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Assessing Lean Six Sigma and quality performance improvement in Italian public healthcare organizations: a validated scale

Angelo Rosa
Department of Management, Finance and Technology, Universita LUM Giuseppe Degennaro, Casamassima, Italy
Nicola Capolupo
DISA-MIS, Universita degli Studi di Salerno, Fisciano, Italy
Emilia Romeo
University of Salerno, Salerno, Italy
Olivia McDermott
University of Galway, Galway, Ireland
Jiju Antony
Department of Industrial and Systems Engineering, Northumbria University, Newcastle upon Tyne, UK
Michael Sony
Oxford Brookes Business School, Oxford Brookes University, Oxford, UK, and
Shreeranga Bhat
Department of Mechanical Engineering, St Joseph Engineering College, Mangalore, India

Abstract

Purpose – This study aims to fully assess the readiness for Lean Six Sigma (LSS) and Quality Performance Improvement (QPI) in an Italian Public Healthcare ecosystem.

Design/methodology/approach – Drawing from previously established survey development and adaptation protocols, a replication study was carried out; Lean, Six Sigma and QPI were extracted and validated through confirmatory factor analysis in an Italian Public Healthcare setting, with a sample of health professionals from the Campania region.

Findings – This study reports the adaptation of an existing scale for measuring LSS and QPI in an Italian public healthcare organisation. This analysis extracts six conceptual domains and constitutes an original adaptation of an existing scale to assess the readiness to adopt Lean, Six Sigma and Quality Performance in Italian Public Health Organizations. The constructs show strong levels of internal consistency, as demonstrated by each item factor loading and each subscale reliability.

Practical implications – Managers, policymakers and academics can employ the proposed tool to assess the public healthcare ecosystem's capability to implement LSS initiatives and strategies to improve quality performance.

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Originality/value – This is one of the first studies to assess cross-regional organisational readiness for LSS and QPI in an Italian Public Healthcare environment at this scope and level.

Keywords Lean Six Sigma, Quality performance improvement, Healthcare organisation, Lean management, Public health, Italy

Paper type Research paper

1. Introduction

Recent trends in improving healthcare service quality and efficiency (Pfaff *et al.*, 2021; Matovu *et al.*, 2022; Anufriyeva *et al.*, 2022) discuss the benefits of Lean process thinking (van Loenen *et al.*, 2022), which draws on proven implementation in the manufacturing sector. Lean thinking derived from the Toyota Production System (TPS) focuses on continuous improvement and is based on the entire organisations involvement in workload simplification, waste reduction and value creation from the consumer's perspective (Womack *et al.*, 1990; Womack and Jones, 1997). Lean methodology and its associated tools and techniques have significantly impacted process efficiency projects in healthcare organisations positively (McDermott *et al.*, 2022a, b). Several studies have revealed evidence of application of Lean philosophy in improving productivity and process efficiencies, in reducing defects (Trakulsunti *et al.*, 2022), cost reduction (Langell, 2021), efficiency (Burroni *et al.*, 2021), enhancing team cooperation (Pan *et al.*, 2022), improving organisational climate (Vaishnavi and Suresh, 2020) and increased patient satisfaction (Sunder *et al.*, 2020). Lean thinking has found fertile soil in healthcare for two main reasons. The first is the need to focus on the patient and the service quality provided, which aligns with the Lean philosophy cornerstone of continuous improvement from the patient or customer viewpoint (Oxner *et al.*, 2020; McDermott *et al.*, 2022a, b). Another factor is that frontline personnel (Mahmoud *et al.*, 2021) are fully involved in the process (bottom-up approach), so they are proactive in developing new ideas and solutions to improve process efficiency and minimise waste. Healthcare organisations have embraced Lean to enhance clinical and technical-administrative processes to boost service quality and patient value (McDermott *et al.*, 2021). As a result, the application of Lean methods and tools used for process diagnosis, redesign and monitoring to organise, standardise and synchronise service delivery has steadily increased (Antony *et al.*, 2023). However, there is a substantial variance in how Lean thinking and tools are absorbed into the mechanisms of healthcare service delivery in the Lean Management literature (Teeling *et al.*, 2021; Harikumar and Saleeshya, 2021). The majority of applications are concentrated towards using different strategies and techniques from the Lean toolbox to improve specific activities or areas rather than establishing a culture of change capable of influencing the entire organisation.

Six Sigma is a structured methodology (Cesarelli *et al.*, 2021) that employs statistical data analysis combined with extensive managerial tools to enhance process performance. It was initially introduced by Motorola's Bob Galvin and Bill Smith in the second half of the 1980s (Dedhia, 2005) and has since spread to other large corporations, the public sector and healthcare (De Koning *et al.*, 2006). Lean is combined with Six Sigma, as Lean Six Sigma (LSS), and aids in reducing waste and variation (George, 2002). Despite the extensive deployment of LSS tools and techniques over the past two decades, the tools deployed are not homogeneous (Samanta and Gurumurthy, 2022) in their potential adoption across various countries (Bhat *et al.*, 2020; Ibrahim *et al.*, 2022; Lee *et al.*, 2021; Yadav *et al.*, 2022). Each country has its own healthcare system, and the aims of LSS implementation may vary proportionately (Kuiper *et al.*, 2022). According to Reibling *et al.* (2019), in a study on the taxonomy of the Organisation for Economic Cooperation and Development (OECD)nations, there seem to be substantial disparities in European healthcare system performance. The Italian public system is part of the Regulation-oriented public system, encompassing Denmark, the Netherlands and Spain. It is distinguished by a lack of resources committed to healthcare expenses and strict access

regulations (Ciasullo *et al.*, 2020). There are several studies on the growth of Italian Healthcare systems, notably improvement in services (Campagna *et al.*, 2021), quality improvement (Ricciardi and Tarricone, 2021) and LSS implementation (Marolla *et al.*, 2022; Improta *et al.*, 2022; Rosa *et al.*, 2023). However, adopting LSS methodologies can vary depending on the organisational goals of the hospital or healthcare region it falls under in Italy. The regional management and funding of healthcare across 20 different Italian regional areas and organisations means that based on population, management, geography and regional factors that performance and efficiency of the healthcare provision may differ across regions (Rosa *et al.*, 2023; Rosa *et al.*, 2023). The literature lacks applications of an existing and tested scale within the Italian context to assess the readiness of Lean and Six Sigma in Italian Public Healthcare and other country-specific organisations.

Moreover, despite a range of effectiveness and efficiency improvement programs currently in operation or proposed within the Italian Public Healthcare system, there is a lack of a defined process for measuring healthcare organisation's readiness for using LSS from the bottom up. Thus, Italy offers a unique case with 20 regional healthcare organisations which to all intensive purposes operate somewhat independently and have their own disparities therein. The uniqueness of this research is that it contextualises LSS within a larger overall scale that focuses on all the elements that enhance Lean and Six Sigma initiatives. The specific goal of this study is to validate a tool for measuring the readiness of Italian public health organisations to implement LSS initiatives while considering their interdependence and other organisational factors along with their main goals.

The article is structured as follows; Section 2 discusses the debate on using Lean Management and Six Sigma in public hospitals and the theoretical routes from which constructs were gathered to build the proposed assessment scale. In Section 3, the replication study and resulting scales adoption methodology and psychometric properties are presented and evaluated through a sample of public hospital personnel from Campania, Italy. Section 4 and Section 5 presents the results and discusses the findings. Finally, section 6 concludes the paper with further conceptual indications.

2. Theoretical background

2.1 Lean and Six Sigma in public health organizations

The public healthcare system is urgently facing many disruptions. The depletion of available resources and the rising demand for specialised services require strategies to enhance productivity through waste mitigation (Walters *et al.*, 2022). Furthermore, service improvement underpins the enabling of health organisations to preserve their patient-centeredness orientation and can result in changing of organizational structures to meet patient requirements (Mostepaniuk *et al.*, 2023).

Both researchers and professionals have presented numerous management methods to simplify organisational procedures and enhance job tasks while responding to patient needs to boost quality performance (Antony *et al.*, 2019). Among these, Lean and Six Sigma effectively integrate useful and practical statistical tools from Six Sigma with the concepts, principles and tools/techniques of Lean thinking aimed at removing waste (Muda) and minimising lead times of processes (Takur *et al.*, 2023; Morales-Contreras *et al.*, 2020).

The difference between value-added and non-value-added operations is critical in healthcare organisations. The former includes activities that satisfy the patient's needs, and the latter represents a substantial expense to the organisation (McDermott *et al.*, 2022a, b). Consequently, they should be recognised and monitored so that they may be decreased or avoided whenever feasible. In Italy, for example, healthcare spending significantly impacts regional and municipal government budgets (Rotulo *et al.*, 2022). The inefficiency of organisational processes is the primary source of growth in healthcare costs, which should be

appropriately assessed and decreased via the execution of appropriate process excellence methodologies such as Lean and Six Sigma.

Defects may arise during medical or therapeutic procedures and administrative and logistical operations, and LSS can aid in defect reduction (Improta *et al.*, 2022; Dixit *et al.*, 2022). The implementation of these approaches may vary widely according to the country, hospital type and organisational culture, professionals and socio-demographic factors (McDermott *et al.*, 2022a, b).

2.2 A scale to measure LSS in healthcare

Lean and Six Sigma integration may enhance healthcare quality performance in nursing care, improve the hospital environment, improve patient safety and reduce waiting time (Gijo *et al.*, 2013). Furthermore, these parameters assist in ensuring the quality of healthcare services in relation to improving patient satisfaction, employee engagement and retention (Ahmed *et al.*, 2018a). Additionally, Lean and Six Sigma readiness can increase the full involvement of everyone in the organisation and enhance quality performance and services (Van den Heuvel *et al.*, 2006). Consequently, whereas the drive for continuous improvement toward value-based patient activities is managed at the organisational level, measuring the readiness to implement LSS from each improvement project is problematic. Rather, they should be part of a broader tool that includes all the basic components of Lean and Six Sigma up to the quality of performance, that is the output of the health service. Also, they should be part of a larger scale that comprises all the central concepts of Lean and Six Sigma up to and including quality performance measures, that is the output of the health system (Capolupo *et al.*, 2023).

Ahmed *et al.* (2018b) propose an organizational scale encompassing all of the Lean organisational assets and the Lean and Six Sigma process improvement principles. Their research in public and private hospitals validated a tool for measuring the readiness of LSS and QPI among Malaysian Healthcare organisations. Their strategy includes six distinct dimensions: Continuous Quality Improvement (CQ), Six Sigma initiatives (SS), Lean Management initiatives (LM), Patient Safety (PS), Teamwork (TW) and QPI. Table 1 depicts the dimensions retrieved from the literature and the relative operational definition provided by a literature review that supports the authors' contextualisation within the healthcare sector.

The importance of this scale has been recognised by several authors who have developed different studies on Lean, Six Sigma and QPI (Peimbert-Garcia *et al.*, 2019; Ahmed *et al.*, 2022; Hussain *et al.*, 2023; Ciasullo *et al.*, 2023). However, these studies have only validated some of these constructs in different healthcare settings and rarely in European countries. Given the institutional, cultural and operational differences between Malaysian and Italian healthcare systems, it is not appropriate to employ Ahmeds *et al.*'s scale to conduct the same study in the Italian context. Differences in the Italian and Malaysian healthcare systems are many, for example the Italian government spend more of their total GDP on healthcare and have a higher number of hospital beds and doctors per 1,000 head of population. Over the period from 2005 to 2022, health expenditure as a share of GDP in Italy fluctuated between 8.1% and 9.6%. Also, the Malaysian system is based on a social insurance contribution model while Italy has a national healthcare funding model. The Malaysian healthcare system has many challenges including a lack of infrastructure, long waiting times for treatment, shortages of healthcare professionals and a two tier health system. The Italian Ministry of Health (Ministero della Salute) coordinates public healthcare and healthcare services are handled by 20 Italian regions. Thus, while Italy's public healthcare system is amongst the most efficient in the world, its performances and quality can be unstandardized and have disparities. For example while services in the richer North such as in Rome and Milan are very efficient and state of the art they can be underdeveloped further south. There is an aging population in Italy with life expectancy well into the 80s. However, due to the nature of public services government being free and paid for by the government, the waiting times for consultants and

Lean Six Sigma construct	Definition
Continuous quality improvement	"An incremental approach towards process improvement takes an organization-wide systems perspective, which is tied to the strategic goals and aligned with a quality culture. This approach integrates continuous quality improvement activities by using interdisciplinary teams at all levels in the healthcare organization and offers reward/recognition for employees who contribute to the quality improvement process" [Ahmed *et al.*, 2018, p. 269]
Lean management initiatives	"They emphasize patient needs by reducing costs and increasing the efficiency of the delivery speed of the medical services. Lean management initiatives include '5S' practices process mapping, value stream mapping, root cause analysis, Kaizen methods, and a just-in-time approach for continuous improvement in the quality performance of the healthcare organization" [Ahmed *et al.*, 2018, p. 269]
Six Sigma initiatives	"This approach includes process improvement methods such as define, measure, analyze, improve and control (DMAIC model processes to focus on continuous improvement" [Ahmed *et al.*, 2018, p. 269]
Patient safety	"It refers to prevention and amelioration of adverse outcomes or injuries that stem from the process of healthcare. In the healthcare service, patient safety depends on a strong and positive patient safety culture such as awareness of patient safety, teamwork, communication, and work climate. Failures in communication and teamwork are the main causes of adverse outcomes in healthcare services" [Ahmed *et al.*, 2018, p. 269]
Teamwork	"It can be described as a collaboration between functional units, employees, employees and managers, employees and suppliers, and between managers and non-managers. Teamwork promotes mutual trust and respect for one another in solving any organizational problems" [Ahmed *et al.*, 2018, p. 269]
Quality performance	"Is an interconnecting set of policies and practices that enhance workforce management to achieve organizational goals through individual performance Quality performance is a system that creates a vision of the organization to understand and help each individual employee of the organization and recognize their contribution to enhance the quality performance to fulfill customer wants and desires. To measure quality performance in the healthcare sector, the managers need to clearly define the performance outcomes of a healthcare system that can be judged and quantified against quality improvement" [Ahmed *et al.*, 2018, p. 270]

Source(s): Authors' elaboration from Ahmed *et al.* (2018)

Table 1.
Taxonomy of Lean Six Sigma and quality performance improvement

other medical appointments can be as long as several months. This leads to patients on waiting lists in the south, travelling north for faster and sometimes better service access. As a consequence the northern regional healthcare services can have longer waiting times and further burden on their services.

Likewise, although an accurate and validated scale in other regions where implemented, Ahmed *et al.*'s scale requires further modification before being used by Italian public health organisations. This regional structure management of Italian healthcare means that healthcare facilities therein may vary, in terms of quality, between the different regions across Italy. Consequently, this contribution can be considered the first original attempt to assess the readiness of Italian Public Healthcare organisations to undertake LSS and QPI projects in a specific region as opposed to an overall country focus. The added benefit of this work is that it validates this approach in a radically different socio-demographic healthcare environment.

3. Methodology

3.1 Settings

This study was carried out in Italy, in Campania (Southern Italy), a region which has been the subject of case studies in the literature for its LSS initiatives within its public healthcare

facilities (Latessa *et al.*, 2021; Improta *et al.*, 2020). Campania has been actively promoting prevention, education and health activities for many years by empowering governmental agencies and pathways at the local and institutional levels. As a result, many effective, efficient and sustainable interventions have been put in place in partnership with local health authorities and the wider society in a range of settings (school, workplace) to involve a large number of citizens, particularly those with limited educational levels and living in the most socioeconomically disadvantaged conditions. This region was an appropriate case study in which to replicate the Ahmed *et al.* (2018b) study as the south of Italy is behind the north in terms of its regional healthcare advances and development.

3.2 Survey cultural adaptation

The scales developed by Ahmed *et al.* (2018b), employed to carry out the study as a replication study have been featured in the literature on LSS and QPI in public healthcare organizations. A replication study was important to prove the validity and generalizability of Ahmed *et al.*'s scale across contexts and samples. Following Park and Park (2016) and Hazell and Berry (2022), the survey was piloted initially with four academic and healthcare professionals, and minor changes were made based on feedback from the pilot. Furthermore, since the Lean Management (LM) and Six Sigma (SS) scale items required basic knowledge of Lean principles, this study's version has included a summary of the terms and visuals (i.e. Kaizen, 5S, etc.) to allow the respondents to answer coherently (Bahn, 2014). Lastly, a smaller pilot test with a sample size of 33 professionals was carried out in line with the protocol's recommended sample size (Beaton *et al.*, 2000). All responses were clear, there were no discrepancies in understanding and all were considered valid.

3.3 Sample description

The final sample size was 303 professionals (87% response rate). Easterby-Smith *et al.* (2012) state that anything over a 20% response rate is deemed a significant sample. The sample professionals were chosen using a non-probabilistic technique from a group of health professionals (i.e. physicians, doctors, nurses) enrolled in the Master of Arts "DAOsan" program at the University of Salerno. Table 2 depicts the sample distribution based on gender, province of residence and professional experience.

Over a four-week period, the survey was sent to respondents via e-mail, and their answers were gathered using a Google Forms survey. The research aim was clearly stated in a preliminary sheet, and respondents were guaranteed the anonymity of their replies and information (Fiscella *et al.*, 2015).

Variable	Modalities	n	Percentage
Gender	Male	170	56.11
	Female	133	43.89%
Professional experience	1–5 years	24	7.92%
	6–10 years	87	28.71%
	Above 10 years	192	63.37%
Province	Avellino	75	24.75%
	Benevento	26	8.58%
	Caserta	30	9.9%
	Napoli	102	33.66%
	Salerno	70	23.1%

Source(s): Authors own work

Table 2.
Sample description

3.4 Data analysis

The survey response options employed a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7) to ensure discrimination in the results (Zhang *et al.*, 2013). For each item, the mean averages were computed. The data was analyzed using IBM AMOS 24. Confirmatory factor analysis (CFA) was carried out to verify the model's reliability and robustness (Marsh *et al.*, 2009).

In social sciences (Spearman, 1961), factor analysis (Churchill, 1979) is used to reduce a large number of variables into a lower number of latent factors.

Cronbach's alpha was used to evaluate the internal consistency of each final component (Singer *et al.*, 2012), and a value of 0.6 was regarded as appropriate to assess internal consistency (Curry *et al.*, 2011).

4. Results

4.1 Descriptive statistics and variance explained

Table 3 shows the mean score for each item. Questions were categorised with a positive response rate of 4–7 and a negative answer rate of 1–3. As can be seen, the average score for all items varied between 4 and 5 on a 7-point Likert scale. Higher scores are considered more promising reviews of implementing LSS and QPI in Public Health Organizations.

Table 3 indicates that six dimensions were confirmed by the CFA. Furthermore, the table revealed that all the items exhibited excellent indicator reliability, since factor loadings ranged between 0.688 and 0.891.

The total amount of variance on the scale is 83.561%, which is explained by 36.86% by the Continuous Quality Improvement realm; LM and SS Initiatives implementation explain the scale for the 16.84 and 12.11%; PS and TW explain the 7.70 and 6.45% and lastly the QPI dimension was retrieved (3.601%).

4.2 Common method bias

Common method bias (CMB) is a potential threat to the validity of results, as it arises when the variance shared by variables is due to the measurement method rather than the constructs being studied. To address this issue, Harman's single factor score (Harman, 1976) is employed. This method involves running the factor analysis on all measured variables, including those not theoretically related, and extracting a single factor from the analysis. If common method bias is present, this single factor is expected to account for more than 50% of the variance across all variables, regardless of their theoretical associations. Nonetheless, if the variance explained by the single factor coefficient is relatively small, it suggests that common method bias is not a concern in the study. Given the 36.86% explained by the first factor (Continuous Quality Improvement), CMB does not represent an issue in this research.

4.3 Construct validity and confirmatory factor analysis

Construct validity is tested using a Q-sorting procedure, which separates elements in the construct depending on their domain (Storey *et al.*, 2000). Confirmatory construct validity was used in this study. Each item was assigned to one of the six constructs by a panel of experts and practitioners (doctors and nurses). The findings were reported in Table 4. The predominant proportion of the construct corresponding to each item confirmed the original categorization arrangement.

Confirmatory Factor Analysis was performed to assess construct reliability and model fit. Internal consistency reliability of constructs (Hair *et al.*, 1997, 2010) is evaluated by measuring the composite reliability (CR) and Cronbach's alpha, while convergent validity is measured through the average variance extracted (AVE). The reliability of the factors, according to

Factor extracted	Items description	Mean	SD	Factor loading	Extraction sums of squares loading *(% variance)*
Continuous quality improvement (CQ)					36.86
CQ1	Employees who contribute to the quality improvement process are rewarded by the hospital	4.7	1.0	0.800	
CQ2	Surveys, focus groups and other methods are used by the hospital to assess patients' satisfaction	4.8	1.1	0.758	
CQ3	The hospital fosters a culture of quality improvement	4.3	1.2	0.808	
CQ4	At all levels, the hospital combines continuous quality improvement initiatives with interdisciplinary teams	4.9	1.2	0.891	
CQ5	Hospital managers have shown outstanding leadership in driving continuous improvement efforts	4.4	1.1	0.789	
Lean management initiatives (LM)					16.84
LM1	To establish a more efficient work environment, the hospital adopts "5S" techniques. (sort, set in order, shine, standardize, sustain)	4.2	0.8	0.880	
LM2	The hospital employs value stream mapping to detect non-value-added activities that result in waste and errors	4.2	0.8	0.734	
LM3	Kaizen steps (Discover Improvement, Analyze Current Methods, Generate Original Ideas. Introduction, Develop an Implementation Plan, Implement the Plan, Evaluate the New Method) are employed in continuously improving hospital process	4.7	0.8	0.853	
LM4	To enhance work process management, the hospital employs the just-in-time principle (producing what the patient needs when it needs it, and in the quantity and quality demanded)	4.5	0.9	0.812	
Six Sigma initiatives (SS)					12.11
SS1	To measure quality improvements, the hospital employs process improvement tools (FMEA, Control Charts)	4.7	0.9	0.789	
SS2	All hospital improvement initiatives are reviewed on a routine basis	4.9	0.8	0.850	
SS3	The hospital manages quality improvement efforts in a systematic manner	5.3	1.0	0.798	

Table 3.
(*continued*) Factor analysis results

Factor extracted	Items description	Mean	SD	Factor loading	Extraction sums of squares loading *(% variance)*
SS4	To decide on significant quality improvement projects, the hospital employs a systematic design process (Project charters)	5.4	0.9	0.788	
SS5	Each hospital improvement project is assessed on a regular basis	4.9	0.8	0.811	
Patient safety (PS)					7.70
PS1	To ensure patient safety, the hospital focuses on reducing the incidence of errors	4.2	1.0	0.750	
PS2	The hospital prioritizes important processes to enhance patient safety	4.1	1.1	0.804	
PS3	To increase patient safety, the hospital raises personnel error awareness	4.3	0.9	0.864	
PS4	The hospital minimized the impact of medical care errors	4.4	0.9	0.704	
PS5	The hospital encourages a working atmosphere that emphasizes patient safety	4.4	1.2	0.721	
Teamwork (TW)					6.45
TW1	When there is a lot of work that needs to be done, we collaborate with one another to accomplish it	4.3	1.2	0.707	
TW2	People in the hospital respect each other	4.8	1.2	0.689	
TW3	When members of our unit get overwhelmed, other members of the same unit support them	4.9	1.0	0.775	
TW4	The hospital units collaborate effectively to provide the most effective patient care	4.1	1.1	0.843	
TW5	Team leaders encourage their employees to collaborate as a team	4.7	1.0	0.820	
Quality performance (QP)					3.60
QP1	Medical treatment expenses have been reduced in recent years	4.3	1.3	0.688	
QP2	Over the years, the severity of medical care errors has decreased	5.1	1.2	0.872	
QP3	Over the years, patient waiting time (meeting with physicians and workers) has been reduced	4.5	1.1	0.824	
QP4	Over the years, waste in hospital processes has decreased	4.6	1.2	0.834	
QP5	Over the years, the frequency of patient complaints has reduced	5.1	1.2	0.756	

Note(s): Factor extracted n.6 Total variance explained: 83.561%
Source(s): Authors own work

Table 3.

Items	Construct %
Employees who contribute to the quality improvement process are rewarded by the hospital	CQ 87.5%
Surveys, focus groups and other methods are used by the hospital to assess patients' satisfaction	CQ 87.5%
The hospital fosters a culture of quality improvement	CQ 100%
At all levels, the hospital combines continuous quality improvement initiatives with interdisciplinary teams	CQ 100%
Hospital managers have shown outstanding leadership in driving continuous improvement efforts	CQ 87.5%
To establish a more efficient work environment, the hospital adopts "5S" techniques. (sort, set in order, shine, standardize, sustain)	LM 100%
The hospital employs value stream mapping to detect non-value-added activities that result in waste and errors	LM 87.5%
Kaizen steps (Discover Improvement, Analyze Current Methods, Generate Original Ideas. Introduction, Develop an Implementation Plan, Implement the Plan, Evaluate the New Method) are employed in continuously improving hospital process	LM 100%
To enhance work process management, the hospital employs the just-in-time principle (producing what the patient needs when it needs it, and in the quantity and quality demanded)	LM 87,5,5%
To measure quality improvements, the hospital employs process improvement tools (FMEA, Control Charts)	SS 50%
All hospital improvement initiatives are reviewed on a routine basis	SS 87.5%
The hospital manages quality improvement efforts in a systematic manner	SS 62.5%
To decide on significant quality improvement projects, the hospital employs a systematic design process (Project charters)	SS 62.5%
Each hospital improvement project is assessed on a regular basis	SS 62.5%
To ensure patient safety, the hospital focuses on reducing the incidence of errors	PS 100%
The hospital prioritizes important processes to enhance patient safety	PS 100%
To increase patient safety, the hospital raises personnel error awareness	PS 100%
The hospital minimized the impact of medical care errors	PS 100%
The hospital encourages a working atmosphere that emphasizes patient safety	PS 100%
When there is a lot of work that needs to be done, we collaborate with one another to accomplish it	TW 87.5%
People in the hospital respect each other	TW 62.5%
When members of our unit get overwhelmed, other members of the same unit support them	TW 100%
The hospital units collaborate effectively to provide the most effective patient care	TW 87.5%
Team leaders encourage their employees to collaborate as a team	TW 100%
Medical treatment expenses have been reduced in recent years	QP 87.5%
Over the years, the severity of medical care errors has decreased	QP 62.5%
Over the years, patient waiting time (meeting with physicians and workers) has been reduced	QP 87.5%
Over the years, waste in hospital processes has decreased	QP 87.5%
Over the years, the frequency of patient complaints has reduced	QP 87.5%

Source(s): Authors own work

Table 4.
Construct results

Fornell and Larcker (1981), should have a value of 0.6 or more. As the results show, for each of the extracted constructs, the CR and AVE values far exceed the minimum threshold:

(1) CQI CR = 0.9 AVE = 0.65;

(2) LM CR = 0.89 AVE = 0.67;

(3) SS CR = 0.9 AVE = 0.65;

(4) PS CR = 0.87 AVE = 0.59;

(5) TW CR = 0.87 AVE = 0.59;

(6) QPI CR = 0.89 AVE = 0.63.

The assessment of discriminant validity for the measures involved determining if the square root of the Average Variance Extracted (AVE) for each construct exceeded its correlation with other factors. Table 5 illustrates that, in line with Fornell and Larcker (1981), the square root of AVE for each construct was indeed more significant than the correlations between them:

SEM-based goodness of fit measures (Mason *et al.*, 2015) are employed in AMOS 23 to assess the closeness of the factor structure to the empirical data. The significance of x^2 *p*-value statistic is greatly influenced by sample size and is no longer considered the sole basis for accepting or rejecting a model (Hoyle, 1995; Schlermelleh-Engel *et al.*, 2003; Vandenberg, 2006). Consequently, there has been a shift towards utilizing multiple fit indexes to offer a more comprehensive assessment of goodness of fit. These indexes take into consideration not only sample size but also model complexity and other pertinent aspects of the study. Therefore, different values were considered. The Adjusted goodness of fit (AGFI = 0.81), standardised root means square residual (SRMR = 0.08) and comparative fit index (CFI = 0.98) reveal that the model is well-fitting.

The goodness of fit values are shown in Table 6:

4.4 Scale's reliability

Cronbach's alpha was employed to estimate scale reliability. Cronbach's alpha is a reliability coefficient that assesses the internal consistency of items. It evaluates the extent to which a set of items (a scale) are linked as a group. According to Kaiser and Rice (1974), Cronbach's alpha provides the evaluation that all components are consistent with one another. As a result, internal consistency was evaluated via Cronbach alpha for each of the six extracted

	CQI	LM	SS	PS	TW	QP
CQI	*0.845*	0.617	0.609	0.637	0.649	0.491
LM	0.617	*0.848*	0.657	0.667	0.558	0.671
SS	0.609	0.657	*0.894*	0.630	0.644	0.651
PS	0.637	0.667	0.630	*0.827*	0.555	0.590
TW	0.649	0.558	0.644	0.555	*0.802*	0.574
QP	0.491	0.671	0.651	0.590	0.574	*0.817*

Table 5. Discriminant validity

Note(s): *AVE values are marked in italic
Source(s): Authors own work

Measure	Results
χ^2/Df	2.245
RSMEA (Root mean squared error of approximation)	0.06
CFI (Comparative fit index)	0.98
NFI (Normed fit index)	0.97
AGFI (Adjusted goodness of fit)	0.81
SRMR (Standardized root mean square residual)	0.08

Table 6. Goodness of fit values

Source(s): Authors own work

components. A Cronbach's value of >0.7 was deemed adequate for this research (Christmann and Van Aelst, 2006).

The reliability for each scale is robust (CQ = 0.874; LM = 0.917; SS = 0.851; PS = 0.838; TW = 0.913; QP = 0.862). The investigation confirms that the coefficient (Nunnally and Bernstein, 1994) exceeds the threshold for measuring LSS and Quality Performance adoption in Italian public healthcare organizations.

5. Discussion

This study successfully reports the adaptation and validation of an existing scale for measuring LSS and QPI in Italy's public healthcare organisations. This analysis extracts six conceptual domains and constitutes an original adaption of a scale to assess the readiness to adopt Lean Six Sigma, and Quality Performance in Italian Public Health Organizations. The constructs show strong levels of internal consistency, as demonstrated by each items factor loading and each subscale reliability (Cronbach's $\alpha > 0.8$). The findings are consistent with previous studies that offer suggestions on potential Lean and Six Sigma applications to managers looking to implement them in their public healthcare organisations, bridging the gap that reveals fragmentation in the application of a comprehensive and all-encompassing scale of Lean and Six Sigma as methods for Quality Performance improvement (Caiado *et al.*, 2020; DelliFraine *et al.*, 2010). Moving from an academic attempt to provide solid theoretical foundations for the domains emerging from the factorial analysis (Table 1), the first adaption of a scale to assess Lean, Six Sigma and Quality performance in Italian Public Healthcare Organisations is provided.

Continuous Quality Improvement (CQI) is the most important factor (36.86%; 0.874) due to the approach to improving organisational processes (Sollecito and Johnson, 2011; Ryan and Thompson, 1998; Henrique *et al.*, 2021), which an individual effort would drive and thus become part of the organisational culture itself (Costa *et al.*, 2019). Continuous Quality Improvement supports Lean Management (LM) and Six Sigma (SS) initiatives. Lean Management (16.84%; 0.917) and Six Sigma (12.11%; 0.851) are considered practical drivers of organisational change because they strive to influence reducing waste and process improvement (Cesarelli *et al.*, 2021; Hollingshed, 2022; Sampalli *et al.*, 2015; Singh *et al.*, 2021; Kaswan *et al.*, 2022). Nonetheless, practitioners and researchers should constantly monitor these realms due to their complexity. Although organisations could be suitable for embracing them, as the study's findings reveal, these prerequisites are not always satisfied owing to internal or external contingencies (Albliwi *et al.*, 2014), particularly in healthcare (Ahmed *et al.*, 2013). LM and SS programs aim to ensure Patient Safety (7.70%;0.838) through error reduction and empowerment initiatives to raise patient awareness of attitudes and behaviour to prevent diseases (Ganaden and Mitchell, 2018; Lee *et al.*, 2021). The literature on LSS emphasizes that such efforts should be driven at the organisational level, encouraging the active engagement of the whole healthcare organisation and strengthening collaboration (McDermott *et al.*, 2022a, b; O'Mahony *et al.*, 2021). Considering the multidisciplinary orientation, inventiveness and diversity of team members, the Teamwork (TW) dimension is significant (6.45%; 0.913) in executing Lean and Six Sigma initiatives (Honda *et al.*, 2018).

The ultimate result of this implementation process is increased Quality Performance. Although at the bottom of the proposed methodological assessment (3.60%; 0.862), it maintains a strategic value, exhibiting the enhanced efficiency and effectiveness of Lean and Six Sigma solutions in organisational processes (Al Khamisi *et al.*, 2019; Ahmed, 2019). According to Saleeshya and Harikumar (2022), performance measurement is related to quality improvement, which should be assessed through a multimodal approach similar to the one proposed. Accordingly, both Lean and Six Sigma have a significant positive impact on quality performance in healthcare organisations.

Lean Management (LM) and Six Sigma (SS) are the approach that guarantee the public healthcare organisation's strategic goals, notably the improvement of Quality Performance (QP) and Patient Safety (PS). The literature explored the strategic importance of both Lean and Six Sigma techniques as quality and patient care drivers in surgery (Mason *et al.*, 2015) or in pharmacy prescription error reduction (Trakulsunti *et al.*, 2021). This is certainly relevant in the Italian context, where scholars support the implementation of Lean and Six Sigma approaches for a wide range of reasons, including reducing the length of hospital stay for patients (Scala *et al.*, 2021), implying a high degree of sensitivity not just to service quality as well as to the patient.

Emerging trends in patient-centeredness emphasise patients as the object of care, putting them at the core of healthcare design and delivery (Ciasullo *et al.*, 2022; Cavallone and Palumbo, 2020). To accomplish this, organisational conditions geared towards staff involvement and teamwork (TW) and a culture of continuous development must occur. The culture of CQI is beneficial when healthcare professionals cooperate. Meetings aided in adopting CQI, notably when team meetings focus on delivering goals and solutions through cooperation (Hill *et al.*, 2020). Simply put, the more frequently teams work together, the greater the continuous quality improvements (Kossaify *et al.*, 2017).

The study provides global public healthcare organisations with a new holistic assessment of LSS and Quality Performance that policymakers and primary healthcare professionals may use to evaluate their institutional readiness for Lean and Six Sigma. Significantly it was more effective to test the Ahmed *et al.* (2018b) scale in one region of Italy's healthcare system as compared to an overall country wide assessment. Testing in one region gave insight into the issues affecting healthcare effectiveness and quality in a poor regional area and thus provided better insights to evaluate readiness at a regional level. Each region has its own specificities, strengths, weaknesses and disparities, as well as regional-specific challenges.

This scale aims to contribute to the existing literature by providing extensive data on assessing public health organisation's Lean and Six Sigma readiness. Lean and Six Sigma are tools to achieve organisational process improvement (Ahmed *et al.*, 2013); their implementation results in public health organisations accomplishing their systemic goals, namely enhancing quality performance and ensuring patient safety (World Health Organization, 2017). This result is related to some critical organisational culture factors, such as openness to continuous employee improvement and teamwork, which, along with other issues, enhance these management methods' influence on process implementation (Talib *et al.*, 2011). To this extent, experts from the survey adaptation's Stage V pilot study address its potential to be adopted as a preliminary assessment before implementing any Lean and Six Sigma projects in the healthcare organisation. In addition, other participants stressed its relevance at the regional policy level, mentioning Campania's strong sensitivity to Lean programs and quality improvement strategies (Latessa *et al.*, 2021; Improta *et al.*, 2020). The ultimate implication of this study for practice is to help healthcare professionals to understand how they can deploy the many benefits of LSS methodology in improving operational efficiency and driving positive patient, staff and safety outcomes. From an academic viewpoint this study adds to the state-of-the-art literature as it further demonstrates how LSS can be deployed successfully in a healthcare environment.

6. Conclusion

Measuring LSS and Quality Performance Improvement readiness is essential in assessing public health organization's ability to implement initiatives to improve and streamline organisational processes. This study has both academic, theoretical and practical implications. From an academic viewpoint, the scale can be used to understand

organisational readiness factors for LSS and quality performance improvement at both an individual healthcare provider level and at a regional level and compare and contrast learnings, From a practical implication's viewpoint, managers and leadership teams can use the scale to assess readiness for continuous improvement initiatives. Patients can benefit as can the wider community from implementing LSS in the global public healthcare sector and leveraging this scale can lead to quality improvements within all areas of healthcare service provision. Thus, this can help enhance patience safety and help strive towards patient WHO rights in terms of healthcare.

This study presents some limitations. The literature from which the dimensions and scales employed for empirical measurement were extracted, although extensive (Hafner *et al.*, 2019), was not systematically conducted. In addition, the non-probabilistic sample chosen restricts the research to a geographically driven sample and adheres to the authors' discretionary criteria. In partnership with specific hospital facilities, professional organisations and local municipalities, future developments of this research could investigate representative samples of public healthcare organisations at both an Italian and a global level.

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Corresponding author
Olivia McDermott can be contacted at: Olivia.mcdermott@universityofgalway.ie