrelated, and which are intertwined with KPIs of other dimensions. The technological dimension is labelled "Research, Development and Innovation" and is formed by three sub-groups, concerning the degree of knowledge sharing, the common use of medical infrastructure, and the coordination of specialists through the digital platform. The organizational dimension is called "Resources allocation" and is depicted by two main subgroups concerning the rationalization of high-value medical devices and reconfiguration of care services. The environmental dimension concerns the relationship between the cancer network and external actors, like the scientific research committee. We called this dimension "Performance of Network", emphasizing the role of the digital platform in monitoring the capacity to be connected to external actors and to be responsive to external changes (e.g. new drugs developments, new medical devices, new software).

4.1. Evidence from an applied case

Our conceptual framework finds a significant correspondence when we observe an applied case concerning ROC. Our conceptual finding is confirmed by the empirical observation of ROC, that is, the regional cancer network of the Campania Region in Southern Italy. Recently, the Campania clinical network has undergone some radical changes that have rapidly changed the relationships between the reference actors, increasing value and revealing how local organizations are increasingly involved in the economic development processes of the regions. On the basis of those considerations, the Campania Region has decided to establish the infrastructure Rete Oncologica Campana (Campanian Oncological Network), which is the result of the activities of the Network of Centers deputies for their areas of expertise in the prevention, diagnosis, treatment and rehabilitation of cancer. The network was formally created a few years ago (2015) but its operations only started in January 2019. ROC also tries to solve the problems relative to identifying patients for clinical trials, how one manages healthcare data securely, and how one deals with data privacy issues. This oncological network is managed by the "Istituto Tumori Pascale", a global excellence center in oncology based in Naples. ROC has set up a monitoring interface by drawing on the data coming from its digital platform. The framework adopted by ROC to organize the exploitation of data seems to fit with our conceptualization by providing consistent examples of how fundamental it is to consider all the components of intellectual capital when we wish to obtain efficient performance monitoring. In order to regulate and manage the dataflow of the Campania cancer network a web platform was developed according to the operating model of the Comprehensive Cancer Center Network (CCCN). This platform tends to include all the structures present in the region. In this way, the platform deals with all the Centers that take part to contribute to the full implementation of an organized and efficient care path, not dispersive for the patient. The platform also guarantees continuity of care with a rapid sending of requests for territorial home services. Furthermore, the digital platform has elaborated performance indicators aimed at monitoring the activities of the healthcare network. Specifically, the ROC KPI dashboard is framed in four main areas: (1) quality of care and healthcare delivery (2) resource utilization (3) network performance (4) R&D and Innovation.

5. Discussion and implications

Our study contributes to the extant theory about intellectual capital components (Huang et al., 2020; M. Subramaniam and Youndt, 2005; Nahapiet and Ghoshal, 1998) by proposing a conceptual model for the measurement and evaluation of the economic and clinical performance of a network. The research supports how valuable and powerful knowledge and innovation are, through the intellectual capital perspective, for the effective management of a cancer network. Furthermore, the proposed model contributes to the role of intellectual capital in managing digitalized health networks. Indeed, the model summarizes and categorizes the intellectual capital components which could be related to evaluating the monitoring dashboard of cancer networks. This is still an underdeveloped area within the healthcare management literature. Second, the study stresses the value and impact of the various sources of knowledge (individual, organizational, inter-organizational) for achieving the effective performance evaluation of these medical networks.

Our conceptual study seeks to grasp an overall understanding by merging two research streams (intellectual capital components and the TOE framework), by providing a reliable baseline to set up further quantitative academic research, centered on the MGCDM dashboard. Due to its standardized approach, the dashboard may improve healthcare policies and the comparability between different healthcare networks and open up the way to comparative studies among different healthcare structures; thus, it might represent an opportunity for policy makers, practitioners, and academics.

Referring to policy makers, the MGCDM dashboard of KPIs could support healthcare policies during the design, introduction, and assessment of digital platforms in the cancer network. The originality of the model lies in its specific focus on confronting the complexity and heterogeneity that irremediably affects the decision-making process. This MGCDM dashboard allows cancer network managers to deal with digitalization in a very broad and successful way.

Referring to the managerial implications for healthcare practitioners, the proposed conceptual model could be useful to classify data for encompasses business intelligence, because information are not simply

interpretable without counting on a reliable framework that results in gathering, sharing, analysis and monitoring of these. Such a conceptual framework should be anchored to certain pillars, which enables detection only of the relevant facts for healthcare professionals. Hence the issue of managing data emerges as one of the difficult factors of success; in other words, only an efficient establishment of a data measurement system can provide an abundance of indicators that boosts the operation. For instance, the core issue around which ROC was created is this idea of trying to once again expedite patients into clinical trials. The complexity and the criteria for identifying patients in a trial have gone up significantly, where, for example, the number of procedures involved in a protocol are different and scarcely controllable. So, given all these complexities, the aim is to remove the ambiguity from the processes of healthcare organizations. Following this line, hospital management could obviously recognize the benefits of the interorganizational teams included in an MCGDM dashboard of KPIs, automatically extracting most of the information about the network from the digital platform. This is because it realizes that the network often fails or is exposed to considerable risks from conflicts, due to a lack of operational alignments or different interpretations of the cooperation's goals, failures in monitoring, or not capturing the evolution of scenario.

This study could also provide useful suggestions and theoretical implications for scholars interested in intellectual capital studies and, more specifically, in healthcare performance indicator studies (Pirozzi and Ferulano, 2016; Voelker et al., 2001; Cavicchi, 2017; Huang et al., 2020; Paoloni et al., 2020). Indeed, our conceptual framework can confront the complexity and heterogeneity of the decision-making process in such complex networks as healthcare by exploiting the intellectual capital components in a different way, in particular by referring to the capacity to organize a very effective and reliable system of values that efficiently drive dashboard construction. Such systemic complexity is much greater in the healthcare cancer network, due to the heterogeneity of actors, knowledge and objectives (Khalifa et al., 2015). Healthcare process mining is not only assigned to the description of dynamics. However, closely linking event data and process models, the cancer network is on the way to validating conformance, coming up with deviations and forecasting delays, providing information for decision making, and reengineering the healthcare design system. In other words, the digital transition may provide a reliable set of KPIs able to dramatically increase the malleability, responsiveness and flexibility of the decision-making healthcare process.

6. Conclusions

Cancer treatment improvement is a theme of increasing concern, and a pivotal factor is the coordination of a very wide network of resources in a fragmented oncology system that is becoming increasingly global. The number of patients affected by cancer around the world is unfortunately increasing, but also the number of treatments, technological devices, and all other medical innovations, is growing at the same pace. The originality of the conceptual model lies in its specific focus on confronting the complexity and heterogeneity that irremediably affects the decision-making process in the healthcare network. An intellectual capital-driven dashboard allows cancer network managers to deal with the digital transition in a very broad and successful way. In other words, a consistent multidisciplinary monitoring dashboard may boost both medical treatment and the organization's healthcare operations. Our conceptual model, intended to bypass the complexity of data coming from digitalization, is projected to achieve an effective monitoring toolkit that enables exploitation of the fundamental factors of intellectual capital framework.

On the other hand, cancer networks have a wide range of goals, for instance economic and financial balance, quality of care services, the number of those who have recovered, or advances in research and development. Indeed, the monitoring processes are mostly related to the structural traits of the healthcare system. This can be dependent on capturing collaborative information and the relationships among the healthcare workers involved in their organizational units. For instance, the study of these digitalized networks is assigned to the analysis and monitoring of the sharing of information and knowledge between different groups of stakeholders (e.g. patients, funders, decision makers, physicians, and so on).

This paper is not without limitations. Firstly, theoretical speculations could be proven in the future by exploring more case studies to examine the improvements in operational performance outcomes. Furthermore, given the great role of the decision-making processes in the healthcare sector, case study exploration could illustrate the effects that digital platforms create for different healthcare actors who have different roles and background. Therefore, the enhancement of process efficiency is becoming a point of the utmost importance. For these reasons, the evaluation of performance is a crucial element, especially in the initial stages, and future studies may be interested in understanding whether the cancer network can provide benefits and value to the patients, health institutions, and professionals in an appropriate way.

CRediT authorship contribution statement

Francesco Schiavone: Conceptualization, Funding acquisition, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Daniele Leone:** Conceptualization, Funding acquisition, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Andrea Caporuscio:** Conceptualization, Funding acquisition, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Ajay Kumar:** Writing – original draft, Writing – review & editing.

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