Does intellectual capital promote the shift of healthcare organizations towards sustainable development? Evidence from Italy

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Abstract

Scholars recently urged for research able to unlock the link between sustainable development (SD) strategy and intellectual capital (IC) at the organization level (CISL, 2016). In line with this call, the present paper aims at investigating strategic planning for sustainability within healthcare organizations (HCOs), and the role that IC plays in SD. Indeed, this latter has been claimed to be a potential enabler of Italian HCOs' shift towards SD which is a major challenge posed by international institutions. Focusing on IC assets that emerged from the institutional context, the authors designed a model of "Sustainable Intellectual Capital for HCOs" and conducted a survey of a sample of General Directors (GDs) of Italian hospitals. The aim was to determine: whether GDs were adopting formalized SD strategies, the kind of organizational positions that managed sustainability issues, the sustainability projects/actions adopted, and the effect of IC in incentivizing those initiatives. The results showed that the majority of GDs had adopted a formalized sustainability plan in which informal and/or occasional structures or collegial bodies dealt with sustainability. Finally, a stochastic ordering test showed an alignment between the GDs who attributed higher relevance to information and communication technologies and advanced technologies for sustainability and the adoption of formal sustainability strategy. Further research should deepen the role of connectivity among different assets for SD. The developed model of sustainable IC for HCOs can support healthcare managers to test the contribution of IC assets to sustainability.

Keywords: intellectual capital; sustainable development; healthcare organizations; sustainable healthcare

Abbreviations

HCOs, healthcare organizations; SD, sustainable development; IC, intellectual capital; PHS, public healthcare system; ICT, information and communication technologies; GDs, General Directors; NPC, non-parametric combination.

1. Introduction

The United Nations Sustainable Development Goals firmly stressed the need to promote healthy lives and wellbeing for all populations (United Nations General Assembly, 2015). In this context, healthcare organizations (HCOs), such as hospitals and local health authorities, are responsible for guiding a shift toward sustainability, which includes a more equitable provision of care and prevention to reduce costs of unnecessary treatments, improving the efficiency of the system, and the reduction of the environmental impact of their structures; indeed, social responsibility should

guide the governance of HCOs (Brandao et al., 2013). In other words, hospitals have to: evolve considering the impacts of the healthcare setting and workplace on hospital populations, act as change agents to enforce healthy behaviors, and develop training and research on health promotion while empowering health services (Pelikan et al., 2001). In the Italian healthcare context, it is claimed that intellectual capital (IC) management can have a role in the shift toward sustainability (Botturi et al., 2015; Lavalle et al., 2015). However, when focusing on the literature about the role of IC for sustainable development, research mainly discussed the business sector, and was routed to investigate the effect of green IC on the competitive advantage of these organizations (see for example Chen, 2008 and Yahya et al., 2014). Models of green IC, such as the one of Chen (2008), have thus been shaped by the conceptualization of IC that identifies human, relational and structural capital as the main dimensions of intellectual capital. This taxonomy originated with the MERITUM project (2002), a European project aiming at setting general guidelines on intangibles' measurement and disclosure, and found consistent application in healthcare studies (Habersam and Piber, 2003; Evans et al., 2015). Based on this taxonomy, human capital is defined "*as the knowledge that employees take with them when they leave the firm", including "the knowledge, skills, experiences and abilities of people*"; structural capital represents "*knowledge that stays within the firm at the end of the working day"*, including *"the organizational routines, procedures, systems, cultures, databases"*, and relational capital defined by *"all resources linked to the external relationships of the firm, with customers, suppliers or R&D partners"* (MERITUM, 2002; pp.10-11). With reference to the contribution of IC to sustainability of HCOs, at the current state of the art we assist at fragmentary studies that looked at single assets' role for sustainability successful implementation, while the whole effect of these assets for organizational performance is left unexplored (Evans et al., 2015), despite connectivity has been considered relevant for IC contribution to organizational performance (Habersam and Piber, 2003). In addition, sustainable healthcare has been mainly deployed by the use of the Triple Bottom Line approach, developed by Elkington (1999) for business organizations; this model focuses on social, economic and financial dimensions of sustainable development and in HCOs has been adapted considering the peculiarities of the sector (Jameton and McGuire, 2002). This calls for an extension of IC conceptualization, that should be inclusive of social and environmental capitals within organizations to unlock the potential contribution of these assets for society and ecosystem (Allee, 2000). Studies such as Mertins and Orth (2012)'s paper, although based on private sector organizations, are in this sense pioneering as they focus on an integrated perspective between sustainability (composed by social, economic and environmental dimensions) and IC management. Indeed, the adoption of innovation (which is a component of intellectual capital) in flexible healthcare structures was depicted as fundamental to HCOs' sustainability strategy planning and implementation (Worley, 2012); nevertheless, studies about the link between IC and strategy and between IC and organizational performance are highly recommended by scholars (Vagnoni and Oppi, 2015; Lev, 2014), as well as research that can deepen the functioning of IC practices within public sector organizations (Dumay and Garanina, 2013; Guthrie and Dumay, 2015). Moreover, IC management for HCOs' sustainability represents an interesting field of research being HCOs knowledge-intensive organizations that need IC to comply with their mission. For these reasons, the study, based on a quantitative data analysis, aims at investigating sustainability planning in the Italian public healthcare system (PHS), the role of IC in prompting sustainability initiatives and its association with sustainability strategy adoption. IC's contribution to sustainable healthcare is analyzed espousing the definition of SD in healthcare where the TBL has been conceptualized by goals of health care services' quality (social dimension),

cost control (economic dimension) and environmental impact reduction (environmental dimension) (Jameton and McGuire, 2002). For the purposes of the paper, sustainable intellectual capital is defined as *"the sum of knowledge that contribute to implement sustainable development projects in healthcare organizations, where sustainable development is composed by social, economic, and environmental dimensions".* This way, using the MERITUM (2002) conceptualization of IC, a sustainable intellectual capital model for HCOs was defined categorizing IC assets that emerged from the investigated institutional context (the Italian healthcare service) as potential contributors to SD. Then, a stochastic ordering test was conducted to verify if GDs attributing higher importance to IC assets for implemented sustainability projects were also the ones adopting sustainability strategy within their organizations. The contributions of the work are several: first, it aims to analyze the role of IC for sustainability management purposes as recommended by the literature calling for research on the link between IC and strategy (Lev, 2014; Vagnoni and Oppi, 2015). Second, it enables the creation of a Sustainable Intellectual Capital framework that can be used by healthcare practitioners as a reference to think about assets that can contribute to implement sustainability within their structures and processes. Third, the use of the developed framework can be of help to discuss connectivity among different assets, as different combinations of assets can facilitate or hinder the shift of HCOs towards sustainable development.
The paper is structured as follows. Section 2 discusses the challenge of sustainability in the Italian public healthcare context, and the role of intangibles in addressing the challenge. Section 3 presents an overview of the scarce research on the relation between IC and SD in the private and public sectors. Section 4 presents findings from a review of the literature on the contribution of IC to the sustainability of healthcare and then proposes a framework: Sustainable Intellectual Capital for Healthcare Organizations. Section 5 presents the research methodology of the study. The results are presented in Section 6 and some conclusions are drawn in Section 7.

2. The challenge of sustainability in the Italian healthcare context: a role for intangibles

In 2015, the Italian Senate produced a document titled "Consultation on the sustainability of the healthcare system" ("*Indagine conoscitiva sulla sostenibilità del Sistema Sanitario*") in which the sustainability of the PHS was presented. In the report, the Senate outlined the main criticalities the Italian PHS should address to achieve sustainability. The containment of healthcare spending, the deficit of some Regions' balance sheets for which repayment plans were issued (De Belvis et al., 2012), and the periodic block of turnover for healthcare professionals (France et al., 2005) were depicted by the Italian Senate (*Senato della Repubblica Italiana*, 2015) as possible causes of high disparities in the provision of services by the regional healthcare systems of the Italian PHS. The economic crisis also affected health expenditure: health expenditure per person decreased by 3.5% in 2013 and 0.4% in 2014 (OECD, 2015). Moreover, an increased citizens' copayment on drugs (De Belvis et al., 2012) and an increase in requests for private health services were the main consequences of a system not designed for quality and efficiency (*Senato della Repubblica Italiana*, 2015).

Examining these issues, some scholars indicated that IC, especially social capital (the combination between human and relational), could help lift the healthcare system out of the crisis (Lavalle et al., 2015). Indeed, IC contributes to public and private organizations' value creation, organizational

performance and competitive advantage (Edvinsson and Sullivan, 1996; Allee, 2000; Lerro, et al. 2014; Vagnoni and Oppi, 2015). Especially in nonprofit organizations, such as HCOs, IC has been claimed to help these entities in a) achieving financial sustainability in front of diminishing public funding, and, b) complying with their social mission, in particular nurturing the relations with stakeholders (Pirozzi and Ferulano, 2016) that count on healthcare professionals' competences. Therefore, *New Public Management* policies in the public organizations' contexts have pushed HCOs to be competitive through efficiency, accountability, transparency and quality of services (Habersam and Piber, 2003). Although studies of IC in healthcare organizations are of low number, the research setting deserves a deeper examination, as IC management can support HCOs in facing these emerging performance challenges (Sillanpää et al., 2010). However, IC management in HCOs is quite tricky for several reasons (Evans et al., 2015): first, it requires to overcome the divide existing between disciplines (e.g. clinic and management knowledge) to function; second, top management and professionals' workforce instability can prevent the organization to accumulate and progress in competences' development; third, HCOs are characterized by high volumes of tacit and explicit knowledge that lack measurability and can be not easily transferred to be exploited by the members of the organization. Indeed, we assist at kind of literal (explainable), intuitive (explicable) and black box (not explicable) knowledge capitals within HCOs; these latter, although not measurable, contribute to organizational performance and require new means of visualization to be accessed (Habersam and Piber, 2003). More recent contributions in the IC literature have also emphasized the potential of IC, when it addresses social and environmental concerns, in redefining the contribution of organizations to global society and ecosystem (Allee, 2000). From an IC perspective, Lavalle et al. (2015) stressed that healthcare can benefit from a participative approach in which patients and professionals share competences, experiences and commit themselves to improve decision making on care provision, taking sustainability into account. Healthcare systems should enable the development and persistence over time of human and relational capital because HCOs are major providers of relational goods. Cooperation and health policies should be first oriented to prevention, which is considered a pillar to achieve sustainability (Macara, 2002). The Italian Senate (2015) addressed prevention as the main contributor to sustainability through the orienting of lifestyles, providing access to screening programs to prevent disease, using health and environmental data to improve citizens' quality of life and reduce the need for care services. Issues of the *unsustainability* of the Italian healthcare service are common issues: as Villa et al. (2009) argue, hospitals need to come far from self-referentiality, duplication of resources and unexploited economies of scale, lack of clinical integration and governance, healthcare professionals' excessive autonomy at the expense of accountability, inefficient setting of personnel for care provision. Therefore, despite budget constraints, we assisted at an uncontrolled spread of technology in many Regions with an uncoordinated use of health technology assessment (France et al., 2005). Although actions were taken to intervene in and update the structural capital of the PHS (such as the introduction of electronical medical records and unified public procurement centers, the digitalization of informative databases, the closure of small health facilities to eliminate waste and problems with quality, and the introduction of registers to monitor prescriptions' appropriateness), high heterogeneity in the provision of services by regional healthcare services persists (OECD, 2014) and may jeopardize the achievement of sustainability goals, as some regions are still in a situation of economic crisis. Moreover, the use of the structural capital, such as technological platforms to manage health data for decision making, risks increasing this inhomogeneity because information technologies have been introduced in HCOs in very different ways across the PHS (Lo

Scalzo et al., 2009). This could represent a huge problem in light of the new managerial approach adopted by the Minister of Health with reference to the use of national health data. Indeed, the Italian Health Minister, has stressed that digitalization can be a lever to the reorganization of the whole system toward SD; the Minister of Health, during her intervention in a conference titled "Sustainable Innovation from Patients to System" ("*Innovazione Sostenibile dal Paziente al Sistema*"; June 14, 2016), stated that new information and communication technologies (ICT) could allow the collection of patients' big data to improve diagnostic and clinical appropriateness. As way of example, ICT in the clinical field has recently enabled the realization of national monitoring registers on drugs' efficacy (the so called *"Registri dell' Agenzia Italiana del Farmaco"*) that will have an impact on healthcare systems' reimbursement policies with reference to expensive and innovative drugs recently entering the market; they will lead a shift to new *Managed Entry Agreements* based on adaptive pathways in which the efficacy of innovative drugs is tested by the prescriber before their market entry (in line with *evidence-based medicine*) and thus help PHS to fix adequate remuneration to pharmaceutical companies as well as reimbursement by pharmaceutical companies to PHS in case of drugs' inefficacy (Montilla et al., 2015). The shift toward sustainability that can be achieved through open innovation and new technologies requires a change in the traditional organizational patterns characterizing the healthcare system and, in particular, the development of social capital that can support their use (Botturi et al., 2011).

As argued, healthcare professionals play a central role not only in healthcare but also for socio-economic development (de Francisco Shapovalova et al., 2015); however, the promotion of sustainable healthcare systems requires the adoption of new models of organization that overtake traditional roles and competences. Among the several elements needed to prompt sustainability within organizations, Smith and Sharicz (2011) identify governance, leadership, culture and organizational learning. Especially for HCOs these elements prove to be relevant to address sustainability challenge, as these entities are part of a wider system in which healthcare objectives are fixed by national and regional policies. Leadership exercised by HCOs' top management can be propeller for SD however, focusing on the Italian healthcare context, leaders tend to be pressed by politicians to balance cost reduction with quality of services (Chiarini and Vagnoni, 2016); cost containment' philosophy can in this sense prevent top management from addressing HCOs' environmental issues, which are often left forgotten (Chiarini and Vagnoni, 2016). The shift towards sustainability to be effective needs new ways of exercising leadership. As Roome argues (2006; p. 138) *"these skills will involve leadership based on the ability to foster principled vision, to facilitate a systems view of present reality, to engage stakeholders […], clusters of organizations and society at large in organizational and social learning and concerted change based on technological, organizational and institutional innovations"*. In HCOs, this requires to develop new and adequate governance mechanisms through supra-organizational and participative models of decision making (Olsen, 1998) in order to: a) achieve integrated care paths derived from the coordination of professional skills and technologies, and b) define and assess healthcare responsibilities to ensure the satisfaction of stakeholders' needs through optimization strategies (Lavalle et al., 2015). To this end, development of the three fundamental components of IC (human, relational and structural capital) is considered essential to promote open innovation for the sustainability of the Italian PHS. To achieve this, authors such as Botturi et al. (2011) suggested: a) the participation of citizens in the evaluation and planning of healthcare services; b) the development of professionals' competences devoted to innovation; c) change in the culture and

structure of the organization to overcome the internal efficiency logic and to develop social capital strategies; and d) cooperation between citizens and public administrations through ICT and social web.

3. The relationship between IC and SD: an overview

The literature discussing the link between IC and SD is mainly related to the private sector. For example, scholars have started to focus on integrated reporting as a means to combine IC and sustainability information. Indeed, the overlap existing between IC and SD in social and environmental reports and sustainability reports (Cordazzo, 2005; Del Bello, 2006; Polo and Vázquez, 2008; Cinquini et al., 2012) and the use of international sustainability guidelines (such as Global Reporting Initiatives) favoring IC disclosure (Oliveira et al., 2010) seem to be the major arguments in favor of integrated reporting. However, many academics have questioned the utility of such a reporting practice: first, firms are not prone to disclose critical success factors such IC and SD in their reports because it can result in a loss of the matured competitive advantage; second, reporting does not have a strategical focus given its impossibility to disclose timely information that can meaningfully modify the value of the firm for stakeholders (Dumay, 2016). However, what emerges from this stream of research is a definite link between IC and SD. From a strategic point of view, many authors argued that the adoption of SD in management and performance measurement practices is scarce, and they urged organizations to integrate IC in management frameworks as a driver of sustainability. Mertins and Orth (2012) presented a draft model based on InCaS Guidelines and Sigma's conceptual categories of capital that supported the causal relation between IC and SD; the model was realized to help firms define the incidence of their intangible assets and their modifications on triple bottom line performance and to help them redesign their business processes to achieve sustainable goals. Sustainability requires "rethinking how business is performed" (Wong, 2010), and the development and organization of new capabilities and innovation through knowledge management and organizational learning to guarantee viable practices and behaviors (Wong, 2010) as well as a distinctive advantage (Rodriguez et al., 2002). Thus, knowledge management has been considered relevant to operationalize sustainability in organizations to improve governance and increase stakeholders' value (Robinson et al., 2006). Organizations need to promote sustainable practices based on their IC to fit with "society's environmental agenda" (Baharum and Pitt, 2009). To this end, authors refer to "sustainable IC" or "green IC" to depict the human, structural and relational capital needed to shift to environmental sustainability.

López-Gamero et al. (2011, p. 20) defined sustainable IC "as the sum of all knowledge that an organization is able to leverage in the process of conducting environmental management to gain competitive advantage". Chen (2008), based on Bontis's (1999) and Johnson's (1999) distinctions of IC, described green IC as having three components:

1. Human capital which is "the employees' stocks of knowledge, skills, capabilities, experience, attitude, wisdom, creativities, and commitments".
2. Structural capital which is "the stock of organizational capabilities, organizational commitments, knowledge management systems, reward systems, information technology systems, databases, managerial institutions, operation processes, managerial philosophies, organizational culture".

3. Relational capital which is “accumulative interactive relationships” about “corporate environmental management and green innovation” that “can help companies obtain competitive advantage” (p. 275).

The tripartite categorization of IC was born with Sveiby (2001) who identified individual competences, and internal and external structures created by individuals’ interactions inside and outside the organization, as intangible assets characterizing knowledge transfers for value creation. Edvinsson and Malone (1997) reclassified IC introducing customer capital as representing external relations and networking an organization develop with its clients. The MERITUM project (2002), extending the potential of firms’ relations with the environment, introduced the concept of relational capital, to include resources coming from firms’ external relationships with the environment (MERITUM, 2002). Variations of the above mentioned Chen’s framework introducing the concept of “green intellectual capital” are reported by Yahya et al. (2014) in which innovation and organizational capital replace structural capital to identify respectively, the firm’s ability to address environmental issues in new products, and the system of procedures to implement and check green operations. Moving from theories to empirical research, scholars focusing on the business sector tested the link between green IC management and performance, starting from the assumption that IC can generate competitive advantage. Chen (2008) conducted research in the Taiwanese information and electronics industry; Chen (2008) showed a positive correlation between the three classifications of green IC and firms’ competitive advantage. Competitive advantage was analyzed using managers’ perceptions of 11 items that included company’s profit, image, R&D and innovation compared to their market rivals. Moreover, the author found evidence of the major relevance of relational capital to create value for firms in the sector. López-Gamero et al. (2011) investigated firms’ propensity to develop green IC; they found that sustainable human capital was cultivated by training and updating employees on changes to business processes due to environmental improvements and by incentivizing employees’ creativity. Firms modified structural capital by adapting structures and roles to deal with the complexity of sustainability issues and they mainly adopted prevention technologies to redesign internal processes. In terms of relational capital, customers and suppliers were considered relevant sources of information to enact sustainable practices. Based on four constructs of green IC (green human capital, green organizational capital, green innovation capital and green relational capital), Yahya et al. (2014) found a positive association between IC and the competitive advantage performance of Malaysian manufacturing firms, with green innovation capital as the main predictor of the model. Delgado-Verde et al. (2014) investigated a sample of firms in the metal industry and discovered that relational capital mediated the relation between organizational capital and environmental product innovation. De Leaniz and Del Bosque (2013) validated the inverse relation between SD and green capital: they found that firms undertaking sustainable initiatives had an increase in their relational capital due to an improvement in their corporate reputation. A study by De Marchi and Grandinetti (2013) showed that green innovators were more prone to engage in networking with external partners (in their search for external sources of knowledge) than non-green innovators. Guerrero-Baena et al. (2015) developed and tested a model allowing to choose among different options of environmental management systems, based on the maximization of firm’s market value, with this latter including both financial and intellectual capital. Other studies focused on the determinants of green IC. Chang and Chen (2012) studied the ways in which corporate social responsibility (CSR) and environmental consciousness can enhance firms’ IC: CSR attracted employees, enhanced

technology rates and involved the public in determining new product innovations, while sensitivity helped orient people and processes to changes due to environmental trends. Liu (2010) showed the significance of green internal control procedures, companies' culture and information system building (as components of structural capital) compared to relational and human capital in achieving competitive advantage in the long term. These studies, except for Mertins and Orth (2012)' paper, mainly focused on the role of intellectual capital in greening organizations for purpose of competitive advantage, but they do not consider sustainability as composed by social, environmental and financial aspects. Therefore, they do not investigate the relation between IC and sustainable strategy. Nevertheless, literature started to focus on the contribution of IC to organizations' value creation, but also to society and the ecosystem by ways of organizations' interactions, when IC concept is extended to include social and environmental concerns (Allee, 2000). In the healthcare sector, we assist at a gap concerning the analysis of the role of IC for HCOs' sustainability; nevertheless international institutions have urged these organizations to act for SD. Based on the definition of sustainable healthcare (Jameton and McGuire, 2002), next section will propose a model of Sustainable Intellectual Capital in HCOs, where MERITUM taxonomy (2002) is used: the model allowed to analyze IC's contribution to HCOs' sustainability planning and implementation, based on the definition of human, structural and organizational capital. From the analysis of the institutional context in which Italian HCOs operate, it was possible to detect assets that can promote the shift towards sustainability of these organizations; based on the literature (Olsen, 1998; Macara, 2002; Botturi et al., 2015; Smith and Sharicz, 2011; Montilla et al., 2015; de Francisco Shapovalova et al., 2015; Lavalle et al., 2015; Pirozzi and Ferulano, 2016; Chiarini and Vagnoni, 2016) the assets were the following: corporate culture, competences and clinical possibilities, managerial philosophies, collaboration with stakeholders, ICT and advanced technologies. With reference to SD, the potentialities of each asset are deeply discussed in next section, and will generate the model of Sustainable IC for HCOs.

4. Sustainable IC in HCOs

4.1 Corporate culture, competences and clinical possibilities

Bontis (1999, p. 450) stated that culture "constitutes the beliefs, values and attitudes pervasive in the organization and results in a language, symbols, and habits of behavior and thought". With reference to culture, many studies showed the relevance of an HCO's sensitivity to SD topics (Ball et al., 2014; Pinzone et al., 2012) as a condition to enact positive engagement of management and employees with sustainability. Ramirez et al. (2013) pointed out the need to train professionals at different stages of study and career, according to the specificities of organizational levels of HCOs, in order to mature competences to enact SD culture and processes. Possible collaborations with universities to develop specific curricula on integration between SD and healthcare could promote an increase in managerial competences in SD (Rich et al., 2013; Ramirez et al., 2013; Rogers et al., 2009; Sarriot et al., 2004, Schroeder et al., 2012). In addition, cutting-edge education for healthcare professions should be offered in non-conventional matters so that they can acquire adequate expertise in dealing with matters of climate change (Frumkin et al., 2008). Human resource management practices adopted by HCOs can also favor employees' sustainable behavior. As Pinzone et al. (2016) argue, "green" competence building, performance management and

employee's involvement practices can positively affect employees' collective and voluntary behavior contributing to environmental management within the organization. The mix of competences an HCOs is able to develop at the operative level influences clinical possibilities (Weisz et al., 2011) that in turn affect the implementation of sustainable programs of care.

4.2 Managerial philosophies

When looking at organizations, the so-called *sustainability champions* can be propellers of SD culture; the literature has stressed managers' leadership as a sustainability driver (Ramirez et al., 2011), as well as promoting collaboration and employees' engagement in interdisciplinary projects for healthcare (Kira and Lifvergren, 2014; Lifvergren et al., 2008). The role of top management is to mediate with politicians on sustainability priorities for the healthcare system and to define strategic areas to be managed in order to foster organizational change. In addition, management determine projects' assignments, time to dedicate to SD, as well as financial and technical capacities to support projects, and can commit the whole organization toward SD by providing periodic feedback (Lifvergren et al., 2008). Leadership can also decide to create ad hoc organizational structures (Pinzone et al., 2012) dedicated to the implementation of SD goals and to propel change management practices (Lettieri et al., 2012; Pencheon, 2013) to make hospital's operations more sustainable. SD-dedicated job positions can help organizations to define responsibilities and develop their commitment toward sustainability (Schroeder et al., 2012). Despite this, empirical evidence has shown that managerial approaches to dealing with sustainability are mixed: some managers prefer to approach sustainability decision making at the Board or at the operational level, while others prefer teams working toward SD that involve different functions in the hospital or teams composed of resource management members (Ling et al., 2012). Key decision makers determine the choices to be made for sustainability and thus the profile of activity (Olsen, 1998). Management has to face major constraints when looking at the actual conditions of the healthcare system; the increase in chronic diseases linked to the age of people has led to an increase in demand for healthcare services, but resources dedicated by government to healthcare are insufficient to deal with new healthcare issues that place emphasis on hospitals becoming more efficient (Weisz et al., 2011; Balcezak et al., 2014; Schroeder et al., 2012) and to orient their activities to prevention.

4.3 Collaboration with stakeholders

The mobilization of partnerships with stakeholders has been depicted as a fundamental step to foster hospitals' contribution to sustainability (Frumkin et al., 2008; Worley, 2012), as partners can provide expertize and infrastructures that may not be present within HCOs (Zimmer and McKinley, 2008; Ryan-Fogarty et al., 2016). Collaborations in the form of *megacommunities* (multinational partnerships) and *intelligent communities* (local or regional communities) were seen as elements necessary to address challenges connected to wellbeing and sustainable growth (Passerini and Wu, 2008). Collaborations can focus on different levels of planning, such as local, regional or national, depending on the goal (Frumkin et al., 2008), and generally include non-profit organizations, firms, community, academia and others. For example, collaborations with local firms have helped HCOs reduce their environmental impact (Gerwig, 2014). Moreover, collaboration between local

authorities and hospitals not only deliver prevention campaigns on sustainable lifestyles, but also create the conditions in which to provide integrated care services. In Italy, the regulation introducing Healthcare Houses (specialized primary surgeries) to integrate social and healthcare services (OECD, 2014) was the result of a national laboratory project with local authorities. The scope of these new structures was to put together all the resources to treat citizens not only as patients, but to consider their health as depending on mental, physical and social status. Integrating public services in local territories with a personalized approach can indeed increase the wellbeing of people because it fosters their sense of belonging to a community and they do not feel abandoned. Actions taken in these primary healthcare centers include: a) the creation of self-help groups; b) the development of therapeutic alliances among professionals, patients and families; and c) continuous communication and mutual exchange between professionals on the improvement of the management of pathologies (Botturi et al., 2015). Other experiences with the same aim that can be attributed to shared decision making are health education groups (e.g. in the field of cancer prevention and treatment) that offer behavioral counseling, therapeutic education, and mutual exchange among patients (Botturi et al., 2015). Social capital proved also to be useful when institutionalizing organizational learning mechanisms toward sustainable healthcare: heterogeneous networks, which can be created externally and internally to a hospital, to stimulate sustainability knowledge sharing, development and exploitation for concrete projects (Albers Mohrman et al., 2013). Social innovation networks are important because they provide knowledge that can be used to make social systems adaptable (McElroy et al., 2006). This is particularly the case for healthcare networks if the goal is to shift the provision of healthcare services toward sustainability. By way of example, Lifvergren et al. (2008) showed that the involvement of professionals at various levels, as well as the commitment of employees and feedback from patients, triggered a learning process on care paths and contributed to the achievement of sustainability goals.

4.4 ICT and advanced technologies

ICT and other advanced technologies are said to reduce indirect costs of treatments and to improve the quality of care by putting hospitals in close and continuous contact with patients (Lettieri et al., 2012); two major examples in this field are telemedicine, which enables the management of distances in patient care, and biomedical technologies, such as robotics for the rehabilitation of patients. However, technologies of this kind need strong enabling factors, such as infrastructure, the support of national health policies and training of the local health operators who have to deal with these new knowledge platforms (Shiferaw and Zolfo, 2012), as well as leadership and organizational support in the implementation of new programs (Whitten et al., 2010). Although technologies can be capital intensive in some cases, they can help increase standardization of work and decrease lengths of stay, as well as increase the possibilities of patients returning sooner to their normal life (Lettieri et al., 2012).

Integrated ICT can provide information and knowledge for SD (Mirghani et al., 2009). In the medical setting, integrated ICT can also: a) allow the exchange among healthcare institutions of patients' medical data to improve the quality of care, b) increase patients' awareness of their own diseases and involve them in a shared decision-making process, and c) orient patients to the best care services they need (Eysenbach, 2001). Moreover, such tools can serve to improve patients' and physicians' capability to manage diseases through real-time monitoring systems (Ball and Lillis, 2001). However, their potential is challenged by infrastructure costs, cultural interpretation of

technology (Séror, 2001), the limited interoperability of such systems that can prevent physicians from exchanging data with other hospitals' facilities (e.g. laboratories) and threats to privacy represented by the fact that clinical data are exchanged over the internet (Anderson, 2007). In addition, the implementation of technological innovations requires communication among healthcare professionals for medical data collection, the development of competences to manage the adoption of innovations, the ability to give timely responses to the personalized requests of patients (Tamburis, 2006) and acceptability from health professionals and patients based on the satisfaction that justifies their use (Moruzzi, 2016). Without any doubt, proper training and security systems that prevent patients and professionals from accessing uncredited information should be adopted (Ball and Lillis, 2001). Finally, the integration of global and local healthcare information systems in order to exchange clinical data requires a change in information architectures. For these reasons, the process of innovation of architecture should be oriented to eliminate niche software and non-communicating networks (Moruzzi, 2016).

To conclude, Séror (2001) described the role of ICT as follows: on the one hand, personalized information for consumers could be made available from certified professionals' websites, on the other hand, the active participation of consumers will lead to major networking between patients and patients, patients and professionals, and among researchers to exchange data to foster interdisciplinary collaboration and improve clinical decision making. The control and checking of the accuracy of information could be guaranteed by standards and ethical protocols of behavior that could autonomously emerge on the internet, technology itself can preserve the integrity of data and regulate access, and institutions' intranet systems could allow access to data while diffusing hierarchical control mechanisms (Séror, 2001). Technologies are said not only to enhance centralized professional healthcare services while guarantying equitable access to information and care, but also to create decentralized consumer-driven networks that exchange medical information certified by independent evaluators (Séror, 2001).

4.5 Framework of Sustainable IC for HCOs

Based on key variables affecting the implementation of sustainability projects that emerged from a review of the literature, the authors designed a framework of Sustainable IC for HCOs in which sustainability is social, environmental and financial. The framework is illustrated in Figure 1.

<Please insert Figure 1>

Although it has been recognized that the adoption of innovation by agile healthcare structures is fundamental to HCOs' sustainability strategy planning and implementation (Worley, 2012), empirical studies on the relevance of IC in the adoption of sustainable strategies are scarce and do not address the value of IC as a whole.

5. Material and methods

The literature review revealed that IC (human, structural and relational capital) can help the implementation of sustainability projects in HCOs. For this reason the paper aimed at investigating strategy planning for sustainability within the Italian PHS and to examine the incidence of IC in the adoption of sustainability projects. Another objective was to determine whether HCOs that adopted

formalized sustainability strategies were also the ones that attributed higher value to IC assets in the adoption of sustainability practices.

Following literature prescriptions (Floyd and Fowler, 2009), a questionnaire was prepared, pre-tested through a focus group with academics specialized in surveys for the healthcare sector and through three pre-colloquiums with General Directors (GDs) of HCOs. The questionnaire was physically posted to a sample of 204 local health authorities and hospitals. The sample was almost equivalent to the total population of hospitals with juridical autonomy (legislative decree d.lgs. number 502 of 1992). The sample did not include: a) the 21 public research institutes ("*Istituti di ricerca a carattere scientifico*") as they have clinical research peculiarities that distinguish their internal organization from hospitals, and b) hospitals which do not have juridical autonomy as they are part of Local Health Authorities. The GD was chosen as the recipient of the survey because he or she would be responsible for strategic thinking, planning and momentum (Swayne et al., 2008). Indeed, GDs s are appointed by the Region, and hold management responsibilities of HCOs. They often have a medical background, and they are called to pursue health care goals contained in the regional health plan by rational management of budget which is made available through public health system funding. E-mails and phone calls were periodically made to solicit the answer of GDs and increase the response rate. Questions posed to GDs mainly concerned:

- whether the organization had or had not adopted a sustainability plan;
- whether the organization had an internal position that managed the hospital's sustainability;
- whether the organization had put in place initiatives to increase the hospital's sustainability;
- finding out the IC factors that conditioned the adoption of sustainability projects.

Data collected from the questionnaires were analyzed using a quantitative approach that enabled a stochastic ordering test to detect if HCOs with formally adopted SD strategies were also the ones that attributed to IC bigger contributions in promoting sustainability practices. The methodology is discussed in detail as follows.

The first stage of the analysis involved the collection of data related to strategy planning and the organizational structure adopted by the hospital to manage sustainability issues. The GDs were asked which organizational position with specific SD competences within the hospital was responsible for sustainability planning and implementation, and they were asked to indicate the degree of formalization and implementation of a SD strategy in his/her organization choosing one of the following options: "not present", "waiting for approval or implementation" and "implemented". Each GD was then given a list of major key projects or actions that was based on an analysis of the literature on sustainable healthcare (Schroeder et al., 2012; Gerwig, 2014; Pelikan et al., 2001) and included: sustainable use of resources, sustainable canteen service, sustainable mobility, waste management, comfort and eco-compatibility of buildings, green public procurement, equal opportunity, projects to increase employment at the local level, health and security for hospital's population, programs to promote sustainable lifestyles, prevention of drug use, personalized and eco-friendly care path, and economic and financial sustainability. They were asked to indicate from the list the major key projects or actions that were implemented in their organization, which they considered to increase their hospital's sustainability; space was provided next to the list in the questionnaire in which the GDs could add more detail to describe the

initiatives undertaken. Finally, the GDs were asked to rate the contribution that each component of the "Sustainable Intellectual Capital for Healthcare Organizations" model, which was developed and discussed in section 4.5, had in favoring the implementation of their indicated sustainability projects using a 5-point Likert scale. The consistency of the rated answers was analyzed using Cronbach' alpha through IBM SPSS statistical software.

The second stage of analysis concerned the use of the information on strategy implementation and on IC to conduct a stochastic ordering test. Statistical units were divided in three main groups: Group 1 (G1) included all the organizations that did not adopt sustainability plans, Group 2 (G2) included all the organizations waiting for approval or implementation of a sustainability plan, while Group 3 (G3) represented all the organizations that had already implemented a sustainability plan. Finally, a stochastic ordering test was conducted using NPC Test R10 software to evaluate whether there was a stochastic order presence among groups looking at the value of relevance GDs attributed to an IC component in adopting sustainability projects; for this latter, the relation tested was G3>G2>G1 looking at the effect of each IC component individually and IC globally. The reasons for adopting a non-parametric approach as well as the presentation of the stochastic order test are explained in detail in the next subsection to aid the readability of the paper.

5.1 Stochastic ordering test

In order to choose the method for data analysis, the normality of distributions of variables that comprise the IC model was first analyzed using the Kolmogorov–Smirnov test, which is suitable for a small sample size. The test indicated significant deviation from normality ($p < 0.05$ significance level) for all the variables in the model. In this case, the literature suggests using a non-parametric approach for data analysis (Pesarin and Salmaso, 2010). The Non-parametric combination (NPC) methodology presents some advantages such as: a) the possibility to make an exact inference for a small sample, b) the inference can be made when missing values are present, and c) the precision of the test increases when information outcomes increase (Arboretti et al., 2015; Pesarin and Salmaso, 2010). According to the non-parametric solution, the testing of differences among the defined groups can be conducted using the stochastic ordering approach. The NPC test is conducted in two phases (Bonnini et al., 2014; Arboretti et al., 2015): first, the NPC methodology works through a decomposition of the verification problem of multivariate hypothesis that represents the number of outcomes to be analyzed for groups. Each partial test is designed to determine the marginal contribution of each response variable in the comparison between the different groups. The second stage consists of the combination of non-parametric partial tests in a single combined test, which serves to evaluate if differences occur globally between the multivariate distributions of the outcomes of the groups (Bonnini et al., 2014; Arboretti et al., 2015).

In this study, the response variables are represented by the single elements composing the IC model shown in Figure 1. I hypothesized (as the alternative hypothesis H1) a stochastic order presence of the kind G3>G2>G1 among the defined groups for each of the response variables. The stochastic ordering test was conducted using the statistical software NPC Test R10. Fisher's combining function was used for partial tests (Pesarin and Salmaso, 2010), and 10,000 permutations on vectors of response variables of each statistical unit (each HCO) were performed using Monte Carlo conditional simulation. The NPC test methodology requires execution of the stochastic ordering test

for each response variable, and comparison of the obtained *p*-value with the significance level (0.05). If the *p*-value is lower than the significance level the null hypothesis should be rejected in favor of the alternative hypothesis for each sub-hypothesis. Finally, to combine the conducted partial tests in one unique global test, Tippett's function was used (Pesarin and Salmaso, 2010). As a rule of thumb, the global alternative hypothesis should be accepted when the *p*-value of the test is lower than 0.05. The literature suggests looking at adjusted *p*-values to sustain the family-wise error rate, the so-called probability to erroneously reject the null hypothesis when it is true.

6. Results

The number of GDs answering the questionnaires was 31, which was a response rate of 15%; of these, 16 GDs responded to the first round of postal delivery, while 15 responded to the second cycle of recall and mailing. Of the 31 completed questionnaires, 14 declared they had adopted a SD plan, 7 were waiting for approval/implementation and 10 GDs affirmed they had not have yet adopted a sustainability plan. However, all the respondents stated they had adopted projects or actions to increase their hospital's sustainability. This result revealed that in the analyzed setting, strategy planning for sustainability was not formalized; the most followed managerial approach seemed to have consisted of adopting fragmentary projects/actions that were thought to be beneficial to sustainability. The typology of implemented initiatives is shown in Figure 2 and mainly included the use of renewables or low-impact energy and heating sources, green public procurement, projects to decrease accidents in the workplace, promotion of sustainable lifestyles campaigns, waste management, cost containment on non-core activities while focusing on the provision of quality services.

<Please insert Figure 2>

Respondents were also asked to indicate who is responsible inside the organization for the implementation of SD projects (please see Figure 3). There were 28 responses out of 31, of which 7 respondents included two options. Twelve GDs affirmed that sustainability planning was a prerogative of informal and/or occasional structures dealing with specific sustainability problems, whereas ten respondents underlined the relevance of a collegial body with interdisciplinary competences traditionally involving the GD, health directors and offices. For 13 respondents, the managerial approach followed to deal with sustainability included the use of dedicated offices (8 respondents) such as quality, prevention and strategic control, and dedicated positions (5 respondents) such as energy and mobility managers operating within the hospital. In this latter case, SD is perceived as under a single office's or person's responsibility, probably due to the fact that some sustainability projects require relevant technical competences. Appointing single individuals within the organization might represent a risk for the creation of an organizational culture that stably commit to SD (Ling et al., 2012); moreover, coherently with Evans et al. (2015), IC does not show its full potential for sustainability planning as connections among different disciplines and specializations within HCOs are not exploited for knowledge transfers (Evans et al., 2015). On the contrary, when the interdisciplinary approach is used to create team and collegial bodies it allows to overcome the disciplines' divide, and consequently, IC management is effective.

The GDs who selected two options indicated the need for a collegial body supported by a budgeting and strategic control office, or coordination between technical offices and specific positions with

sustainability competences. This means that sustainability requires consideration of environmental, social, and cost aspects.

<Please insert Figure 3>

In general, the findings are coherent with Ling et al. (2012) who stated that PHS leaders have different preferences for organizational approaches to deal with SD. It is therefore currently impossible to identify an optimal organizational structure to deal with SD topics. Finally, for organizations whose GDs argued to rely on informal and occasional bodies for sustainability decision-making, it can be presumed that SD in these HCOs is managed through piecemeal projects rather than through continuity and long term commitment.

6.1 IC and sustainability

Cronbach's alpha was equal to 78.6 % and, according to the literature (Hair et al., 2013), was considered acceptable for further data analysis. Cronbach's alpha would have increased to 79.6% if the item "Competences and training" was excluded; however, because the literature indicates that competences and training are relevant to sustainability planning in HCOs, I decided to retain the variable in the model. The descriptive statistics for the variables of the IC model are shown in Table 1.

<Please insert Table 1>

Table 1 shows that the scores of all the variables in the model were above the mean (m=2.5) of the 5-point Likert scale: they were all considered important for the success of sustainability initiatives. The variable "competences and training" was given the lowest rating indicating that it was perceived to contribute less to sustainability initiatives (2.67±1.295); "research of efficiency" was given the highest rating indicating that it was perceived to contribute more to sustainability initiatives (3.79±0.902). With reference to competences and training, although the literature urged the development of special education programs that connect healthcare professionals with sustainability (Rich et al., 2013; Ramirez et al., 2013; Rogers et al., 2009; Sarriot et al., 2004, Frumkin et al., 2008; Schroeder et al., 2012), this study shows that competences and training were not considered relevant in implementing new projects for sustainability. With reference to research of efficiency, given the strong financial pressure exercised on hospitals, the rationalization of resources through efficiency and a lean approach can help hospitals be sustainable in the provision of quality services (Schroeder et al., 2012).

In the presence of normal distributions of variables the values of skewness and kurtosis are equal to zero; the bigger the departure from zero, the less the data are normally distributed. Table 1 shows that all the variables have values of skewness that depart from zero, except for "clinical possibilities" and "stakeholders' support". While for kurtosis, only the variable "dedicated time" has a value near to zero. The variable "culture" was bimodal; thus, normality of the distribution for the variable was excluded. To test the results, the Kolmogorov–Smirnov test was conducted and for all the variables in the model the test indicated significant deviation from normality (the significance level of all the items considered in the IC model were each less than 0.5). For these reasons the authors opted for a non-parametric approach because it would be more suitable for non-

normal distributions of variables and for small samples. The results of the stochastic ordering test are presented in Table 2.

<Please insert table 2>

Table 2 shows a stochastic order presence by analyzing the combined test *p*-value (equal to 0.016). However, the stochastic order presence is attributable only to the response variable "ICT and advanced technologies" (*p*-value equal to 0.006) whose test is significant at a 0.01 level. This means that the higher values of relevance of ICT and advanced technologies for the implementation of SD projects were attributed by GDs belonging to G3, that is, the GDs who had adopted sustainability strategies. Results are confirmed when looking at the adjusted *p*-values for the partial test on ICT (*p*-value equal to 0.0127) and global test (*p*-value equal to 0.0284).

7. Conclusions

The aim of the present paper was to investigate strategic planning and implementation of sustainability in the Italian PHS and, in particular, to analyze the role of IC in sustainability development. The results showed that the majority of GDs had adopted or were planning to adopt a formalized strategy for sustainability. In addition, except for three organizations that did not set dedicated internal positions for SD, the managerial approaches to deal with sustainability were various and mainly pertained to the use of informal and occasional structures or collegial bodies that can mix their competences in favor of sustainability decision making. In the case of HCOs' whose sustainability decision-making is demanded to informal and occasional structures' use, it seems that sustainable development have been confined to fragmentary projects rather than being a part of a long-term organization's strategy. Although organizational positions are needed to achieve the commitment of professionals to SD (Schroeder et al., 2012), the results showed that several approaches are used for sustainability management (Ling et al., 2012). Some of the GDs also demanded sustainability problem solving to dedicated offices and positions. Appointing single individuals within the organization to deal with sustainability might represent a risk, as sustainability can become a problem of the individual; as a consequence, this approach hinders interactions and participation that represent valuable ways to nurture members' knowledge and stable commitment to SD (Ling et al., 2012). Therefore, the divide among specializations or disciplines (Evans et al., 2015) do not allow HCOs adopting this approach to fully exploit the potential of intellectual capital for sustainability planning. Projects undertaken in the field of SD mainly addressed the sustainable use of natural resources, green public procurement, waste management, health and security projects within hospitals, promotion of sustainable lifestyles and prevention on the use of drugs, and actions to improve financial sustainability.

The results of our investigation of the role of IC in the implementation of sustainable projects showed that all the assets of the proposed Sustainable Intellectual Capital for HCOs framework were said on average to have contributed to the implementation of sustainability projects. Among IC assets, "competences and training" were perceived by GDs to make the least contribution to sustainability, whereas "research of efficiency" was perceived by GDs to make the most contribution to sustainability, probably due to the fact that the rationalization of resources in healthcare systems have driven HCOs to efficiency in order to guarantee sustainability in the provision of quality care services. Leaner approaches can indeed help hospitals to maintain their

sustainability (Schroeder et al., 2012). Furthermore, a stochastic ordering test showed that GDs who attributed higher values of relevance to ICT in the implementation of sustainability projects were also the ones implementing sustainability strategies. This finding is not surprising considering the interpretation of sustainability emerging from the Italian PHS, where technologies and, in particular, informatics, have been claimed to promote a shift toward sustainability, not only for administrative services but also to improve clinical paths. In fact, technologies and ICT applications in particular, are considered enablers to sustainability in the healthcare sector (Ball and Lillis, 2001; Eysenbach, 2001). Technologies and ICT applications can be used in several ways: to assess appropriateness of care services and drug treatments; to improve physicians' decision making by the storage of a patient's entire clinical history; and to increase patients' ability to manage their own diseases with the direct and continuous supervision of healthcare professionals. Despite the above-mentioned benefits, concerns such as the security of patients' data, the limited interoperability of informatics systems and the higher costs of informatics platforms threaten their application in the healthcare context (Séror, 2001; Anderson, 2007).

Limitations of the present study concerns the limited number of respondents for the analysis of survey results. Moreover, the contribution of connectivity between different types of intellectual capital (human, structural and relational capital) to HCOs' sustainability planning and implementation has not been analyzed, and constitute a possible issue to unlock through further research (Habersam and Piber, 2003). Future research may also discuss how the principle of sustainable development has been interpreted and operationalized in different countries and contexts, as well as IC conceptualization that can vary across HCOs as they can be characterized by different mandates, histories and cultures (Evans et al., 2015). This will help policy makers to have a more complete view on healthcare sustainable development when setting new policies for the healthcare service considering the role that IC plays for value creation and organizational performance (Lerro, et al. 2014; Vagnoni and Oppi, 2015).

In addition, further case studies could explore the benefits and limitations linked to the implementation of technologies and ICT applications in SD, and more in general, the role played by different IC assets in the adoption of sustainability strategies, as recommended by literature that calls to critically discuss IC practices within organizations (Dumay and Garanina, 2013; Guthrie and Dumay, 2015). The study has practical implications: first, the developed model of Sustainable IC for HCOs can help healthcare managers to focus on the assets that are needed to make their organizations more sustainable. The testing of the model in different organizations can help managers to focus on IC components that are weak and need reinforcement in order to contribute to sustainability. The developed model is not exhaustive and can be modified or extended to other IC components that can emerge from the organization's conceptualization of IC; as a matter of example, further research can look to personal experiences and attitudes of healthcare employees impacting to SD as part of the human capital of HCOs. The originality of the present work lies in the fact that it represents the first attempt to investigate the strategic management of sustainability in the Italian healthcare context, and to deepen the role of IC assets in promoting HCOs' sustainable development. The authors hope this study encourages debate on sustainability in the public sector as it currently represents an under-investigated topic.

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Figures

Fig. 1: Sustainable Intellectual Capital for Healthcare Organizations

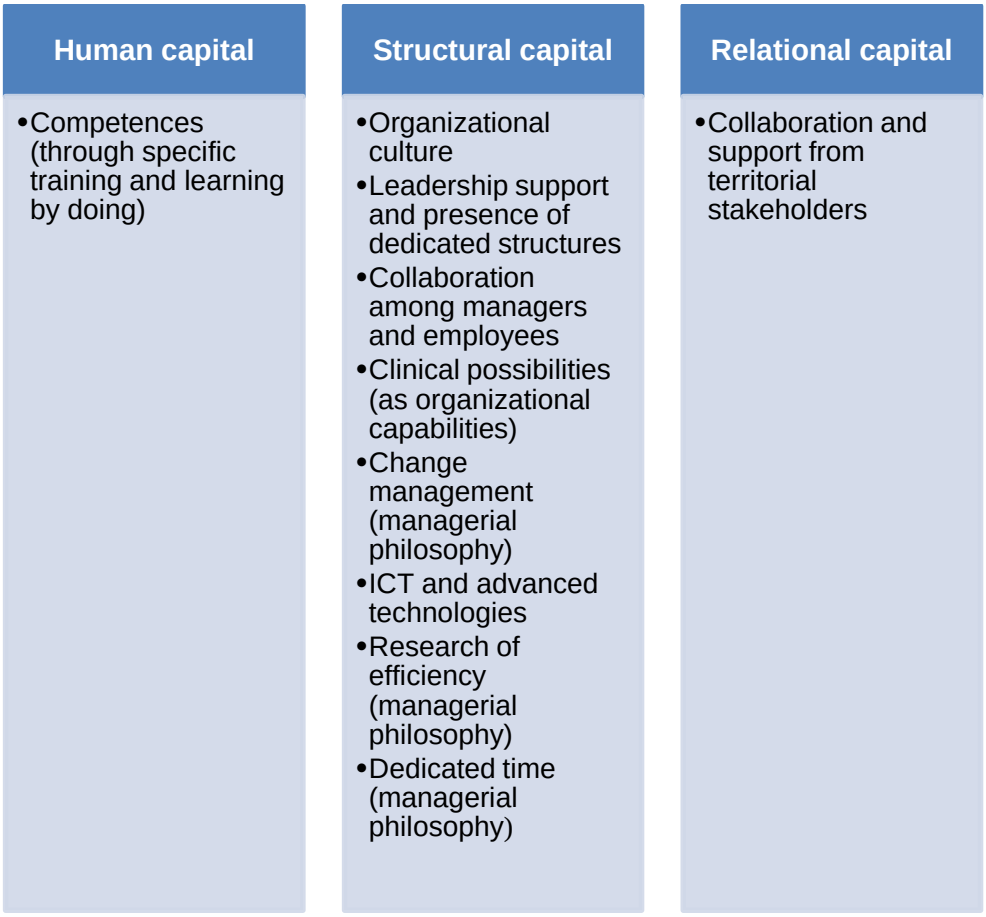


Fig. 2: Sustainability initiatives implemented by healthcare organizations

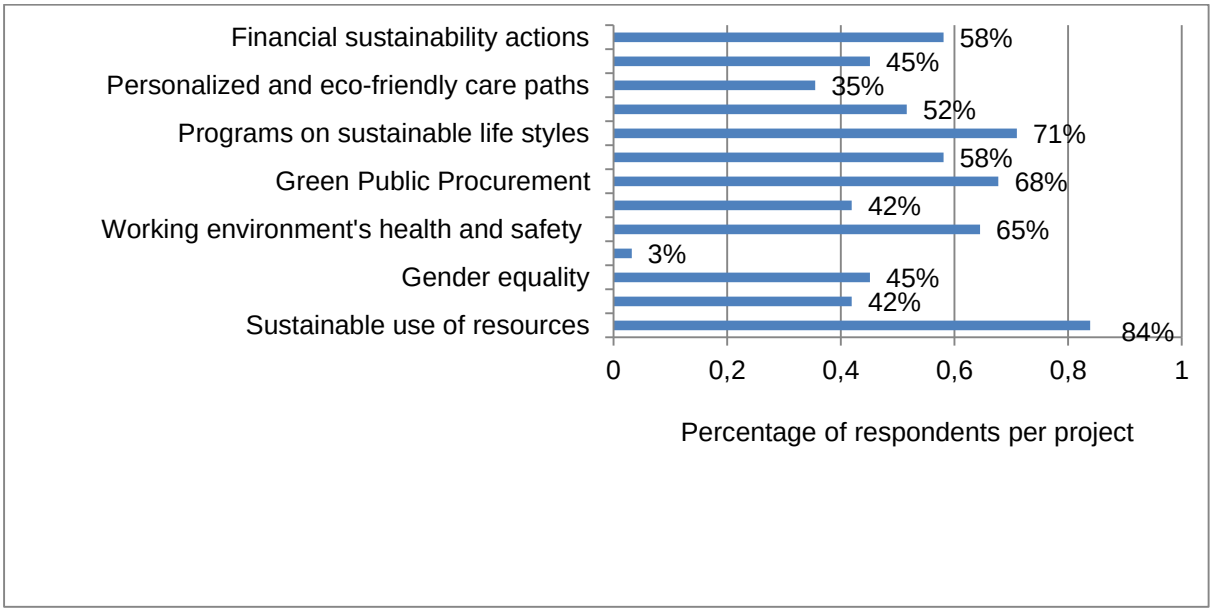
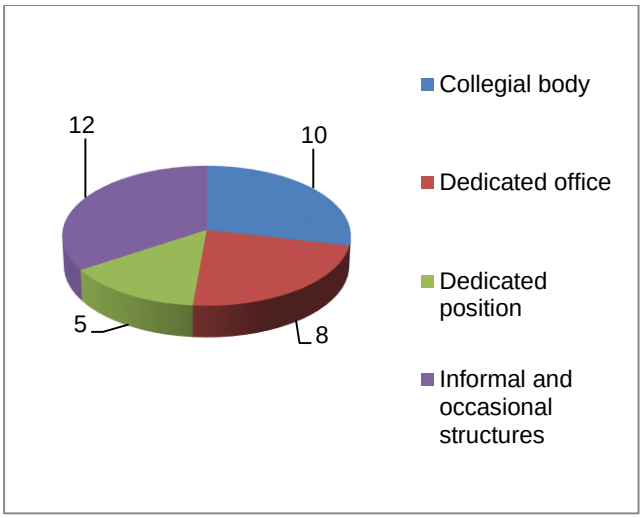


Fig. 3: Organizational positions dealing with sustainable development



Tables

Table 1: Descriptive statistics of variables composing the IC model

	Organizational culture	Research of efficiency	Clinical possibilities	Collaboration between managers and employees	Competences and training	Dedicated time	Change management	ICT and advanced technologies	Leadership support and presence of dedicated structures	Collaboration and support from territorial stakeholders
Mean	3.47	3.79	2.97	3.52	2.67	2.90	3.30	3.35	3.34	3.10
Median	3.50	4.00	3.00	4.00	3.00	3.00	3.50	3.00	3.00	3.00
Mode	3[a]	4	3	4	3	3	4	3	3	4
Std. deviation	.973	.902	1.033	1.151	1.295	1.076	.988	.877	1.010	1.155
Skewness	–.381	–.189	.070	–.603	.268	.547	–.432	–.473	–.549	–.063
Std. error of skewness	.427	.434	.427	.421	.427	.421	.427	.421	.434	.427
Kurtosis	.182	–.730	–.396	–.273	–.924	.096	–.441	.645	.546	–1.009
Std. error of kurtosis	.833	.845	.833	.821	.833	.821	.833	.821	.845	.833

a. Multiple modes exist. The smallest value is shown.

Table 2: Stochastic ordering test – variables' level of significance

Variables	*P* value	Adjusted *P* value
Culture	0.4629	0.4629
Research of efficiency	0.1950	0.1950
Competences and training	0.4629	0.4629
Change management	0.4629	0.4629
Leadership support and dedicated structures	0.4114	0.4114
Clinical possibilities	0.4629	0.4629
Stakeholders collaboration	0.4471	0.4471
Employees commitment and collaboration with managers	0.0639	0.1135
ICT and advanced technologies	0.0043**	0.0127*
Dedicated time	0.1809	0.1809
Combined test	0.0127*	0.0284*

$* p < 0.05, ** p < 0.01$