

Lean Six Sigma adoption in clinical pharmacy practice for reducing medicine waste in the NHS: Overcoming leadership and cultural barriers.

Krishnendu Saha¹

Bhavesh Patel²

Stefania Paladini³

¹Birmingham City University, Birmingham, UK.

²Croydon Health Services & Croydon Place, Croydon, UK.

³Queen Margaret University, Edinburgh, UK.

Corresponding author's email: krish.saha@bcu.ac.uk

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Abstract:

Purpose: This study investigates the role of leadership and cultural transformation in facilitating Lean Six Sigma (LSS) practices in clinical pharmacy settings to reduce medicine waste within the UK National Health Services (NHS).

Design/methodology/approach: A systematic literature review on Lean Six Sigma in health care was conducted to develop an analytical framework. This was followed by a qualitative case study of an English NHS trust to test the framework, exploring pharmacists' adoption of LSS practices and their impact on staff behaviour, focusing on leadership decisions and organisational culture.

Findings: The research highlights the significance of leadership's prioritisation in waste reduction efforts and its influence on staff engagement. It also examines the intricate relationship between leadership decisions, education and training, resource allocation, and the prevailing clinical culture, which shapes pharmacists' behaviours and attitudes towards LSS practices and waste reduction.

Originality: We developed a leadership model for the NHS to reduce medicine waste, offering a novel approach to addressing the challenge of medicine waste through leadership and cultural transformation.

Research limitations/implications: The study's focus on a single NHS trust limits the generalisability of the findings, suggesting the need for further research across different healthcare settings.

Practical implications: The study recommends a cultural transformation, earlier training, and reformation in service strategy to enhance the adoption of LSS practices and contribute to a more sustainable future for the wider health services.

Social implications: Effective medicine waste management prevents harm and helps address the current NHS medicine shortage. The NHS can allocate resources efficiently, ensure timely treatment, and prepare for future disruptions by implementing the proposed framework.

Keywords: Health care, Waste Management, Lean Six Sigma, Quality improvement, NHS, Leadership, Organisational culture.

Abbreviations:

E&T: Education and training
IQ: Indicative quotes
LSS: Lean and Six Sigma
NHS: National Health Service

PDSA: Plan-Do-Study-Act
QI: Quality improvement
SLR: Systematic literature review
UK: United Kingdom

1. Introduction

The NHS in the UK is a complex ecosystem that must balance multiple stakeholders' aspirations and the pressure to improve performance with limited resources, and providing prescribed medicines to patients under hospital care is one of its remits. Medicines delivered through the clinical pharmacies of NHS hospitals in England cost approximately £7.6 billion in 2020/21 (NHSBA, 2021). It is 40.4% of the NHS' total medicines expenditure and increased by 22% since 2016/17 (Koechlin et al., 2014).

Most medicines confer positive benefits when taken as intended; however, waste is inevitable (Peltoniemi & Suomi, 2019). Hazell & Robson (2015) identified two types of medicine waste: therapeutic loss and material waste. Therapeutic loss occurs when the medicines' effect is negated by the patient's failure to take them as prescribed due to non-compliance or non-adherence. On the other hand, material waste occurs when the medicines are physically unused and can be non-preventable (i.e., the patient dies) or preventable (supplied medicines are not needed or used). Reducing medical waste is essential for promoting sustainable use of NHS resources (Consolandi et al., 2020), with estimated waste costs reaching £300 million in 2010 (Trueman et al., 2010). Medicines also contribute to 25% of emissions in the healthcare system (NHS England, 2022). Although medicine waste represents a pressing issue, there has been no evaluation since 2010 due to the labour-intensive and challenging nature of the task.

The adoption of Lean Six Sigma (LSS) has successfully improved the NHS operational performance by reducing waiting times, improving dispensing flows, and reducing errors (Bancroft & Saha, 2016; Lima et al., 2020; Putra & Yusof, 2015). However, its success in improving clinical practice is contentious since the capacity-led orientation of the NHS constrains its ability to influence demand and re-utilise freed-up clinical resources. McCann et al. (2015) conclude that many LS projects were superficial, while Wright & McSherry (2013) highlight a publication bias towards reporting positive results of those projects.

Moreover, any efficiency assessment is limited by existing biases. Upon systematic literature review (SLR), our investigation revealed that existing studies (e.g., Joosten et al., 2009; Trakulsunti & Antony, 2018) primarily focus on the operational aspects of pharmacy when discussing LSS implementation, whereas clinical pharmacy is process-driven and more subjective (Lima et al., 2020), requiring a different approach. Further research is therefore needed on LSS adoption to improve clinical pharmacy practice.

Our review identified three contributions (i.e., De Souza & Pidd, 2011; McCann et al., 2015; Wright & McSherry, 2013) that extensively address the challenges NHS hospitals face in influencing staff behaviour and perceptions regarding LSS implementation, which, as we posited, are due more to leadership and governance than sheer operation management factors. Pharmacy staff resistance and lack of training and leadership support (John et al., 2017; Trakulsunti & Antony, 2018) emerge as critical barriers to LSS implementation. Hohmeier et al. (2020) and John et al. (2017) identify that pharmacists often lack training in LSS techniques as their education or employer-sponsored programs do not often include such QI initiatives.

This study aims to offer insights into leadership-related issues in LSS implementation in the clinical sector by identifying socio-cultural barriers (e.g., leadership, clinical culture) and strategies required for LSS-driven QI practice. Importantly, these insights will provide an immediate and actionable advice to the NHS in reducing medicine waste.

Two research questions guide the study, and namely:

RQ1. What are the leadership and cultural challenges to implementing LSS in clinical practice?

RQ2. How to overcome these challenges?

Using a combination of SLR and case study approach (Dubois & Gadde, 2014), we contribute to the existing literature by establishing that leadership prioritisation of QI and comprehensive E&T could reconfigure the clinical culture to adopt LSS successfully. Firstly, it reveals that hierarchical structures within pharmacy settings and a lack of leadership emphasis on waste reduction have hindered its integration into routine practice. Secondly, it demonstrates the importance of leadership decisions concerning education, training, and resource allocation. It also identifies that limited QI training for junior staff, offered years after registration, creates a knowledge gap, and impedes the effective implementation of LSS practices. And finally, the investigation emphasises how leadership's lack of prioritisation and direction for QI contributes to forming a culture where QI and patient care compete for pharmacists' attention.

This paper conducts an SLR to identify international factors influencing LSS implementation in section 2. Section 3 presents the rationale for our methodology. The analysis of qualitative data is presented in section 4. Section 5 presents the broader meanings of our findings, while section 6 concludes the paper.

2. Lean Six Sigma (LSS) adoption in the public healthcare system: a systematic review

The capacity-driven service delivery of the NHS hinders its ability to influence demand and reallocate resources to provide greater values, a fundamental principle of LSS philosophy (McCann et al., 2015). This affects employee motivation and engagement with LSS initiatives (De Souza & Pidd, 2011). Wright and McSherry (2013) and McCann et al. (2015) echoed these findings, highlighting how managing workload and staff resources significantly limit the implementation of LSS initiatives for clinical staff. Additionally, there is variation among stakeholders in defining customer value in the NHS since there is a divergence between valuing patients' perspectives and those of the individuals' commissioning services on their behalf. Therefore, De Souza & Pidd (2011) categorised the implementation challenges as either people-based (including leadership and staff resistance) or organisational (such as data collection, resource allocation, and siloed implementation of LSS).

After establishing the focus on the management side of LSS implementation as one of the crucial points, we applied the SLR method to identify the specific challenges, barriers, and critical leadership requirements. It appears evident that LSS can support clinical pharmacists in reducing medicine waste by increasing their awareness of wasteful practices and addressing issues related to duplication, oversupply, and errors. The extent is more of a matter of discussion: some authors (e.g., D'Andreamatteo et al., 2015; Putra & Yusof, 2015) argue that the narrow focus of initiatives limits their impact, others (e.g., (Trakulsunti & Antony, 2018) have shown that LSS practices can successfully reduce medication errors and improve processes in pharmacies.

Table 1 Analysis of LSS research in healthcare

Authors	Methodology	Scope	Key Findings
Abdallah [1]	Quantitative case-study	International (Jordan)	Leadership and employee behaviours affect implementation success.
Abdallah [2]	Quantitative case-study	International (Jordan)	Leadership, employee behaviour, and training are dominant factors.
Aij et al. [3]	Qualitative case study	International (Netherlands)	Leadership support is essential.
Bortolotti et al. [7]	Quantitative case-study	International (Italy)	Leadership aspects are the most influential determinants
Costa et al. [12]	Qualitative case study	International (Brazil)	Barriers associated with human-factors and organisational structure
D'Andreamatteo et al. [13]	Literature review	International (Italy)	Narrow approach, resources, and staff behaviours are barriers

Deblois & Lepanto [15]	Literature review	International Emergency-Departments (USA)	Higher methodological quality is required to understand influencing factors
De Souza & Pidd [14]	Qualitative case study	NHS (UK)	Staff behaviour and organisational culture are responsible for LSS failure
Erthal et al. [17]	Qualitative case study	International (Italy)	Organisational culture implicit to lean implementation
Glasgow et al. [18]	Literature review	International (USA)	Require information on sustained improvements
Hohmeier et al. [20]	Qualitative case study	Clinical Pharmacy (USA)	LSS can support clinical decision-making
Holden [21]	Literature review	International Emergency-Departments (USA)	Employee involvement and management support are critical success factors
John et al. [22]	Qualitative case study	Clinical Pharmacy (USA)	LSS benefitted from leadership opportunities and communication.
Joosten et al. [23]	Literature review	International (Netherlands)	Require more attention to sociotechnical dynamics
Lima et al. [25]	Literature review	International (Portugal)	Lack of sustainability and system-wide focus
Marolla et al. [26]	Qualitative case study	International (Italy)	Leadership and staff engagement are critical success factors
Mazur et al. [27]	Mixed-method case-study	International (USA)	Staff to develop double-loop learning
Mazzocato et al. [28]	Mixed-method case-study	International Emergency-Departments (Sweden)	Employee behaviour
McCann et al. [29]	Qualitative case study	NHS (UK)	LSS is not embedded into the culture, which limits the value
Poksinska [33]	Literature review	International (Sweden)	LSS generally used as a process-improvement approach
Putra & Yusof [34]	Literature review	Clinical Pharmacy (Malaysia)	Unclear roles and responsibilities are a barrier
Rees [35]	Mixed-method case study (New Zealand)	International Emergency-Departments	Organisational preparedness is essential for LSS to succeed
Spagnol et al. [37]	Literature review	International (Brazil)	Culture and staff mindset are prerequisites for LSS success
Tortorella et al. [38]	Quantitative case-study	International (Brazil)	Provides a theoretical framework for leadership to mitigate problems
Trakulsunti & Antony [39]	Conference paper	Clinical Pharmacy (UK)	Lack of leadership support and commitment are barriers to LSS success.
Wright & McSherry [42]	Literature review	NHS (UK)	Identify positive-results bias and culture and leadership barriers

The details of the SLR results appear in Appendix 1, while a summary of the findings is listed below (Table 1). The SLR here has identified seven overarching implementation challenges, i.e., strategy, leadership, processes, training, resources, technology, and staff behaviour. In particular, Table 2 shows that 26 reviewed articles found various aspects of leadership issues and staff behaviours as the key barriers to LSS-based QI implementation, while technology (4 articles) received the least coverage. However, the review also shows that training (4) is the most critical barrier for pharmacies, followed by staff behaviour.

Table 2. SLR summary by area of focus

Research scope	Implementation challenges						
	Leadership	Staff behaviour	Training	Strategy	Process	Resources	Technology
International hospitals (25)	22	21	15	14	13	9	4
NHS hospitals (3)	3	3	3	3	N/A	2	N/A
Pharmacy (4)	1	2	4	N/A	N/A	1	N/A
Total (32)	26	26	22	17	13	12	4

Figure 1, building on De Souza and Pidd (2011) and taking stock of the reviewed literature, proposes an analytical framework for reducing medicine waste. De Souza and Pidd (2011) divide these factors into human and organisational, namely leadership and staff behaviour in the human category and strategy, resources, technology, training, and processes in the organisational category.

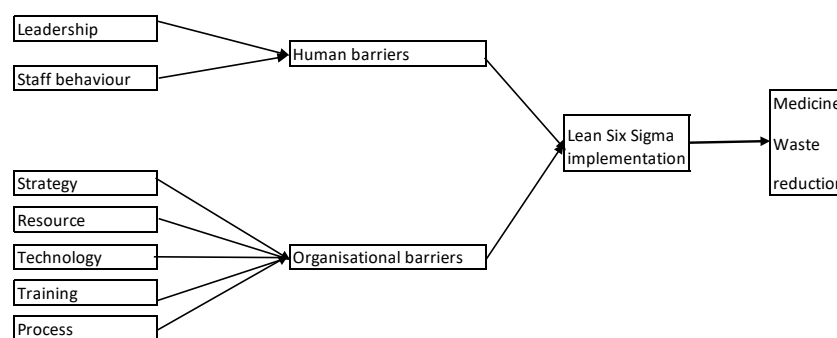


Figure 1: Analytical framework for reducing medicine waste.

Table 3 summarises the findings of our review of these seven factors crucial to LSS implementation. Such findings from the SLR correspond to Antony et al. (2023) recent review of LSS, which will then be critically discussed in the next two subsections.

Table 3 Barriers to LSS implementation

Barriers to LSS implementation	Factors	Critical observations for LSS implementation
Human barriers	Leadership	Effective leadership is vital for positive cultural change [13].
		Lack of leadership engagement negatively impacts staff motivation [1, 25, 28].
	Staff Behaviour	Staff resistance is a key challenge [18, 25].
		Resistance stems from inadequate training, resources, unclear processes, and reluctance to change [3].
		Communication gaps leave employees uncertain about alignment with job specifications and organisational goals [1,2].
	Organisational barriers	Strategy for LSS
LSS should be a continuous operating philosophy, not a one-time change [17, 27].		
Isolated LSS implementation affects inter-department workflow [13].		
Process for LSS		LSS standardisation may simplify clinical jobs, diminishing engagement [23].
		Inclusion of clinical practitioners is critical for successful LSS initiatives [15, 28].
LSS Training		Lack of training is a barrier to LSS implementation [1, 12, 15, 17, 25].
		Lack of personnel with knowledge and experience of LSS methods to provide training [15].
		Developing employees' problem-solving skills through double-loop learning [21, 33].
Resource for LSS		Implementing LSS has significant resource implications [15,25].
	Misallocating resources is a leadership error that reduces employee motivation and leads to failed LSS initiatives [37].	
Technology for LSS	Technology, especially data technology, is a significant barrier to LSS in healthcare [1, 38].	

2.1 Human factor significant in LSS implementation

(a) Leadership

Effective leadership, particularly from executives and middle managers, is vital in creating a positive cultural change necessary for LSS implementation (D'Andreamatteo et al., 2015). This entails empowering employees, providing motivation and support, and fostering the visibility and identification of leaders during the various stages of implementation (Erthal et al., 2021). However, hierarchical organisational structures are an implicit barrier to LSS implementation (Costa et al., 2017), as they hinder visibility, communication, and engagement between leaders and frontline staff (Aij et al., 2013; Poksinska, 2010). Therefore, leaders play a critical role in shaping organisational structures, enabling engagement with all staff, and embedding new behaviours into the culture (Abdallah, 2020; Spagnol et al., 2013).

The lack of leadership engagement, support, and commitment negatively contributes to staff demotivation and LSS project failures (Abdallah, 2014; Lima et al., 2020; Mazzocato et al., 2012). Aij et al. (2013) suggest that leaders must engage employees in developing a vision of a waste-free future, a momentum for QI initiatives, and a strategy for LSS implementation. Leaders who drive change in line with the organisational strategy and boost staff motivation can lead to the widespread adoption of LSS methodologies (Marolla et al., 2021). Therefore, clinical leadership has two key deliverables: (i) aligning organisational culture and structure, and (ii) enhancing employee motivation for LSS implementation.

(b) Staff Behaviour

A key challenge many hospitals face in adopting LSS principles is resistance to change from staff (Glasgow et al., 2010; Lima et al., 2020). Existing literature fails to measure how LSS initiatives may lead to staff resistance (Bortolotti et al., 2018; Costa et al., 2017) due to its excessive focus on operational barriers. Employee resistance can stem from insufficient training, resources, unclear processes, and a reluctance to change (Aij et al., 2013). Abdallah (2020) observed that the communication gap during LSS implementation leaves employees uncertain about its alignment with their job specifications and broader organisational goals. Such uncertainty creates tensions and cultural clashes among employees (Erthal et al., 2021) if resources, training, and motivational needs are not addressed adequately (Poksinska, 2010). Negotiating with employees with different goals and values can help deal with behavioural resistance (Joosten et al., 2009; Spagnol et al., 2013).

2.2 Organisational issues critical for LSS implementation

(c) Strategy for LSS

The LSS implementation strategy needs to define the value from the customer's perspective (Rees, 2014). However, determining what holds value for clinical staff can be ambiguous due to varying stakeholder perspectives (Holden, 2011). LSS implementation strategy should align organisational vision, culture, and values to avoid conflicting stakeholder priorities (Holden, 2011; Rees, 2014). Part of the literature (e.g., Aij et al., 2013; Holden, 2011; Poksinska, 2010) argues that LSS implementation is not a one-time change in work processes but a new way of thinking. However, organisations often fail to incorporate LSS as an operating philosophy as opposed to an application of tools. If principles are not embedded into employees' thinking and behaviours, organisations revert to their usual working methods, especially when finding themselves with competing priorities (Erthal et al., 2021; Mazur et al., 2012).

Similarly, many organisations have implemented LSS in isolation and not across the organisation (Lima et al., 2020; Mazzocato et al., 2012). This narrowly focused approach affects other departments' workflow and hinders the integration of LSS initiatives into routine practice (D'Andreamatteo et al., 2015). When an organisation embeds LSS as a philosophy for continual improvement, it increases the chances of successful implementation (Rees, 2014; Deblois & Lepanto, 2016). Poksinska (2010) reaffirms that organisations implementing LSS must review its principles, methods, and tools whilst aligning concepts to fit their context and strategy.

(d) Process to deliver LSS

One commonly implemented LSS initiative in hospitals is standardisation, aimed at reducing variation, errors, and waste (Tortorella et al., 2019). However, standardisation makes clinical jobs simpler and more repetitive and diminishes the challenging nature of work for trained healthcare practitioners (Lima et al., 2020). This can hinder their engagement with LSS initiatives as they may feel less motivated to implement interventions unless the freed-up time is replaced with more stimulating and meaningful tasks (Joosten et al., 2009). Therefore, when organisations seek to improve their processes, they must identify key operational areas and determine how resulting changes impact employees (Tortorella et al., 2019). The inclusion and active engagement of clinical practitioners in the design, management, and evaluation of process improvements are critical for successful LSS initiatives (Deblois & Lepanto, 2016; Mazzocato et al., 2012). This approach not only supports the problem-solving skills of clinical staff but also fosters their engagement with LSS practices (D'Andreamatteo et al., 2015).

(e) LSS Training

A substantial number of existing papers (e.g., Costa et al., 2017; Deblois & Lepanto, 2016; Erthal et al., 2021) indicate a lack of training as a barrier to LSS implementation. Most experienced clinical staff are unfamiliar with LSS methodology. Their clinical competencies, therefore, do not automatically translate into waste reduction practices.

The problem for hospitals is the lack of personnel with knowledge and experience of LSS methods to provide training (Poksinska, 2010). Training is often delivered internally due to resource constraints, which significantly limits the hospital's capacity and quality of training (Holden, 2011). To resolve this, D'Andreamatteo et al. (2015) suggest that organisations can develop LSS training programmes with external expertise. Mazur et al. (2012) found that clinicians solve most problems through single-loop learning. However, a central part of LSS training is developing employees' problem-solving skills through double-loop learning. Clinicians need to reflect and internalise insights to become root-cause problem-solvers (Bortolotti et al., 2018).

(f) Resource to deliver LSS

Implementing LSS methodologies in healthcare has significant financial and non-financial resource implications. For Spagnol et al. (2013), misallocating resources is a critical leadership error that reduces employee motivation and engagement and ultimately fails LSS initiatives.

Public sector hospitals like the NHS face a dilemma in allocating scarce resources effectively to foster a culture of continuous improvement (D'Andreamatteo et al., 2015). This is exacerbated while training staff, as substituting them for those training hours is problematic for an under-resourced team. This creates tensions and trade-offs with resource allocation, especially for clinical staff whose roles and responsibilities are not easily substituted without impacting patient care. Pharmacists need adequate time to actively participate in improvement initiatives (Aij et al., 2013).

(g) Technology to facilitate LSS

Studies on healthcare systems (e.g., Abdallah, 2014; Angeli & Jaiswal, 2016; Tortorella et al., 2019) in developing countries have identified data technology as a significant barrier to successfully implementing LSS methodologies. Data supports employee engagement, motivation, and stability by establishing a link between implementation efforts and the overall improvement strategy (Poksinska, 2010). To adopt LSS principles and behaviours successfully, leaders define quality targets, understand customer value, and make data available to highlight performance improvements (Costa et al., 2017; Rees, 2014). Unfortunately, the collection and effective communication of reliable data in a timely manner poses challenges in healthcare settings (Lima et al., 2020).

The SLR carried out has identified a strong connection between the factors influencing LSS implementation and their impact on staff behaviour. Leadership and employee behaviour are the most critical factors for successful implementation (Erthal et al., 2021). The remaining factors indirectly influence LSS implementation by shaping staff behaviour and resistance to change, together with organisational resources and capabilities. Addressing these factors within pharmacy management can positively influence staff behaviour and facilitate the implementation of LSS practices to reduce waste, as shown in the analytical framework developed in Figure 1.

This analytical framework will now be tested through a qualitative survey of clinical pharmacists to ascertain if it is possible to implement it to support clinical pharmacists in adopting LSS to reduce medicine waste.

3. Methodology

Case studies are the preferred methodological approach in 17 of 32 papers reviewed here (Table 1), and qualitative research is the methodological approach privileged in organisational behaviour (Aij et al., 2013) for a better understanding of context, personal experiences, and interpretations of participants. This explains why a mono-method qualitative study was selected to test the analytical framework of Section 2. We used Semi-structured interviews for the data collection, enabling a detailed insight into the perceptions of clinical pharmacists based on their contexts (Bell et al., 2019). Interviews were conducted in January 2023 through Microsoft Teams on the respondents' chosen date and time to minimise the impact on their daily patient care activities.

As for the selection criteria and to ensure purposeful and rich data, interviewees must have sufficient experience and knowledge regarding the clinical pharmacist's responsibilities, as well as barriers and enablers to LSS-based QI initiatives. The research was therefore conducted at the pharmacy department of a district general hospital in London, United Kingdom. The selected London hospital provides healthcare services to a large, multi-ethnic, and diverse population. The hospital also runs its own quality improvement programme, which has not delivered envisaged waste reduction across its operations. With a pharmacy department comprising 38 full-time clinical pharmacists of different seniority levels, the hospital presents an adequate setting for studying LSS-based QIs. Recent reorganisations, staff recruitment freeze and multimillion-pound cost-cutting measures at the hospital also provide an opportunity to investigate the resilience and adaptability of LSS methodologies in challenging circumstances.

Clinical pharmacists conduct medicine reviews and reconciliation of medicines, order medication for patients, and prepare discharge prescriptions. As reducing medicine waste is a vital expectation of the

clinical pharmacist's role in supporting the NHS Trust's cost and efficiency improvement plans, this sample provided the best possible opportunity to carry out our data collection. An iterative sampling approach was applied until no new information was found, making further sampling redundant and leading to data saturation (Busetto et al., 2020). Data was collected based on the experiences of 14 clinical pharmacists (Table 4).

Table 4 Sample demography

Group	Number of Pharmacists	Average Experience (Years)
Junior Pharmacists	4	1.6
Senior Pharmacists	5	3.3
Lead Pharmacists	4	10.3
Chief Pharmacist	1	15
Sample coverage	14	7.5

It is essential to point out that while our research focuses on a single NHS trust, our data represents broader trends and challenges in LSS adoption within the NHS. For the way it was selected, the sample can be considered representative of the standard clinical pharmacy practice in NHS hospitals and, therefore, serve as a foundation for theory development and guide actionable suggestions.

The semi-structured interview questions (itemised in Appendix 2) were derived from the SLR to capture the relevant insights necessary to address the research questions. The interviews focused on concepts such as current clinical priorities, perceptions and experiences related to QI, factors influencing the adoption of QI practices, and opinions on LSS and its impact on waste reduction. Data analysis followed established procedures recommended by Braun & Clarke's (2021) six-phase thematic analysis framework to establish rigour through confirmability, dependability, credibility, and transferability, enabling orientation of data collection and categorisation for thematic analysis. Recordings were transcribed verbatim using Microsoft Teams into transcripts, with each transcript

manually double-checked for accuracy against the respective recordings, allowing familiarisation with the data. Transcripts were uploaded to QSR NVivo, version 12[®], a qualitative data management software for coding using an inductive thematic analysis approach and systematically organising the data whilst still providing an audit trail (Bryman & Bell, 2016).

All the interview results were loaded and processed through NVivo. A set of working codes was produced based on the categories identified from the SLR to facilitate analysis (Appendix 3), followed by coding transcripts using a 2-step open and axial coding process (Corbin & Strauss, 2015). Coding makes raw data sortable by connecting data to relationships between them, and transcripts on NVivo[®] were coded using descriptive coding for each text fragment (open coding), which helped summarise segments (Busetto et al., 2020).

Following the coding of the first transcript, open codes were grouped, cleansed, and then categorised based on codes from the SLR. The coding of all transcripts was re-analysed to ensure consistency following each interview, combining codes to distil them down. Open codes were refined using axial coding, identifying patterns through synthesis and abstraction, removing, summarising, and grouping where appropriate (Corbin & Strauss, 2015). For example, several pharmacists mentioned that there needed to be a 'vision' and awareness of the 'bigger picture' to reduce waste, both initially categorised as strategies from the SLR and mentioned in more than one context when required, such as (1) Senior management needed to highlight how medicine waste fits the bigger picture. (2) Senior management is responsible for creating a vision to reduce waste or (3) a vision is required to engage pharmacists to reduce waste.

Through the refinement process, the initial open codes of 'vision' and 'bigger picture', categorised as strategy, were refined to axial codes of senior management and engagement. This process was repeated for each transcript, comparing open and axial codes to those previously generated to ensure consistency. Axial categories were critically reviewed to determine their core meaning, with those that displayed similar patterns making sub-themes of an overarching theme. For example, axial categories of senior management and engagement were grouped under the theme of 'insufficient leadership', with both categories consisting of open codes negatively correlating to the role of leadership.

4. Data Presentation and Analysis

The data preprocessing carried out above identified 95 codes grouped into nine axial categories from which four themes (i.e., resources, E&T, leadership, and clinical culture) emerged. These themes were interdependent but distinctly different in how they influenced pharmacists' participation in reducing medicines waste.

4.1 LSS in NHS pharmacy

Our interview with the chief pharmacist revealed that LSS practices were introduced to the NHS in 2010, which is consistent with the existing literature (Bancroft et al., 2018). However, the NHS has often failed to adopt a systemic view and instead attempted to implement lean practices on a more localised level through departmental leaders. LSS practice delivery was not integrated into the trust's overarching strategy, and training was sporadically provided through webinars and managers. The primary focus was on reviewing processes, but due to the lack of a clear strategy and the narrow focus of many managers, the broader system benefits were seldom realised.

Interview data also suggests that in pharmacy, numerous processes are interdependent, making it challenging to isolate improvements. Pharmacists examined different processes to cut waste. A critical issue was that these improvements were treated as isolated changes, as the chief pharmacist felt with the whole implementation process:

Lean became a common term used for any improvement, no matter how large or small and one which rarely delivered sustained improvements and soon just became a term with little meaning other than reduce waste. [Participant 1]

Consequently, when clinical activity increased within the trust, the newly introduced behaviours and processes were not adopted as routine practice. Many staff reverted to their usual practices, resulting in the stalling of improvements. Additionally, insufficient time was allocated to integrating these changes into the culture. Routine care delivery consistently took precedence, and staff had to put initiatives on hold.

The chief pharmacist identified eight key reasons, and namely lack of (1) clear strategy, (2) training, (3) awareness and (4) integration, (5) time constraints, (6) cultural resistance, (7) leadership engagement, and (8) disconnect between strategy and practice, for which NHS did not gain the expected outcome from LSS implementation. For the benefit of discussion, we aggregate the reasons into E&T, resources, and leadership as the principal determinants of LSS supporting clinical pharmacists to reduce waste.

4.2 Inadequate E&T

This theme consisted of two sub-themes: *E&T itself*, with nine codes and 91 references, and *QI experience*, with 126 references (Appendix 3). Around half of the most experienced pharmacists in our data set had formal QI training through post-graduate clinical diplomas. The department funded this three-year course, aiding juniors in their career development and delivering QI training in the last 12 months (UCL, 2023). However, the formal training rate of recently employed pharmacists was far

lower (Table 5). For the most part, pharmacists learned audit and PDSA cycles in the diploma program, while no participants indicated awareness of LSS practices.

Table 5: Summary of pharmacists' QI training & experience

Seniority level	Awareness of LSS-QI methodology	Formal LSS-QI training	Practical Experience of LSS-QI	Used LSS-QI more than once in practice	Successful implementation
Junior Pharmacists (4)	4	0	2	0	7
Senior Pharmacists (5)	4	2	3	0	7
Lead Pharmacists (4)	4	4	4	2	4
Chief Pharmacist (1)	1	1	1	1	1
Total (14)	13	7	10	3	7

Although reducing medicine waste through QI is a strategic goal and an implicit requirement for all pharmacists, our data reveal that training opportunities are non-existent for early-career pharmacists. However, the formal training opportunity usually arises three to four years after a pharmacist's registration, and by this time, they have typically reached senior positions. Our investigation of the UK undergraduate pharmacy curriculum indicated the absence of QI through efficiency and waste reduction (UCL.,2023). This training deficit has wider repercussions, as pharmacists' collective experience and knowledge in effectively implementing and embedding LSS within their practice is constrained.

One finding is that only a few have utilised LSS methodologies more than once in their careers despite practical training. This reality casts doubt on the potential of LSS to significantly reduce waste (Table 6, IQ 1). Remarkably, five of the six pharmacists with formal training expressed the need for further E&T to proficiently deliver QI initiatives alongside their clinical responsibilities (Table 6, IQ 2). The inability of trained pharmacists to effectively apply these skills in their own practice and when guiding junior colleagues has led to a basic grasp of QI among juniors (Table 6, IQ 3).

Table 6 Illustrative quotes on E&T

Education and Training (ET) issues	Illustrative Quote (IQ)	Source
Lack of depth	1. I think my training is not in-depth as it should be to deliver a proper QI. I only have what I studied in diploma four years ago and have used it once, as it's not been drilled into me or ever made a priority.	MP, Lead-Pharmacist
Limited application	2. With all my other responsibilities, I don't use it as much as I probably should as using it once in five years, I don't even remember what we done, so none of these skills have become embedded, and I would need further training to deliver an improvement.	MH, Lead-Pharmacist
Lack of understanding	3. My junior did not know what I was even talking about, so the time to explain things to them and train them makes it difficult. Because of that, you don't have the staff with the basic skills to help deliver QI.	MR, Senior-Pharmacist
Lack of importance	4. While training is always beneficial, since we all engage in QI within our roles and have an awareness of it, I don't think specific training is essential.	HJ, Junior-Pharmacist
Earlier training	5. Training needs to be much earlier. It's so important to have basic QI training before being signed off as a pharmacist so they appreciate this as part of the role and are empowered to improve services. That would remove half the battle in teaching them the basics, which is difficult when their focus is naturally on patients, at which point it's not our priority either.	OA, Lead-Pharmacist

We observed differing opinions among pharmacists on the importance of E&T for successful LSS implementation (Table 6, IQ 4). These findings contrast previous literature (D'Andreanmatteo et al., 2015; Glasgow et al., 2010), which accentuates the potential of organisations to nurture employees skilled in LSS initiatives. This is also reflected in how pharmacists perceive various success factors for LSS implementation, with importance increasing alongside experience (Table 7).

Table 7: Pharmacist importance of factors influencing LSS implementation.

Success factors	Junior Pharmacists (4)	Senior Pharmacists (5)	Lead Pharmacists (4)	Chief Pharmacist (1)
Leadership	very high	very high	very high	very high
Strategy	high	very high	very high	very high
Resources	very high	very high	high	medium
Education & Training	high	very high	very high	high
Technology	high	high	high	low
Process	high	high	high	high

To address these issues, participants highlighted (25 references in interview data) the importance of earlier LSS-based QI training for junior pharmacists (Table 6, IQ5) in a similar way as Deblois & Lepanto, (2016) and Poksinska (2010). Earlier training would empower pharmacists to utilise LSS more effectively and would enable lead pharmacists to focus more on service improvements (Holden, 2011).

4.3 Resources constraints

The overwhelming nature of resource constraints within NHS hospitals is evidenced through 96 citations in our data transcripts and correspond to previous works of McCann et al. (2015) and Wright & McSherry (2013). Lack of time, insufficient staff, and insufficient staff support are earmarked for resource issues. Such constraints result in excessive workloads and well-being issues. Consequently, pharmacists face fatigue, emotional, physical, and psychological stress, absenteeism, and unintended errors in procedures. Pharmacists intrinsically linked lack of time, insufficient staff, and workload to one another (Table 8, IQ 1):

Table 8 Illustrative quotes on Resource constraints

Resource constraints	Illustrative Quote (IQ)	Source
Lack of time, insufficient staff and workload	1. Our crisis is staffing, as we constantly have no staff, affecting our time. Because pharmacists have to take on more wards, there is no time to think about the other aspects of our role, such as finances or improvements.	AH, Senior-Pharmacist
Resource constraints leading to competing priorities	2. Most projects fail or become stagnant as we are always pushed for time. So to deliver improvements and implement changes requires more staff and time, as if it is something just added to your daily role, then you are never going to prioritise wastage ahead of seeing patients.	MR, Senior-Pharmacist
Managerial intention for waste management	3. In order to reduce waste, it must be given priority. Without that, even if there is available time, it won't be dedicated to it. If it were a priority, I would strive to incorporate it more into my team's objectives.	MP, Lead-Pharmacist

Increasing patient-facing responsibilities limits pharmacists' time to engage with LSS (Table 8, IQ 2). Figure 2 demonstrates how delivering patient safety and participating in QI are competing priorities for pharmacy staff time.

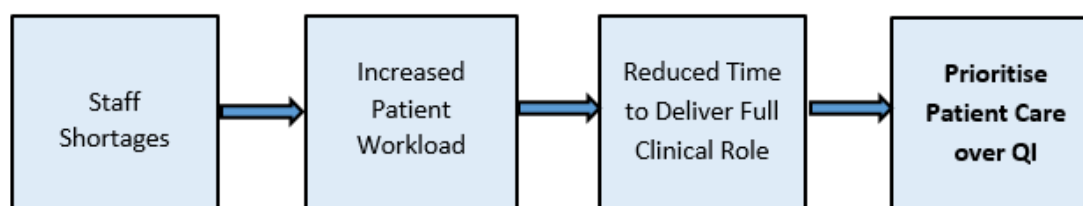


Figure 2: Impact of resources on clinical priorities

Often the first to take on additional clinical responsibilities, junior pharmacists found it challenging to look beyond their clinical duties. Although all the interviewed pharmacists recognised the significance of having more resources for LSS to cut down waste, its importance diminishes with the pharmacists' experience. This trend is evident in Table 8, where resources ranked highest for junior and senior pharmacists but decreased to medium for lead pharmacists. Time was a crucial resource for them to engage with LSS initiatives (Table 8, IQ 3). Making LSS a priority within the department and explaining its relevance to pharmacists' roles could assist lead pharmacists in setting aside time for themselves and their junior colleagues to engage in QI initiatives.

4.4 Clinical Culture of the NHS Pharmacies

Pharmacists' focus on patient safety and limited consideration for waste strongly shaped the clinical culture. Patient safety was a recurring theme in all interviews, referenced 236 times, while waste received little attention, mentioned 91 times. Pharmacists prioritised patient safety in their clinical roles, with four key processes (i.e., completing discharges, ordering critical medicines, undertaking histories for new patients, and ordering medicines for the remaining patients) aimed at providing patient care and reducing harm being consistently highlighted (Table 9, IQ1).

Table 9 Illustrative quotes on practice priorities

Practice priority		Illustrative Quote (IQ)	Source
Safety	1	My daily priorities are based on safety as I prioritise what will have the most patient harm, so it has to be ordering critical medicines and completing discharges. I think it will be safety for any ward pharmacist, so they will prioritise based on that."	OA, Lead-Pharmacist
Waste reduction	2	I would say it's a consideration every time I order something. I'm thinking, OK, is this a valid request as I won't re-order medicines if they already have it or more at home.	JQ, Junior-Pharmacist

Competing priorities	3	I know, as pharmacists, we should all be doing it, but if I am honest, efficiency, improvements and stuff like that are much lower than safety and everything else. If I was making an improvement and did not order a med or see a patient and they came to harm, how can I justify that.	MP, Lead-Pharmacist
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For most, waste reduction was a reactive response triggered by incidents (Table 9, IQ2) when considering the subsequent supply of medicines (Table 9, IQ3). Pharmacists rated their priority of the critical processes in Table 10.

Table 10: Pharmacist importance attributed to aspects of their clinical role.

PRIORITIES	PHARMACIST SENIORITY LEVEL			
	Junior	Senior	Lead	Overall
1. DISCHARGES	moderate	very high	very high	high
2. CRITICAL MEDICINE	very high	very high	very high	very high
3. NEW PATIENTS/DRUG HISTORY	high	high	high	high
4. ORDERING MEDICINES FOR THE REMAINING PATIENTS	moderate	moderate	moderate	moderate
5. MEDICINE WASTAGE	moderate	moderate	moderate	moderate

Our interview data reveals that a timely medication supply ensures that patients receive their medications promptly. This is especially crucial for high-risk patients who require urgent and critical medications to manage their conditions effectively. Discharges are also a significant consideration for pharmacists, as they understand the importance of freeing up hospital beds for new patients in critical condition. Therefore, they prioritise medication orders and administrative tasks related to discharges to expedite the process and optimise bed utilisation as interviewee SH indicated:

It's embedded in me to prioritise discharges first. [Participant 2]

4.5 Leading the LSS based QI for medicine waste reduction.

This significance of leadership is evident in our data as it is the only factor that received high-importance ratings from all pharmacists (Table 8). Those with QI training consistently ranked it with the highest importance. We have further dissected the leadership theme into (i) engagement and (ii) senior management support subthemes (Aij et al., 2013). Effective implementation of QI initiatives hinges on a multi-faceted foundation, as IH, a Lead-Pharmacist in our sample, aptly articulated. When looking at engagement, nine codes and 90 references included engaging staff with a vision, articulating the need to change, raising awareness, and making the change a priority for staff. For those

pharmacists who had formal QI training, engagement in using LSS to reduce waste was a responsibility of the leadership team. Awareness and priority are the most notable elements that positively affect engagement with LSS, as a junior pharmacist indicated:

People know it's a problem, but I do not think we know how big. I certainly did not until now. I wasn't even aware we had tried any initiatives as there is no plan, so to participate, everyone needs to be aware of it, and it needs to be a priority for them. [Participant 4, SH, Junior-Pharmacist]

Although all pharmacists recognised waste reduction as a concern, their understanding of its magnitude and the expectation for their involvement could have been improved. This observed negative connection between insufficient engagement and successful LSS implementation echoes findings from other studies (e.g., D'Andreamatteo et al., 2015; Holden, 2011; Poksinska, 2010).

Senior management support is heavily referenced in our data and corresponds to existing literature (e.g., Aij et al., 2013; Lima et al., 2020; Mazzocato et al., 2012). With 131 instances and 12 codes highlighting the significance of factors like (1) management engagement, (2) infrastructure, (3) culture, and (4) support. Sustained commitment and active involvement from senior management signal that QI holds considerable significance and warrants dedicated pursuit. Training and resources are of little use if management does not support QI practice (IH, Lead-Pharmacist). We understand that senior management buy-in is critical to fostering an environment and culture conducive to QI success.

4.6 Eliminating cultural barriers

Despite junior pharmacists being ideally positioned to identify and address waste-related issues due to their involvement in the bulk of clinical services, a hierarchical clinical structure creates a disconnect between them and the leadership team. Moreover, the disconnect between frontline pharmacists and the leadership team blinds senior managers to the actual extent of the waste problems (Holden, 2011). Such a hierarchical structure impedes communication and participatory engagement in QI initiatives (Costa et al., 2017).

The values, experiences, and behaviours related to safety exhibited by more experienced pharmacists establish a benchmark for the practice of junior pharmacists. As junior pharmacists gain experience and subsequently impart training, they perpetuate these same values and behaviours, thereby ingraining them into the prevailing culture that defines clinical practice (Figure 3).

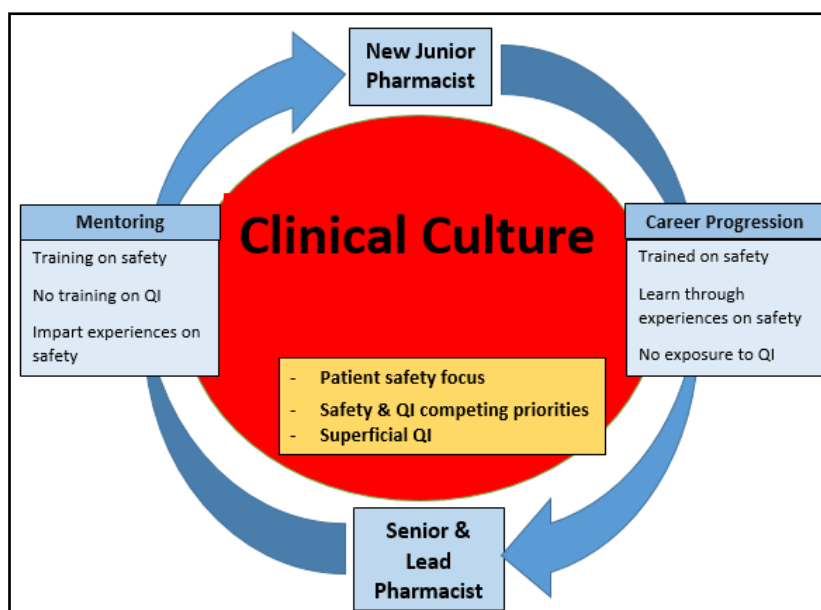


Figure 3: Factors determining clinical culture.

These findings align with existing literature (D'Andreamatteo et al., 2015; Erthal et al., 2021) that emphasises the need for a culture of continuous improvement. For pharmacists with formal QI training, a shift in the mindset of their peers is considered the most crucial factor in adopting LSS for waste reduction. They emphasise the need for leadership to steer a cultural shift, moving QI from a secondary aspect of their roles to an integral part of regular clinical decision-making processes (Holden, 2011). Otherwise, LSS principles and patient care will always be competing priorities (Table 9, IQ5).

5. Discussion of the Results

Based on an extensive SLR and in-depth interview data, we established that strategy, leadership, processes, training, resources, technology, and staff behaviour all bear a significant influence on LSS practices in healthcare settings. The interviews highlighted the presence of hierarchical structures in pharmacy settings, wherein leadership engagement with junior pharmacists was limited, subsequently impacting the awareness and priority of QI initiatives and leading to a reactive and incident-driven approach to waste reduction. This finding aligns with earlier research (Table 11), confirming the pivotal role of leadership engagement, awareness, priority, direction, and support in successful LSS implementation.

Table 11 Summary of findings and corresponding literature

Critical factors of successful LSS-based QI	Key findings	Corresponding literature
Inadequate E&T	Lack of QI training for early-career pharmacists leads to a shortage of skilled resources for LSS initiatives. The importance of E&T increases with experience and seniority of pharmacists.	[15, 17, 21, 33]
Resource constraints	Limited time and staff lead to fatigue and challenge the balance between patient safety and medicine waste reduction. Junior pharmacists face the most difficulty allocating time for QI alongside patient care.	[29, 42]
Leadership engagement with LSS-based QI	Lack of engagement among pharmacists in waste reduction hindered the effectiveness of LSS. The absence of a comprehensive strategy contributed to the lack of guidance in this area.	[13, 21, 33]
Leadership support for LSS-based QI	The absence of leadership support in integrating waste reduction practices demotivates pharmacists. Active involvement from senior management signals the importance of the initiative and encourages a problem-solving approach.	[3, 25, 28]
Clinical Culture of the NHS Pharmacies	Hierarchical structures create a disconnect between junior pharmacists and the leadership team. Cultural transformation needs to integrate LSS practices and patient care seamlessly.	[2, 14, 17, 21, 28, 37]

Our study also found that leadership decisions pertaining to the E&T of pharmacists play a significant role in the execution of QI initiatives. The lack of basic QI knowledge among junior staff acts as a barrier, rendering training resource-intensive and limiting the pool of empowered resources capable of contributing to QI initiatives.

Moreover, when lead pharmacists face increased workloads due to staffing shortages, they prioritise patient care over QI. Over time, this approach has become embedded in practice and perpetuated through training, assessments, and senior pharmacists' experiences. Patient care and QI began to vie for pharmacists' time, creating a competition between these two priorities. As a result, patient care inevitably took precedence over QI, establishing this as a characteristic feature of the clinical culture.

For NHS pharmacy departments, the prioritisation of QI, resourcing, and support for E&T play pivotal roles in reshaping the prevailing clinical culture. To successfully adopt LSS practices for waste reduction, these leadership decisions need to evolve. Consistent with the reviewed literature, these findings offer insights into the technology and process aspects that are currently not a priority for pharmacists but become critical during QI implementation (Samanta et al., 2023). Our study also

confirmed earlier research about the need for pharmacy leaders to adopt LSS into the operating culture for pharmacists as an essential step to achieving medicine waste.

An integrated conceptual model, presented in Figure 4, demonstrates the importance of pharmacy leaders in integrating waste reduction into daily practice, revealing three key factors critical to advancing LSS for waste reduction efforts within NHS pharmacies.

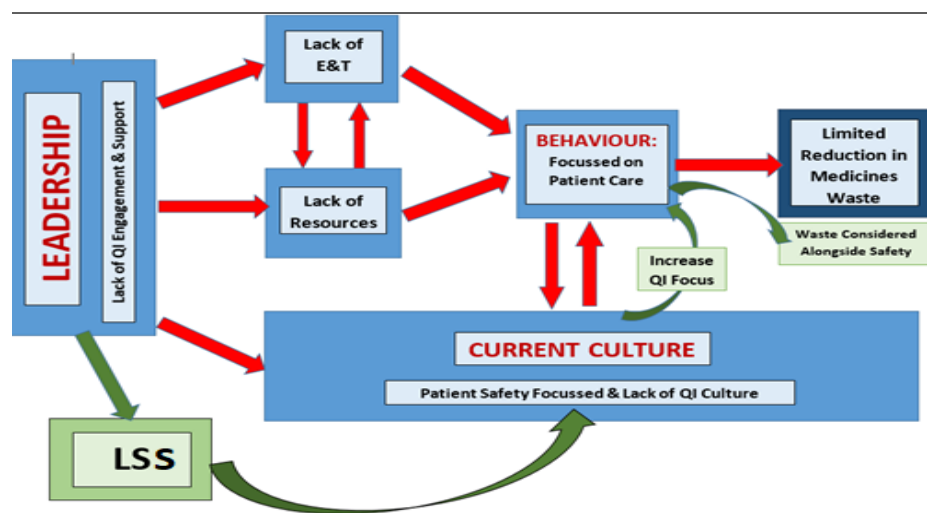


Figure 4: Conceptual model for reducing medicine waste.

First, leadership prioritising LSS will naturally allocate more time and resources to this pursuit. The second critical element is training. A gap exists between experienced lead pharmacists and junior staff, leading to an underutilisation of QI skills. Bridging this gap can be achieved by offering comprehensive QI training to junior staff, enhancing their active engagement in waste reduction initiatives.

As the third and fundamental step, it is critical to reshape the clinical culture. Leadership decisions profoundly impact how pharmacists perceive their clinical roles, align with waste reduction goals, and prioritise their actions. Therefore, Figure 4 proposes a cultural transformation championed by leadership, wherein QI and patient care intertwine harmoniously to reshape the clinical landscape and enable meaningful waste reduction. This transformation is essential to seamlessly integrate QI practices and patient care into everyday clinical practice.

But, in order to achieve this, leaders must actively infuse LSS principles into the culture and ensure they become a routine part of pharmacists' clinical roles. Failure to do so would result in superficial and process-driven implementation. This, in turn, requires leaders to challenge established practices regarding QI training timing and methods, address clinical priorities, and dismantle

hierarchical organisational structures that hinder pharmacist empowerment and problem-solving capabilities.

Our study, therefore, recommends that pharmacy leaders take ownership of delivering a cultural change. NHS leaders need to transition from using QI solely for process improvement to utilising it as a catalyst for change and integrating QI into the clinical service strategy. This involves increasing awareness, understanding its practical implementation, actively engaging with pharmacists, and providing support and direction for its delivery. To address the critical time poverty of NHS pharmacists, we recommend embedding QI initiatives in the undergraduate course. Offering QI training at the undergraduate level instils an understanding of resource efficiency, aligning with NHS and public expectations. Providing QI training to student pharmacists during their supernumerary year will also empower them to reduce waste without impacting patient care.

6. Conclusions

How can LSS practices usefully contribute to waste reduction in the healthcare sector in general and the NHS in particular, and what are the specific challenges they have to address for this to happen? This was the overall aim of our study. Our main contribution was to demonstrate the pivotal role of leadership in driving cultural change and implementing LSS practices within clinical pharmacy, establishing how leadership decisions, training, and cultural factors influence LSS adoption through a comprehensive approach combining an SLR and qualitative interviews. Our research found that leadership is not just a passive element but a critical driver in shaping training priorities, resource allocation, and overall cultural dynamics.

Effective medicine waste management can help prevent medication-related harm, such as accidental ingestion, incorrect administration, or misuse. The societal contribution of our work is also noteworthy during the current shortage of medicines facing the NHS (Boffey, 2024). Patients are experiencing difficulties accessing vital medications as the NHS grapples with decreased purchasing power due to currency fluctuations, taxation policies, and disruptions in global supply chains. By implementing the proposed framework (figure 4), the NHS and other healthcare organisations can ensure that resources are allocated efficiently, and patients receive timely treatment. This not only mitigates the impact of the current medicine shortages but also addresses future supply chain disruptions.

However, the paucity of literature on the challenges of implementing LSS in clinical pharmacy practice limits the interpretation of the findings, an issue that studies like ours and future ones that will build on the present work (by us and other scholars) will hopefully address and contribute to

solving. A second limitation is that this research was carried out on a single NHS pharmacy department, potentially limiting the generalisation of findings to other pharmacy departments. Considering that most NHS Trusts and pharmacy departments face similar capacity and resourcing pressures, there is a convincing argument for the applicability of the findings to the overall sector. Moreover, these findings are consistent with the existing literature about hospital clinical pharmacy practice in the NHS, which comforts our confidence in them.

Nonetheless, more work is required to understand how well the results translate to other pharmacy and clinical hospital departments. Future research should consider a selection of pharmacies and other clinical departments in NHS organisations to assess the generalisability of these results and inter- and intra-organisational variability.

By examining pharmacists' insights, we uncovered the critical importance of instilling a cultural shift that integrates quality improvement seamlessly into patient care practices. Our findings emphasise the need for leadership to embrace LSS both as a procedural tool and a philosophy that reshapes clinical culture, and they offer a practical roadmap for pharmacy leadership to navigate the complexities of medicine waste reduction through LSS implementation.

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Appendices

Appendix 1: SLR methodology

PICO strategy is followed to develop specific review questions for appropriate research sensitivity and specificity. The literature search and selection process adhered to the PRISMA recommendation, with the Scopus database utilised for identifying relevant literature.

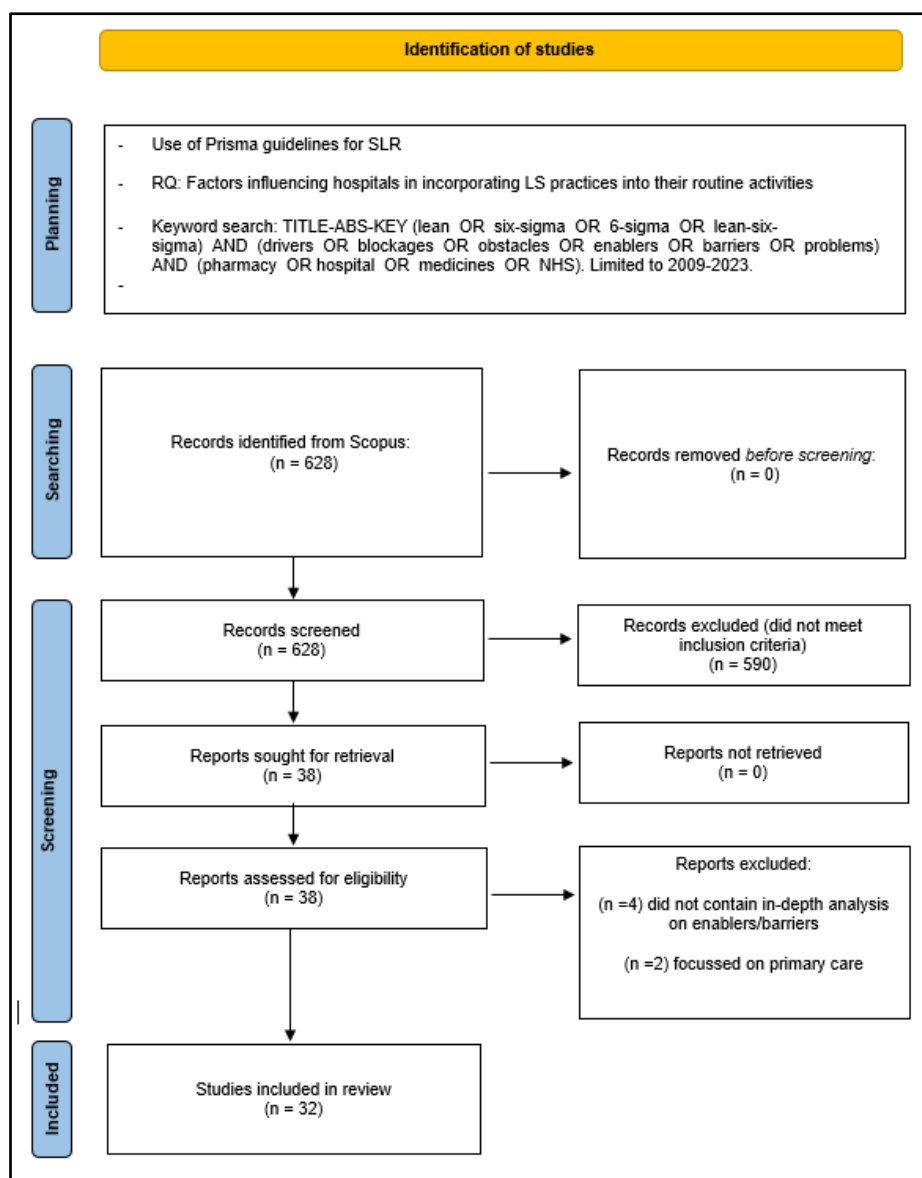


Figure: Selection process for studies

The initial keyword search criteria included TITLE-ABS-KEY (lean OR six-sigma OR 6-sigma OR lean-six-sigma) AND (drivers OR blockages OR obstacles OR enablers OR barriers OR problems) AND (pharmacy OR hospital OR medicines OR NHS). These were limited to the following inclusion criteria: published between 2009 and 2023, last performed on 15 Nov 2022. Papers were suitable if they discussed factors influencing LSS implementation in a public hospital, clinical pharmacy, or a speciality where clinical pharmacists practice. The 'subject area' is used to assess eligibility by reading each paper's abstracts. The search returned 628 papers, from which 32 were analysed following the screening process.

Appendix 2: Interview questions, corresponding RQs and informing source

Question Number	Question	RQ	Source
1a	What is your role in the clinical team?	RQ 1	[1-3, 14, 35]
1b	What is your grade?		
1c	How many years of experience do you have?		
2a	What are your daily priorities in your clinical role?		
2b	What determines these priorities?		
2c	Do you think all your clinical pharmacist colleagues within the department share the same priorities? Why/why not?		
2d	Is reducing medicines wastage a consideration for you when delivering these? Why/why not?		
2e	If 2d no, then why not?		
2f	If yes, can you explain how you implement it in delivering these priorities?		
2g	Using a scale of 1 (lowest)-10 (highest), can you rate each priority, including medicines wastage, in its importance to you?		
2h	Is there anything else you would like to add that we have not covered regarding your clinical priorities?		
3a	What quality improvement methodologies are you aware of to improve clinical pharmacy practice?		
3b	Have you used any of these in practice If not go to 3f.		
3c	If so, was the improvement embedded into practice?		
3d	What do you think was key in embedding it into routine practice?	RQ 2	[1-3, 14, 33, 42]
3e	If not embedded, why do you think that was?		
3f	Do you think you are suited to successfully deliver QI initiatives alongside your clinical role? Why/Why not?		
3g	Do you think pharmacists can use QI practices to reduce medicine waste? Why/Why not?		
4a	In a QI initiative such as to reduce medicines waste, what factors would help you implement initiatives in your daily practice?		
4b	From these factors, which would be the most important enabler in implementing Lean Six Sigma initiatives		
4c	Which would be the most critical barrier in implementing initiatives		
4d	Using a scale of 1-10, how important do you consider the following factors in increasing the priority you give to medicine wastage?		
4di	Leadership		
4dii	Strategy		
4diii	Resources		
4div	Training		
4dv	Technology		
4dvi	Process		
4e	For each of the above, explain why you chose that score.		
4f	Anything else you would like to add or any factors influencing implementation that we have not discussed?		
5	Lean Six Sigma seeks to improve quality and efficiency by reducing process errors and removing non-value-adding activities. Has management addressed the implementation factors in the previous question you highlighted? If yes, in what ways?		
5a	Can you describe the impact LSS would have on your priority to medicine wastage?		
5b	Following LSS implementation, rate medicine waste in importance to you using a scale of 1 (lowest) and 10 (highest).		

APPENDIX 3: Open & Axial Codes Generating Themes

Codes from Literature	Refined Open Codes with Axial Codes in Bold	Number of Interviewees	Number of References	Theme
Education & Training	Education & Training			Inadequate E&T
	Training on QI processes	7	8	
	Identifying problems systematically	2	4	
	Training on engagement	1	1	
	Implementation problems	2	3	
	With further training	7	19	
	With practical training	5	10	
	With increase knowledge	8	12	
	Adequately trained	5	9	
	Earlier training	6	25	
	QI Experience	11	17	
	Audit	12	13	
	PDSA	8	9	
	Limited use RCA	2	2	
	Limited use Forcefield	1	1	
	Limited use Lewin	1	1	
	Limited use stakeholder analysis	1	1	
	Limited use process mapping	1	1	
	Not QI	6	7	
	Unclear understanding of Audit	4	8	
	Limited application of QI	7	14	
	Not used any	4	4	
	Yes as improvement experience (superficial)	5	16	
	Different - Flexibility to demands	6	7	
	With earlier training	6	25	
Resources	Resources			Limited Resources
	Workload	6	10	
	Insufficient staff	11	25	
	Staff support	7	13	
	Affects safety	12	15	
	Dedicated time	5	8	
	Not enough time	11	35	
Technology	Technology			Miscellaneous
	Data to show improvement	5	5	
	Can get data manually	6	6	
Process	Process			
	Not complex QI process	7	8	
	QI process variable	3	3	
	SOP	7	10	
	Standards	4	6	
	Holistic process	3	3	

Codes from Literature	Refined Open Codes with Axial Codes in Bold	Number of Interviewees	Number of References	Theme
Strategy	Senior Management			Insufficient Leadership
	Bigger picture	3	3	
	Guidance	6	7	
	Direction	9	14	
Leadership	Management priority	5	6	
	With senior engagement and awareness	12	27	
	With management support	9	15	
	Empowered staff	5	7	
	Vision	4	6	
	Culture	7	15	
	Leadership Increases LS wastage importance	12	13	
	Accountability	2	3	
	Infrastructure	8	18	
	Engagement	3	4	
	Vision	3	3	
	Change need	4	5	
	Empowerment	6	8	
	Direction	12	13	
	Communication	2	2	
	Awareness of problem	13	24	
	Made a priority	11	21	
	Benefits	8	10	
	Safety Priority & Experience	13	36	Clinical Culture
	Advice	3	3	
	Counselling	5	5	
	TTAs, Discharges	13	19	
	New patients/Drug histories	13	16	
	Critical medicines	13	32	
	Safety values	4	7	
	Same priorities	2	2	
	Shared safety priority	9	13	
	SOP to prioritise	4	4	
	Same goals	7	11	
	Lack of time/staff	6	6	
	LS increase priority of wastage	3	3	
	LS does not affect wastage priority	10	10	
	Different -workload	2	2	
	Flexibility	8	11	
	Organisational priorities	8	11	
	Different - Knowledge	5	10	
	Safety training	10	13	
	Different - Organisational priorities	5	8	
	Remainder patients	12	14	
	Limited Wastage Consideration	10	13	
	Trigger by incident	8	12	
	Triggers - Expensive meds	3	3	
	Triggers - Blisters	2	3	
	Triggers - Reordering	6	7	
	Triggers - Stockpiling	1	1	
	Ordering only	11	22	
	Screening only	6	8	
	All processes	2	2	
	TTAs	7	10	
	Drug History	4	4	
	Pod Checks	1	1	
	Medicines optimisation	2	2	
	Lack of training on wastage	1	1	
	Wastage in all priorities	2	2	
	Lack of wastage awareness	2	2	