

Title: Lean management in health care: a review of reviews of socio-technical components for effective impact

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Abstract

Purpose: The aims of the implementation of lean management in health care are to improve quality of care, to eliminate waste and to increase efficiency. The purpose of this study is to contribute to the advancement of knowledge by investigating which main socio-technical factors are considered to be effective for the implementation and management of lean initiatives.

Research design: A systematic review of literature reviews on lean management in health care was conducted. The components of the socio-technical system are identified by moving from the socio-technical drivers that support organization-wide quality improvement practices and the lean implementation process in health care. The impacts of lean management are classified using the internal processes, patient, learning and financial dimensions.

Findings: The 28 reviews retrieved confirm the current and increasing interest in lean management. While more than 60% of them call for a system-wide approach, system-wide implementations have rarely been observed, and, instead, adoption in isolated units or departments, or the use of single techniques and tools, prevails. The most commonly investigated socio-technical components are organizational structure, techniques and tools, and organizational culture and strategic management. Significant impacts are reported for all the four dimensions. Nonetheless, the review reveals that there is still a lack of evidence on the sustainability of lean results and a need for a standardized impact measurement system.

Originality: This work stands out as the first review of reviews of how the socio-technical components of the lean management approach obtain positive impacts within the patient, internal processes, learning and financial dimensions.

Keywords

Review of reviews; Lean management, Health care, Socio-technical system, Evaluation, Sustainability

1. Introduction

The rising costs of care, and budget constraints, are forcing health care providers to adopt innovative approaches and methodologies in an effort to meet efficiency, performance and quality improvement goals (Walshe, 2009). Various approaches (such as Business Process Redesign, Total Quality Management, Continuous Quality Improvement, and Six Sigma) have been adopted with the aim of improving efficiency, quality, clinical outcomes, and the satisfaction and safety of both staff and patients, and reducing medical errors (Walshe, 2009). Among these practices, lean management stands out in terms of diffusion in many hospitals (D'Andreamatteo et al., 2015; Mazzocato et al., 2010; Radnor et al., 2012).

Since its first adoption into health care in the early 1990s (Womack and Jones, 1997), lean has become one of the most frequently reported approaches in the health care management literature (Aij and Teunissen, 2017; Mazzocato et al., 2014).

Lean is a strategy that focuses on meeting customer needs (i.e. the needs of patients, internal staff, and the organization), improving quality by reducing waste (i.e. those activities that are not adding value (Crema and Verbano, 2017; Pegels, 1984; Westwood et al., 2007), optimizing organizational processes and patient flows, and creating value, with the direct involvement of the organization's personnel (Al-Balushi et al., 2014).

The provisioning of health services involves people (e.g. patients, caregivers, staff, suppliers) and items (e.g. supplies, equipment, information) that interact in different processes. Lean aims to improve the flow of the processes, enhancing the throughput of work undertaken in the processes, letting the processes move steadily and predictably, and improving organizational efficiency, the quality of the service and patient satisfaction. Thus, lean aims to identify both physical (e.g. distance) and intangible (e.g. resistance to change) barriers that can negatively affect how the processes flow, and to remove these barriers using specific approaches and tools.

The literature calls for a comprehensive approach to the effective implementation of lean in health care (Andersen, 2015; Brandao de Souza, 2009). Nonetheless, most published lean studies have had a narrow focus on single technical applications or short-term improvements resulting in small pockets of best practice, with limited evidence on what drives effective system-wide lean implementation (Andersen, 2015; Centauri et al., 2018; Radnor et al., 2012). Recent work in the U.S., using a national survey of over 1,000 hospitals, has examined the relationship between lean adoption and implementation and overall organization performance, with mixed results. Most hospitals were still in the relatively early stages of lean implementation (Po et al., 2019; Rundall et al., 2020; Shortell et al., 2018, 2019).

In order to understand the variation in how and when lean works in health care organizations, it is of paramount importance to examine the organizational patterns that play a relevant role in the integration and internalization of the change process within the organization (Andersen, 2015; de Souza and Pidd, 2011; Waring and Bishop, 2010). The purpose of this study is to contribute to the advancement of knowledge by investigating which socio-technical factors are the main factors that are considered effective in the implementation and management of lean initiatives, and the interplay between these variables. In order to achieve this, a systematic review of literature reviews on lean management in health care was conducted.

2. The theoretical framework

It was deemed appropriate to use the socio-technical system (STS) model to analyse the organizational system in which lean is implemented (Davis et al., 2014; Keating et al., 2001; Leavitt, 1964; Trist and Bamforth, 1951). The STS model embraces a system perspective on organizations (Boulding, 1956; Meehan, 1969), and thus allows the organizational factors that influence a change process to be identified. Thus, the STS framework helps to give a system-wide approach to studying how lean efforts are grounded in the organizational context (Holden, 2011; Mazzocato et al., 2014; Poksinska, 2010). Both intra-organizational and external contexts (i.e. purchasers, competition, payment, lean training and support) can shape lean implementation and outcomes (Harrison et al., 2016).

The components of the STS model have been identified from previous frameworks developed to understand the socio-technical drivers that support organization-wide quality improvement practices (O'Brien et al., 1995) and the lean implementation process (Centauri et al., 2018) in health care.

Table 1 summarizes the most relevant social (strategic management, organizational structure and organizational culture), technical (techniques, tools and lay-out) and external factors that constitute the framework adopted for the analysis of the reviews included in this research.

[INSERT TABLE 1]

As far as the impacts of lean initiatives are concerned, the four outcome dimensions proposed by Barnabè et al. (2019, p. 507) are considered: 1) the patient, focusing on lean ensuring “*access to health care services that have the characteristics of valuable provision of services*”; 2) internal processes, aiming to evaluate the contribution of the lean approach to improving “*the quality of the service delivered through enhanced process management thereby reducing defects, variability, and ambiguity, eliminating waste, and optimizing lead time*”; 3) learning and growth, to evaluate the

impact of lean in ensuring “*organizational wellbeing and enhanc[ing] the contribution of health care staff, strengthened through training*”; and 4) financial results, focused on the economic results of lean in “*creating and recovering value for enhancing the patient care experience in the hospital*”.

Figure 1 represents the system-wide STS-impact framework adopted for the analysis of the reviews.

[INSERT FIGURE 1]

3. Research Method

A systematic narrative review of reviews on lean management was conducted (Hart, 1998) following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. PRISMA is a widely used standard for reporting reviews and meta-analyses; it has been used mainly in the medical literature (Diwakar et al., 2017, Seufert et al., 2019) but is also spreading into the managerial literature because of its rigour (Ianniello et al., 2019; Voorberg et al., 2015). It provides a set of checklist items and a four-phase flow diagram (Moher et al., 2009), which helps authors to make the review process more objective and to report their findings clearly (Liberati et al., 2009).

A comprehensive search took place on 7th January 2020 across the two main electronic databases for management studies, Scopus and Web of Science. The search query was “lean management” OR “lean” AND “health*” in the string “topic” (Web of Science) or “article title, abstract and keywords” (Scopus), according to the specific label used by each database. The four-phase flow diagram is represented in Figure 2. One reviewer performed the systematic review, supervised by the co-author. Any confusion was resolved by discussion involving the two authors. The final database contained 28 articles. Each article was systematically analysed and categorized in a standardized format, using a worksheet to report on the system-wide STS-impact framework.

[INSERT FIGURE 2]

4. Results

The results are presented below. First, the main characteristics of the sample are discussed through a descriptive analysis of the database. Secondly, the main socio-technical components and lean impacts investigated in the 28 literature reviews in the analysis are highlighted.

Descriptive analysis

The distribution of the reviews according to their year of publication confirms the current and increasing interest in lean management in health care: more than 61% of the reviews (17) were published in the last four years (2016-2019), with peaks in 2018 and 2019 (Figure 3).

[INSERT FIGURE 3]

The most frequent journal categories were “health care science and services” (Web of Science, eleven journals), “health policy and services” (Web of Science, three journals) and “medicine health policy” (Scopus, nine journals); two of the reviews were in the category “management” (Web of Science), and three in “business, management and accounting” (Scopus). There were also three categories covering “nursing” (two for Scopus and one for Web of Science).

Looking at the journals in which the reviews were published, almost 39% of them were published in three main outlets: *International Journal of Health, Organization and Management* (five reviews), *International Journal for Quality in Health Care* (three reviews) and *International Journal of Health Care Quality Assurance* (three reviews).

As far as the searching database is concerned, the reviews reported on searches in both social science databases (Scopus, Web of Science, Emerald) and medical databases (Pubmed, Medline, Cinahl). Those searched the most often were Pubmed (64%), Scopus (43%), Web of Science (39%), Emerald (32%), and Cinahl and Medline (both 25%).

The most frequent review research approach was the systematic review (75%). Looking at the breadth of reviews, most had a general focus on lean management, considering health care organizations/hospitals overall and with a worldwide geographical spectrum. Only two of the reviews analysed specific clinical units (ophthalmology and acute care).

Looking at the time span of the works retrieved in the reviews, most of them (43%) had no time limits, while 11% of them focused on research published from 2000 onwards, taking this year as the

starting point of academic interest on lean management in health care, 14% considered a specific and restricted period, and 14% looked at the two decades before 2000.

Findings of content analysis

Table 2 summarizes the distribution of the reviews according to the dimensions of the STS-impact framework. Only five reviews in the database focused exclusively on the impacts of lean management, seven investigated the socio-technical components without any analysis of their impacts, and most of the reviews (16) explored both the socio-technical components and their impacts.

[INSERT TABLE 2]

In the following paragraphs, the results for each socio-technical component and its impact are reported. Only selected references are quoted. The full list is provided in the references section.

Socio-technical components

Strategic management has been reported as one of the most relevant dimensions for the successful implementation of lean. Long-term organizational policies and strategic planning are identified as essential requirements for the successful implementation of lean management in a health care setting, while short-term goals could represent a barrier (Al-Balushi et al., 2014; Antierens et al., 2018; Borges et al., 2019; Deblois and Lepanto, 2016). For example, more than 80% of the articles reviewed by Antierens et al. (2018) reported the importance of a long-term view for a sustainable approach to lean implementation. Lean management targets should be aligned with the hospital's overall objectives, strategies and values, and goals must be strategic, realistic, and based on simple and practical solutions (Andersen et al., 2014; Verbano and Crema, 2013). The planning phase should be valorized, in order to ensure sustainability and the successful implementation of projects (Verbano and Crema, 2013). The quality targets need to be clearly defined, and there needs to be an understanding of who the customers are and what values, processes and stakeholders are involved, strengthening the links between implementation attempts and an improvement strategy (D'Andreamatteo et al., 2015). Defining an overall lean strategy helps the leadership team to identify or align all the required changes with the organizational settings (Al-Balushi et al., 2014). Communicating lean as a long-term policy within the strategic agenda of the setting will convince the organization's members to accept the reorganization or reallocation of roles and/or processes (Al-Balushi et al., 2014). Several reviews address the problem of the sustainability of the results of lean (Al-Balushi et al., 2014; Deblois and Lepanto, 2016; Peimbert-García, 2019; Rotter et al.,

2019), but only a few of them focus specifically on the sustainability of the impacts of lean (Hallam and Contreras, 2018; Woodnutt, 2018). Despite the repeated call for a strategic management approach to the sustainability of lean, the literature still provides only a small amount of data about long-term effects (Deblois and Lepanto, 2016). There is a general lack of evidence about the sustainability of results (e.g. improvements that are maintained at the same level over time) (D'Andreamatteo et al., 2015; Peimbert-García, 2019) and about tools and approaches that can be used in order to pursue the sustainability of the implementation (Costa and Godinho Filho, 2016).

Organizational structure encompasses the overall organizational structures, systems and human resources involved in producing and delivering services in lean projects. The attention paid by the literature to organizational structures, roles and responsibilities covers different issues. Several reviews (11) underlined the importance of the structural organization (always avoiding silos and compartmentalization) and the necessity of adapting lean to the local context (Al-Balushi et al., 2014; Andersen et al., 2014; D'Andreamatteo et al., 2015).

For a health care organization, applying lean might mean redefining or changing existing job descriptions, and redistributing roles within the institution. Health care structures are often very hierarchical, with physicians as the dominant decision makers. However, lean requires going beyond the hierarchical blame culture, with the leadership playing a significant role in changing this culture (Aij and Teunissen, 2017; Al-Balushi et al., 2014; Crema and Verbano, 2013; Poksinska, 2010). Launching and implementing lean in health care requires organizational readiness and the presence of an information-led organizational design (D'Andreamatteo et al., 2015).

Human resources are considered one of the most relevant facilitators of the success of lean implementation (18 reviews reported on this). The participation of all employees in lean efforts is widely recognized as a fundamental driver. Everyone should be engaged (Verbano and Crema, 2013), and a multiple-stakeholder (e.g. managers, staff and clinicians) approach is required (Abdallah and Alkhalidi, 2019; Al-Balushi et al., 2014; D'Andreamatteo et al., 2015; Hallam and Contreras, 2018; Parkhi, 2019; Poksinska, 2010). Lean principles suggest that problems should be identified and addressed through frontline staff empowerment and training: the people doing the work are the best suited to create solutions (Deblois and Lepanto, 2016; Mazzocato et al., 2010; Poksinska, 2010; Rotter et al., 2019) The importance of the presence of a lean team has been widely reported within the reviews (eight reviews). The evidence suggests that multiskilled, multidisciplinary cross-functional teams should be set up (Antierens et al., 2018; Poksinska, 2010), and that these should be adequately coordinated or supported by properly skilled facilitators, champions and sponsors (Andersen et al., 2014; Deblois and Lepanto, 2016; Poksinska, 2010).

Multiskilled teams are an advantage for hospitals because they stimulate employees and create a culture of continuous improvement and learning. A team approach to problem solving can create a shared understanding of problems and solutions, and an acceptance of the subsequent countermeasures (Al-Balushi et al., 2014; Andersen et al., 2014; Mazzocato et al., 2010). On this issue, Mazzocato et al. (2010) warned against commissioning change only through ad hoc “lean teams”, so that, instead, a culture is created where quality improvement becomes everyone’s responsibility.

At the same time, employees need to be supported by a strong leadership and management commitment (Aij and Rapsaniotis, 2017; Aij and Teunissen, 2017; Maijala et al., 2018).

Additionally, management commitment plays a significant role in changing the hierarchical culture that characterizes the health care setting administered by the management (Al-Balushi et al., 2014). Changing to an improvement culture presupposes workforce stability, team leadership and decentralized decision making (Andersen et al., 2014). Several reviews (five) claimed that leaders should facilitate the cultural change required by lean (Aij and Rapsaniotis, 2017; Aij and Teunissen, 2017; Al-Balushi et al., 2014; D’Andreamatteo et al., 2015; Verbano and Crema, 2013) by engaging in continuous problem solving and helping colleagues to identify and solve problems enthusiastically on their own instead of providing ready-made solutions. The evidence suggests that lean leaders should encourage a culture of continuous quality improvement, leading personnel to focus on waste elimination and the development of initiatives to improve work processes (Aij and Teunissen, 2017; Parkhi, 2019; Poksinska, 2010; Woodnutt, 2018).

Although several reviews claimed that management practices can strongly influence lean implementation, the empirical findings on this issue are still scarce. The literature fails to measure the impacts of the soft socio-technical enablers on the sustainability and the continuous improvement of lean (Crema and Verbano, 2017). Maijala et al. (2018), discussing the characteristics of leadership and management that are associated with a successful lean implementation, emphasized how little evidence there is on how lean leadership and management are practically applied and the impact they have on the process of lean adoption.

Organizational culture. Lean principles refer to an overarching set of principles aimed at transforming the workplace culture (Rotter et al., 2019). Most of the reviews evidenced the need for a change in the organizational culture accompanying lean implementation (Abdallah and Alkhalidi, 2019; Aij and Teunissen, 2017; Borges et al., 2019; D’Andreamatteo et al., 2015; Deblois and Lepanto, 2016; Peimbert-García, 2019; Verbano and Crema, 2013; Vest and Gamm, 2009; Woodnutt, 2018). An appropriate organizational climate and culture helps to overcome resistance (Verbano and Crema, 2013), and the hierarchical culture is replaced by a supportive culture of

safety, of proactive error reduction, and of continuous improvement and structured problem solving (Al-Balushi et al., 2014; Andersen et al., 2014; Deblois and Lepanto, 2016; Parkhi, 2019; Verbano and Crema, 2013; Woodnutt, 2018).

Education, training, motivation, involvement, empowerment and valorization are important drivers for supporting employees to take a lean organizational culture approach (Aij and Rapsaniotis, 2017; Al-Balushi et al., 2014; Andersen et al., 2014; Deblois and Lepanto, 2016; Mazzocato et al., 2010; Parkhi, 2019; Peimbert-García, 2019; Poksinska, 2010; Sommer and Blumenthal, 2019; Verbano and Crema, 2013). However, a learning environment should be developed for both staff and managers (D'Andreamatteo et al., 2015). Lean leaders play a significant role in the involvement of employees in the change process, contributing to improving the work performed by staff, to empowering personnel, to creating a culture where errors are reported in time, to avoiding blame, and to encouraging creativity and communication, all skills in which employees need to be trained and empowered.

Further key drivers emerged: learning from previous experiences and mistakes and providing rewards and incentives to achieve greater involvement at all levels create the culture for lean health care and strong communication and collaboration within the entire organization (Al-Balushi et al., 2014; D'Andreamatteo et al., 2015; Hallam and Contreras, 2018; Peimbert-García, 2019; Poksinska, 2010; Sommer and Blumenthal, 2019).

One of the most important issues in lean is empowering staff and creating a continuous improvement culture, going beyond the simple application of tools to every process. Lean tools should then support the lean culture and embody lean principles (Poksinska, 2010). Lean principles are the main pillars of lean implementation in health care. The main lean principles identified by the thirteen reviews that specifically address them as the overarching principles are the following:

- identify customers and specify what is/adds value for them, in order to maximize the care value from a patient-centred point of view (Borges et al., 2019; Moraros et al., 2016; Vinodhini et al., 2018).
- map the value stream, categorizing the huge variety of patients with different conditions into groups with similar needs and value streams, and mapping the different patient flows through the health care system (D'Andreamatteo et al., 2015; Mazzocato et al., 2010).
- identify and eliminate waste (“non value-added activities”) that are not adding value to the process or to the patients (e.g. overproduction) (Crema and Verbano, 2017; Sommer and Blumenthal, 2019).

- improve flows and reduce time, creating a continuous process flow, making value flow without interruptions, reducing waiting times and “getting things done the right way” (Antierens et al., 2018; Poksinska, 2010).
- continuous improvement, striving for perfection, constantly evaluating outcomes, and learning from mistakes (Ferreira et al., 2018; Rotter et al., 2019).

Techniques and tools gain a great deal of attention in the literature. Lean is widely considered as a tools-based approach (Parkhi, 2019). Among the common lean tools, Value Stream Mapping (VSM) is most frequently used, helping improving patient flow and enhancing process redesign (Costa and Godinho Filho, 2016; Hallam and Contreras, 2018). Other commonly used tools are Kaizen Event, 5S techniques, A3, just in time, standardized work, Rapid Improvement Events (RIE), visual management, definition of standard procedures, a team approach to problem solving, process mapping, and process orientation (Deblois and Lepanto, 2016; Mazzocato et al., 2010; Peimbert-García, 2019).

Lean tools are fundamental to support the implementation of lean principles.

The use of the right tools is fundamental: failures may be associated with the use of a wrong tool to solve a problem, with the use of a single tool to solve all problems or with the use of all the tools for every problem (Costa and Godinho Filho, 2016).

On the other hand, D’Andreamatteo et al. (2015) reported the risk of a prevailing focus on specific principles or tools of lean rather than a holistic approach. Health care organizations tend to limit the adoption of lean management by using only few practices and tools, rather than following a comprehensive approach. This may have a negative influence on the successful implementation, which requires both a system-wide and a tools-wide implementation.

The application of tools has positive results on quality of care and efficiency with respect to time, costs, the reduction of variability and the improvement of productivity. Even in this case, the evidence rarely reported the sustainability of outcomes over time (Poksinska, 2010).

Layout. The role of layout has rarely been considered in the literature as a driver for successful implementation. Among the reviews considered in this work, only two specifically addressed layout. Vinodhini et al. (2018) reported that, for a successful improvement in the outcomes of a health system, lean management should adopt a strategy for the design of the physical layout. Sommer and Blumenthal (2019) pointed out that in the emergency room setting, changes in the layout of items and equipment, the organization of supplies and inventory maintenance are important to improve the project.

External context helps by viewing lean as a system embedded in, and interacting with, a larger environment. It includes the characteristics of the environment in which the practices of lean management take place, and includes several elements such institutional arrangements (e.g. the health system regulatory framework and the expectations from external relevant stakeholders, such as regional or local health authorities), socio-demographic issues (e.g. the trends and behaviours of the population and the customers), economic factors (e.g. recession or expansion period, the availability of financial resources), political factors (e.g. the prevalent ideology that shapes the policy making process), and competitive forces (e.g. the level of competition between health providers).

Several of the reviews (eight) investigated the influence of the external context on lean implementation. The decisions of health care organizations are influenced by the regional/administrative context, legislation, surges in demand, the knowledge of decision makers and constraints (Al-Balushi et al., 2014; Andersen et al., 2014; Borges et al., 2019; Peimbert-García, 2019). It is not possible to overlook these economic and political factors in order to define quality (Woodnutt, 2018). The context of the negotiations in which the lean planning and implementation phases occur influences the processes and results of lean, especially in the public sector (D'Andreamatteo et al., 2015). Multiple stakeholders influence health care settings: patients themselves and their relatives, caregivers, commissioners, decision makers, those who provide education for doctors and nurses, and even government, the taxpayers, and insurance companies (Al-Balushi et al., 2014).

For this dimension, too, empirical findings are scarce. An analysis of how these factors could have an impact on lean implementation (and on its outcomes) should be carried out, with academics, health managers, experts and the external stakeholders involved as key collaborators.

Impacts

As regards lean impacts, this work contributes to identifying and comparing the most relevant outcomes for each category in the framework (the patient, internal processes, learning and growth, and financial dimensions). Table 3 reports the indicators of the impacts most commonly observed for each category of the framework.

[INSERT TABLE 3]

Patient. Lean impacts on the patient dimension have been widely investigated. The most common indicators are: patients' perceived quality of care (reported by 13 reviews), patient satisfaction (11) and security and safety (7). The reviews generally reported positive impacts for lean on the patient dimension (Crema and Verbano, 2013, 2015; Ferreira et al., 2018; Sommer and Blumenthal, 2019). For example, considerable patient satisfaction improvements were reported through "*improvement in the patient's perception of the helpfulness and friendliness of the staff, the length of time patients perceived they had waited, and an overall score of the clinic experience*" (Sommer and Blumenthal, 2019, p. 725). Crema and Verbano (2015) found that there were correlations between the objectives of quality of care and time spent with patients by clinicians (0.54) and between an increase in the number of patients and hospital reputation (0.31).

Other indicators related to patient are health/clinical outcomes (considered in 12 reviews), such as: a reduction in mortality rate (D'Andreamatteo et al., 2015; Ferreira et al., 2018; Hallam and Contreras, 2018; Mazzocato et al., 2010; Mousavi Isfahani et al., 2019; Abdallah and Alkhaldi, 2019); the appropriateness of treatment (two reviews) (Abdallah and Alkhaldi, 2019; Crema and Verbano, 2017); improved accessibility (two reviews) (D'Andreamatteo et al., 2015; Poksinska, 2010); the effectiveness of care (three reviews) (Abdallah and Alkhaldi, 2019; Crema and Verbano, 2013, 2017); increased capacity (increasing the provision of services or the number of patients who can be adequately serviced without sacrificing other measures, such as patient safety, quality of care, and so forth) (three reviews) (Costa and Godinho Filho, 2016; Crema and Verbano, 2015; Parkhi, 2019); and infection reduction (Deblois and Lepanto, 2016).

However, the analysis reveals few works that report negative or no significant results for the patient dimension. Harvey et al. (2018) highlighted negative impacts of lean on quality of care, nurses' job satisfaction and patient safety. Moraros et al.'s (2016) review did not find any study demonstrating statistically significant evidence of a positive impact of lean on health outcomes (e.g. mortality), and Deblois and Lepanto (2016) reported only one study with no change in the patient perception of health care or in the mortality rate.

Internal processes. All the reviews dealing with impacts investigated the effects on internal processes. An increase in the efficiency of managing internal processes is frequently reported, such as the optimization of the flow of patients, staff and resources (eight reviews) and the elimination of wasteful/non value-added activities (for patients and the organization) (nine reviews). Lean management helps to eliminate the seven types of Ohno waste: waiting, defects, overproduction, transport, inventory, motion and overburden, especially the first two of these (Hallam and Contreras, 2018).

The most commonly reported indicator used to measure internal process efficiency was time reduction (16 reviews), defined as a reduction in length of stay, waiting times, turnaround times, lead times, processing times, time to admit patients and time to deliver services, decreased delay between sample collection and the release of test results, and a reduction in the notification time of infections (Mousavi Isfahani et al., 2019; Sommer and Blumenthal, 2019; Vest and Gamm, 2009; Woodnutt, 2018).

Other lean process improvements are reported in terms of a reduction in errors or defects (11 reviews), variability (two reviews), better physical layout (two reviews) and the optimization of resource allocation and inventory (Abdallah and Alkhalidi, 2019; Deblois and Lepanto, 2016). Only one review highlighted a statistically significant positive effect of lean on internal processes (reduced patient visits and reduced surgical consultations) (Moraros et al., 2016).

Lean requires a patient-centred approach. Identifying and defining value for the customer first means obtaining an understanding of who the patients and the multiple other stakeholders in health care are (Al-Balushi et al., 2014; Crema and Verbano, 2013; Parkhi, 2019; Rotter et al., 2019), and secondly eliminating non value-added activities for which patients would not be willing to pay (Hallam and Contreras, 2018; Poksinska, 2010). Leadership should contribute to defining value for patients (Maijala et al., 2018) and should listen to patients' voices (Crema and Verbano, 2013). However, the patient point of view is not widely emphasized in the lean literature (Crema and Verbano, 2017).

Learning and growth are extensively reported by the reviews investigating outcomes (71% of the reviews). Benefits for employees and organizational wellbeing are evaluated through staff satisfaction and safety (12 reviews), improvements in working conditions and wellbeing (10 reviews), and staff involvement/empowerment (eight reviews) (Ferreira et al., 2018; Peimbert-García, 2019; Poksinska, 2010). Less often quoted but still relevant are the impacts on teamwork attitudes (five reviews) and the proactive attitude of staff to problem solving (Crema and Verbano, 2013; Mazzocato et al., 2010; Poksinska, 2010). Some examples of the positive impacts on staff are the following: reduction in overtime, reduced staff walking distance, increased motivation, increases in the number of patients seen by nurses per unit of time, increased staff responsibility, reinforcement of work teams through empowerment, a more organized working environment and more involvement of team leaders in work spaces (Crema and Verbano, 2013; Deblois and Lepanto, 2016; Ferreira et al., 2018; Mazzocato et al., 2010; Poksinska, 2010). Antierens et al. (2018) found that higher morale or staff involvement were reported in 26.5% of studies, while additional outcomes regarding the learning and growth dimension, such as increased communication, better

leadership skills, improved learning behaviour by employees or an improved perception of the organizational climate were identified in only 15.7% of health care organizations. A negative association of lean with worker satisfaction was reported in only one review (Moraros et al., 2016). Finally, staff satisfaction can be better achieved when efforts are made to improve the performance of the whole organization (D'Andreamatteo et al., 2015).

Financial. Relevant financial outcomes, in terms of cost reduction (14 reviews), efficiency and savings, improved efficiency (10 reviews) and productivity (7 seven reviews) and increased revenues (two reviews), are reported in 76% of the reviews (Antierens et al., 2018; D'Andreamatteo et al., 2015; Mousavi Isfahani et al., 2019). Scholars assume that financial impact is a direct consequence of cost saving coming from the elimination of non value-added activities (Parkhi, 2019). Only Moraros et al. (2016) reported a negative association with financial costs.

5. Discussion

An effective lean implementation requires an integrated and coordinated strategy involving the different socio-technical components of the overall hospital system (Centauri et al., 2018; Shortell et al., 2018).

Most of the reviews included in this study (almost 60%) claimed the importance of implementing lean management in the whole organization, but there were still a significant number that did not focus on this relevant issue. Parkhi (2019) found that a silos approach in health care was a barrier to the successful implementation of lean, and that lean transformation might end up failing to reach the expected outcomes when implemented in isolation (Hallam and Contreras, 2018). However, an actual system-wide implementation has rarely been observed, with the prevailing studies being of adoption in isolated units or departments, or with single techniques and tools rather than a holistic approach (D'Andreamatteo et al., 2015; Parkhi, 2019; Peimbert-García, 2019; Woodnutt, 2018). Among the reviews included, only Costa and Godinho Filho (2016) reported a significant number of papers concerning the application of lean in a hospital as a whole. The preference for the silos approach has been related to the risk that the quality of work may decrease or be affected by many confounding variables when spreading lean implementation into numerous hospital departments and processes (Mousavi Isfahani et al., 2019).

The review reveals that all socio-technical components have been investigated. The most commonly evaluated components are organizational structure and techniques and tools, but organizational culture and strategic management are widely reported, too. Less commonly investigated is the external context, with no empirical evidence provided in the literature reviews analysed. Further

research is needed to fill this gap, even with explorative qualitative research. For example, Harrison et al. (2016) provided some evidence on this aspect through multiple case studies, highlighting how, prior to launching lean initiatives, all of the organizations investigated faced shrinking reimbursements and profit margins, along with strong market competition for at least some of their services.

A decade ago, there was a lack of rigorous research into the outcomes of lean (Poksinska, 2010). This study confirms that there is still a gap in this area: out of 28 reviews, only five specifically investigated the outcomes of lean. Internal processes stand out as the most relevant dimension (out of the four main categories used in this paper), with time reduction as the most commonly reported indicator (16 reviews), followed by error reduction (11 reviews), waste elimination (nine reviews) and optimization of flows (eight reviews). The patient category was also investigated by several reviews. In this dimension, clinical/health outcomes (12 reviews), improved patient satisfaction (11 reviews) and patient safety (seven reviews) were the most commonly reported indicators. The learning and growth and financial dimensions were less often investigated. Further indicators, reported by fewer than five of the reviews, are: improved accessibility, appropriateness, effectiveness of care, capacity, reduced variability, increased teamwork and communication, optimization of layout and inventory, and increased revenues.

6. Conclusion

This work stands out as the first review of reviews of how the socio-technical components of the lean management approach obtain positive impacts within the patient, internal processes, learning and growth and financial categories.

The interactions between the different S-T dimensions emerged as important drivers in supporting effective lean implementation. The leadership of health care managers has an important role in supporting employees, letting them identify and solve problems enthusiastically on their own, facilitating teamwork, providing training and involvement, and aligning goals with the organization's strategy. Communicating lean implementation as a long-term policy within the strategy of the health care setting leads health care members to accept the reorganization or reallocation of roles. All employees, with the support of lean teams, are fundamental to supporting change, moving the organization from a hierarchical culture to one of continuous improvement. Additionally, lean tools are a fundamental element in supporting the cultural change needed by lean, and they should embody lean principles. Training allows staff to make use of lean tools to support the implementation process.

However, not all the reviews investigated the relationship between the S-T dimensions and the impacts. In some cases (seven reviews), the reviews exclusively explored the facilitators of lean implementation, specifically avoiding explaining the related impacts. Thus, there is still room to foster the advancement of lean implementation that helps health organizations to adopt a socio-technical integrated approach in order to guarantee the sustainability and the continuous improvement of the solutions they adopt.

The analysis of the impacts highlighted some major concerns on this issue.

First, although several studies reported the results from lean initiatives, they are not methodologically comparable. The reviews used different ways to measure, investigate and report results. There is therefore a clear need for a standardized comparative measurement system in order to obtain clear and objective evidence. Some recent pieces of work on lean in hospitals have provided useful insights into designing a multiple performance evaluation system (Po et al., 2019; Rundall et al., 2020; Shortell et al., 2019), suggesting that financial performance, clinical outcomes and patient satisfaction should be included.

Secondly, some indicators were widely adopted. Time reduction, the most commonly reported impact, was observed in terms of reduced length of stay, waiting times, turnaround times, lead times, processing times, time to admit patients, and time to deliver services, decreased delay between sample collection and the release of test results, and other aspects. Lean management pays more attention to indicators related to time, because of the breadth, importance and ease of improving time indicators. Impacts on time or reduction of costs were reported in the literature most frequently and often together, because they are benefits that are easy to quantify. There is therefore a need to put more effort into the deployment and testing of a broader set of indicators.

Thirdly, most of the outcomes were self-reported and not validated. This should act as a warning about the risk of the manipulation of outcome measurements (e.g. waiting times) in the absence of a valid performance measurement programme. Most of the studies reported only on positive impacts, neglecting any potential drawbacks.

Finally, although the need for long-term policies and strategies has been highlighted, there is still a general lack of studies and of evidence about the sustainability of results (i.e. improvements that maintain the achieved level over time).

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