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Reasoned transparency in AI systems as enabling factor of value co-creation

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Abstract (max 250 words)

This conceptual paper aims to understand if the reasoned transparency in artificial intelligence (AI) systems can be considered a value co-creation enabler for patients suffering from neurodegenerative diseases.

Starting from a literature review, the 'theory synthesis' has been used to draw up suggestions about AI impact on value co-creation in this field.

AI systems are increasingly widespread to treat neurodegenerative diseases and reasoned transparency can allow value co-creation. However, value co-creation phenomena in healthcare depend on patients' empowerment; in this case, the patients may be less active, so families or caregivers would be value co-creation agents. The service ecosystems (SES) perspective helps to understand how to engage them in value co-creation by improving their technology acceptance.

Managers and scholars have to propose AI systems easy to use, ethical from the value co-creation agents' perspective, and sustainable, as compatible with social values and able to promote social well-being.

The paper analyzes the role of transparency in value co-creation focusing on agents' AI acceptance degree.

Keywords (max six words)
reasoned transparency; AI systems; value co-creation; service ecosystems; neurodegenerative diseases; social well-being

1. Introduction and motivation

There is an increasing debate today about the need for intelligent healthcare, characterized by various components, including artificial intelligence (AI) systems (Alshehri and Muhammad, 2020). AI in health would allow the management of a large amount of useful data to allow health professionals to diagnose more and more accurate and timely.

AI would enable the design of a health data infrastructure capable of securely aggregating, storing, processing and transmitting health data and this could be even more interesting when considering the impact of such systems concerning the treatment of neurodegenerative diseases, characterized by the high complexity of the molecular mechanisms underlying neuronal degeneration and the heterogeneity of the patient population (Myszczynska et al., 2020) for which there is a huge and continuous need for early diagnostic tools and effective treatments.

However, Panch et al. (2019) question whether the responsibilities related to the management of this infrastructure can fall on individual health organizations, and health systems or whether it should be understood as a public good.

Not only that, some gaps and clear research directions with respect to technology design and acceptance, data security and privacy regulations, and systems and security effectiveness have been identified (Shah and Chircu, 2018).

AI systems in healthcare could generate service innovation (Polese et al., 2021a), it is necessary to evaluate how much this is possible in the context of these diseases in which the patient could be less and less active and increasingly difficult to manage his/her empowerment.

The impact of AI systems on the treatment of neurodegenerative diseases, in terms of service innovation according to the service ecosystem (SES) perspective, appears to be scarcely debated in the literature, so the motivation for this contribution lies in the need to contribute to the literature on this topic.

This conceptual paper attempts to answer the following research question (RQ):

R.Q.: is it possible to consider AI systems as enabling factors for value co-creation for patients suffering from neurodegenerative diseases?

With the aim of giving back drivers and suggestions to researchers and professionals in order to correctly understand how to properly approach the design and adoption of AI systems in healthcare, for the treatment of neurodegenerative diseases, following the proposed "theoretical synthesis" approach from Jaakkola (2020), the paper starts with the description of the theoretical background (par.2), based on service innovation (Vargo et al., 2015; Lusch and Nambisan, 2015) (par.2.1), that has to be understood by using the SES perspective (Koskela-Huotari et al., 2016; Kaartemo et al., 2018) to deepen its impact on value co-creation (Akaka et al., 2017; Helkkula et al., 2018), and on sustainability concept (par.2.2) (Wilkinson et al., 2001; Elkington, 2006) to understand if AI systems in healthcare, for the treatment of neurodegenerative diseases, can foster an improvement in the social well-being (van Wynsberghe, 2021).

The third paragraph presents the opportunities related to the introduction of AI systems in healthcare, in particular for the treatment of neurodegenerative diseases, focusing attention on the doubts on transparency and on how this can be sought in this context, and on the need for ever more collaborative and trusting doctor-patient relationships.

In the end, reflections concerning the potential for value co-creation, for these pathologies, and social well-being enabled by AI systems based on reasoned transparency (par.4) and non-conclusive considerations (par.5) are described.

2. Theoretical background

2.1 Value-driven service innovation in a SES perspective

Service innovation has its roots in the perspective of synthesis proposed by Coombs and Miles (2000) to analyze service innovation, as opposed to the perspective of assimilation and that of distinction, refers to an integrated perspective, which can refer to both technological innovation and non-technological innovation and involves a fruitful combination of technological elements, social relations, organizational adjustments and commercial interactions.

According to Service-Dominant Logic, service innovation must be analyzed assuming a networked approach to innovation (Vargo et al., 2015), and is achieved through a process of recombination of resources, the main activity that drives the emergence of innovation (Colurcio et al., 2017), which leads to a modification of existing value propositions (Åkesson et al., 2016) and the creation, renewal and transformation of pre-existing knowledge (Ciasullo, 2018; Ciasullo et al., 2021), as well as the design and redefinition of value propositions (Taivonen and Kijima, 2019), in favor of cooperative practices, not referable to the mere dyadic, supplier-customer dimension (Lusch and Nambisan, 2015), but with impacts on the ability of the actors to co-create value.

In this regard, it becomes relevant, according to the Service-Dominant Logic authors, to adopt the SES perspective to understand its potential. The SES is an autonomous and self-regulating system (Vargo and Lusch, 2016), dynamic, changing, reconfigurable and emerging on the basis of shared intentionality (Polese et al., 2017) that allows collective action and determines different modalities of integration of resources (Polese et al., 2021b), aimed at the value co-creation (Wieland et al., 2012), pursued by the actors involved (Lusch et al., 2016), which are linked together by value propositions (Frow et al., 2014), and placed on distinct dynamic levels (Taillard et al., 2016), the micro, meso and macro levels (Vargo and Lusch, 2016). The actors interact with the aim of pursuing collective well-being (Vargo and Lusch, 2017) on the basis of coordination mechanisms, called institutions, which are emerging social practices, not established and pre-established structures to manage human action, but symbols, meanings and tacit "rules of the game" (Koskela-Huotari and Vargo, 2016), capable of modifying human behavior (Wieland et al., 2016). The set of institutions forms the institutional arrangements which foster the coordination between the different levels of the SES (Vargo et al., 2015).

It is believed that innovation does not occur when a new product or service is proposed within a market, but when its introduction determines new practices for value co-creation and when these new practices become common and shared, and therefore institutionalized (Koskela-Huotari et al., 2016). Central to the understanding of this assumption is the concept of institutionalization, understood as the maintenance, disintegration, and change of institutions (Vargo et al., 2015) and which can lead to new value propositions (Ciasullo et al., 2016) and new SES (Kaartemo et al., 2018).

In order for the new solution to lead to innovation, it is necessary to evaluate the perception of end-users and their willingness to accept it in their ordinary practices. In the case of new technology, the possibility that innovation will be generated through the new technology depends on the perception of users who will have to use it and who will attribute different meanings to it and evaluate its effectiveness based on the resources held (Wieland et al., 2018) and personal, social and contextual perceptions (Edvardsson et al., 2018).

According to this perspective, the service is strongly focused on value (Helkkula et al., 2018), in fact, the collaborative practices that lead to the value co-creation can also lead to innovation since both technologies and markets are shaped by the value co-creation and from the ongoing negotiation and recombination of overlapping and intersecting institutions, whereby it is the institutionalization that allows multiple actors, in dynamic social systems, to develop new technologies and markets (Akaka et al., 2017).

2.2 Sustainable AI to shape social sustainability

Sustainability can be defined as a dynamic and changing process that depends on the changing needs of the context and the actors present in it (Barile et al., 2014) and implies that organizations are required to have a sustainable approach in terms of managing people and environmental issues, characterized by a decentralized decision-making process oriented to the medium and long term rather than short-term horizons and by a reassessment of managerial responsibility (Wilkinson et al., 2001).

Sustainability is often addressed through the Triple-Bottom-Line (TBL) framework, which implies that true sustainability results from the intersection of economic (financial), environmental (ecological) and social aspects. The concept of TBL substantially expresses the fact that companies and other organizations create value by acting on multiple dimensions, with reference to economic, social and environmental value (Elkington, 2006). This allows us to overcome the traditional measures of profits, return on investment and shareholder value in order to include the environmental and social dimensions, and represent the three dimensions of sustainability. Barile et al. (2014) define economic sustainability as the ability to efficiently use the resources available to ensure profitability over time, social sustainability as the ability to ensure conditions of stability, democracy, participation and justice, as well as the possibility of ensuring that the human well-being (safety, health, education) are equally distributed among classes and genders, environmental sustainability as the ability to preserve the quality and reproducibility of natural resources.

The most relevant dimension for the purposes of this paper is social sustainability. Social variables that characterize social sustainability refer to the social dimensions of a community or region and could include measures of education, equity and access to social resources, health and well-being, quality of life and social capital (Slaper and Hall, 2011).

Social sustainability refers to the responsibility of companies towards stakeholders and the social environment in which they operate, with attention to the internal development of the organization, proactively managing the expectations of their social context, and improving their social and human well-being (Ciasullo and Troisi, 2013).

Polese et al. (2018) point out the connection between the SES perspective and sustainability, underlining that the challenges of sustainability can only be addressed through approaches capable of guaranteeing that value is co-created by acting through the integration of resources between actors belonging to different contexts, to which can be argued that a sustainable SES is a dynamic configuration that can be reconfigured and addresses the challenges of sustainability through continuous adaptation (Badr et al., 2021), the interaction of actors, and sharing of resources.

The ecosystem approach to sustainability is based on the adoption of a vision that interprets a context as an ecosystem in which heterogeneous actors, placed on different ecosystem levels (micro, meso and macro), can interact and co-create value, generating multiple outcomes in terms of sustainability (Troisi et al., 2019).

Within this SES, new technologies can enable these interactions and have effects in terms of sustainability, it is believed intact that the use of new technologies can contribute to the

genesis of a condition of well-being, capable of also impacting the social sphere and cultural context: intelligent technology is considered a fundamental lever for the well-being of the community that should be associated with human and managerial skills to favor the emergence of sustainable growth (Ciasullo et al., 2020).

In this regard, van Wynsberghe (2021) proposes the concept of sustainable AI that goes beyond mere applications of AI but investigates its impact on the entire sociotechnical system of AI. Sustainable AI is understood as an AI compatible with the support of environmental resources for current and future generations; economic models for companies; and social values that are fundamental to a given society.

3. AI systems for neurodegenerative diseases: doubts about transparency and need for trust

Service innovation in a SES perspective for neurodegenerative diseases can be based on AI systems. The use of AI systems is increasingly widespread, also in the health sector where it is playing an increasingly important role in the development of eHealth, allowing the development of entirely new health areas.

AI systems in healthcare provide physicians with the opportunity to tailor early interventions to each individual and foster the design of healthcare models based on precision medicine practices, (Subramanian et al., 2020), thanks to the use of broad and complex data sets that allow for greater accuracy in risk prediction and better outcomes in terms of diagnosis, therapy and treatment.

Fascinating is the impact that the use of such systems can have on the treatment of neurodegenerative diseases: computational methods, and machine learning techniques, are tools considered beneficial to help and improve the diagnosis and monitoring process of the disease (Tăuțan et al., 2021). Machine learning is a subfield of artificial intelligence that would allow early diagnosis and interpretation of medical images, as well as the discovery and development of new therapies thanks to the integration of multiple high-dimensional data sources, all of which provide a different vision on disease (Myszczynska et al., 2020).

However, although AI systems allow the recovery and analysis of huge amounts of data that promise to improve health performance, doubts arise concerning the quality of the data collected and analyzed (Tao et al., 2019) and concerns about ethical aspects and regulatory and regulatory enforcement of AI in healthcare, including, the possibility of bias, the lack of transparency of certain AI algorithms, privacy concerns with the data used to train AI models, security and accountability issues (Reddy et al., 2020), data standardization and interoperability across multiple platforms, and patient safety concern (He et al., 2019).

Fears related to automatic decision-making, generated by the black box of AI (de Fine Licht and de Fine Licht, 2020), especially in healthcare where decisions made by machines could save lives, have led to a growing need for explainable AI systems (XAI) (Ahmed and Zubair, 2022; Meske et al., 2022). XAI is a domain in which techniques are developed to explain the predictions made by AI systems and can be understood as a technique that can be used in the analysis and diagnosis of health data by systems based on AI (Pawar et al., 2020).

However, for AI to be considered reliable and for there to be trust in AI systems, it is not enough for all participants to understand how their data is used and how AI makes decisions, and therefore how the algorithms operate (XAI), but it is also necessary to understand how the people who interact with AI systems operate, in order to clearly establish who is responsible for the data and the choices made.

Questions in terms of trust and transparency, regarding the implementation of AI systems, take on an even more relevant meaning concerning clinical practice, in which the decisions made are literally related to matters of life and death (Adadi and Berrada, 2020).

Loiotile et al. (2021) highlight the need to consider, in this context, aspects related to human-machine interaction that can influence the spread of these solutions, noting that, although AI can represent a useful tool for effectively addressing aspects related to diagnosis and monitoring of patients suffering from various neurodegenerative diseases, it is important that these tools are accessible and easy to use for the majority of the population.

Mabillard et al. (2021) address the problem of maintaining trusting and high-quality relationships between doctors and patients, increasingly challenged by the dissemination of information online and by the pressures on the responsibility of healthcare professionals toward patients. They note that transparency may be a factor capable of enabling digital co-creation between actors, but for it to be effective in this sense, it must be reasoned transparency, capable of overcoming pitfalls and doubts relating to AI systems.

The theme of the relationship between doctor and patient is particularly interesting and controversial in the treatment of neurodegenerative diseases since, in general, patient involvement and empowerment can stimulate co-creative events in healthcare (Polese and Carrubbo, 2016) through a doctor / patient co-learning process (McColl-Kennedy et al., 2012), but in the specific case of these pathologies the patient may be less active, and doubts could arise on how much total transparency, also understood in the context of the relationship, is desirable.

New technologies in healthcare can be understood as an enabling factor for value co-creation (Masucci et al., 2021), as they affect how value can be determined and co-created between actors (Akaka and Vargo, 2014). Kaartemo and Helkkula (2018) identify the first series of literature on AI in the value co-creation: AI can contribute to the emergence of co-creation factors because it can support service providers and allow the integration of resources between actors and support the welfare of the beneficiaries. Certainly, AI in healthcare can modify the factors of value co-creation (Beirão et al., 2017), but to understand if, in the case of neurodegenerative diseases it can also improve them, it is necessary to consider other actors SES (e.g., families or caregivers) as value co-creation agents.

4 Reasoned transparency in sustainable AI to enable social well-being and value co-creation in the neurodegenerative diseases SES

The doctor-patient relationship is a hot topic in healthcare, the quality of which is able to influence the therapeutic experience. Therefore, there is a need for increasingly collaborative relationships, no longer based on information asymmetry (Tellis and Wernerfelt, 1987) or the dominance of one actor over the other (Langeard et al., 1981). AI systems based on reasoned transparency can be understood as drivers for a smart healthcare context given that the reasoned transparency can allow a decipherable and intelligible functioning of the black box of AI systems and make them more understandable, usable, and explainable in favor of decision-making processes more based on objective evidence for the protection of patients (Wischmeyer, 2020).

Furthermore, for AI to allow sustainable development, its development must be supported by regulatory knowledge and common principles and approaches that allow to safeguard the ethical perspective of AI (Leimanis and Palkova, 2021), avoiding gaps in terms of transparency, safety and ethical standards (Vinuesa et al., 2020).

In this regard, the World Health Organization (WHO) has published guidelines (2021) to clarify how ethics and rights should be put at the center of the design, distribution and use of

AI systems and the guarantee of transparency, explainability. and intelligibility in AI systems is one of the six principles identified. Given that ethics is strictly connected to custom and social customs and that the ethical company is a company aware of its social role, which acts in compliance with a scale of values widely shared within its community of reference, we note how ethics and rights protection can be understood as important levers to guarantee social sustainability and, for this reason, reasoned transparency in AI systems can also be understood as a driver of social well-being.

The reasoned transparency would stimulate collaboration between actors as it would allow doctors to communicate with patients about the use of digital tools and devices, and reassure them about the confidentiality of data, in order to also increase patients' awareness of the treatment (Mabillard et al., 2021). The greater awareness of patients, which stimulates patient empowerment, should improve the potential for value co-creation in the health sector (Polese and Carrubbo, 2016), however, in the case of neurodegenerative diseases, the question arises as to how much this awareness can be profitable or not.

Neurodegenerative diseases are characterized by progressive decline and loss of function by the patient. This determines the need for considerable assistance from caregivers for which, moreover, there is a low quality of life (Aoun et al., 2010) and the need for psychosocial interventions (Marziale and Donahue, 2006), with the risk that critical aspects such as their capacity, agency and autonomy, which characterize their responsibility, can lead to effects in terms of value co-destruction (Skarli, 2021). For this reason, conditions should be sought that can simplify their task and ensure that they are better prepared for value co-creation.

The ecosystem perspective, which goes beyond the dyadic perspective, allows us to investigate the drivers to be activated to stimulate positive interactions between all actors involved in a collaborative and sustainable orientation (Polese et al., 2018).

The health system can be understood as a service ecosystem in which the patient is the centre of a network of relationships (Lapão, 2019) between interconnected actors through value propositions that exchange resources of different types that contribute to the service ecosystem well-being.

The actors are placed on different ecosystem levels, according to Sebastiani and Anzivino (2021) at the micro level, there are individual actors, including health workers, patients and caregivers; at the meso level, there are intra-organizational actors, including hospitals, clinics, technology providers, patient communities; at the macro level, there are government actors, including government agencies, WHO, Ministry of Health. In this multi-actor organization, which combines health care and social needs, to evaluate the potential for value co-creation, it is necessary to consider the interactions between the different actors that can be guided by the diffusion of new digital technologies. These new technologies favor the integration of resources and support collaboration. The condition of caregivers and relatives can be improved by using new technological devices: for example, they can improve them to access information or allow them to monitor the status or activities of a loved one while they are at work or in a distant place (Czaja, 2016). AI systems could make them increasingly aware of daily practices, improving their perception of self-efficacy with positive effects on their caregiving experience (Semiatin and O'Connor, 2012) and quality of life.

Thus, just as patient empowerment can contribute to the value co-creation, also their empowerment can play an important role in the value co-creation (Palumbo et al., 2017) as long as they are adequately informed about the disease and placed in the conditions of using technological devices, also thanks to the support of doctors, nurses and health professionals who refer them (Sebastiani and Anzivino, 2021), which is why such devices should be increasingly usable and understandable for everyone.

Reasoned transparency, which can make systems increasingly understandable and easy to use, can support actors in overcoming the problems related to the functioning of AI tools and can improve their technology acceptance.

These considerations make it possible to answer the research question affirmatively: it is possible to consider AI as an enabling factor for value co-creation even in the case of neurodegenerative diseases, as long as the AI systems are characterized by reasoned transparency that would make them more understandable and ethical and it would improve the predisposition for use and acceptance also by caregivers, who in this case are intended as main value co-creation agents.

5 Non-conclusive considerations, research limitations and implications

This conceptual work aimed to understand if AI systems could enable value co-creation phenomena in the case of neurodegenerative diseases. Although some advantages have been recognized in the use of AI systems for the diagnosis, monitoring and treatment of this pathology, problems arise in terms of transparency and trust; in particular, doubts about how transparency could always be desirable in this case and could foster relationships of trust between doctor and patient arose. The patient suffering from this type of pathology is an increasingly less active patient so, although patient empowerment is always useful, in this case, caregivers should be considered as value co-creation agents. However, some critical issues were found although beneficial impacts related to the use of AI in their daily care practices: the low quality of life and frustration feelings could discourage them from having a proactive attitude. Reasoned transparency has been considered a driver to entice them to use these systems and favor their empowerment.

The main implication of this work concerns the need, for scholars and practitioners, to approach the study of a service innovation based on AI systems in the diagnosis, treatment and monitoring of neurodegenerative diseases by adopting an ecosystem perspective that allows them to grasp and highlight different perspectives and different possibilities in terms of resources integration.

The main limitation concerns the need for empirical research to confirm the effectiveness of these insights.

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