Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Managing Surgical Waiting Lists in Public Health Systems: A Soft Systems Methodology Study in Brazil

Bruno Baptista Blanco

brunoblanco@macae.ufrj.br

Federal University of Rio de Janeiro

Eliane Berinqué Braga

National Institute of Traumatology and Orthopedics

Eliane Augusta da Silveira

National Institute of Traumatology and Orthopedics

Igor Leão dos Santos Montes

Federal Center for Technological Education Celso Suckow da Fonseca (CEFET/RJ)

Research Article

Keywords: Soft Systems Methodology, Surgical waiting lists, Public health systems, Problem structuring methods, Qualitative research, Health services management, Brazil, Unified Health System

Posted Date: October 29th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11000953/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Managing Surgical Waiting Lists in Public Health Systems: A Soft Systems Methodology Study in Brazil

Bruno Baptista Blanco[1,2,3*], Eliane Berinqué Braga[2], Eliane Augusta da Silveira[2], Igor Leão dos Santos Montes[3]

[1*]Polytechnic Institute, Federal University of Rio de Janeiro, Macaé, RJ, Brazil.

[2]National Institute of Traumatology and Orthopedics (INTO), Ministry of Health, Rio de Janeiro, RJ, Brazil.

[3]Graduate Program in Production Engineering and Systems (PPPRO), Federal Center for Technological Education Celso Suckow da Fonseca (CEFET/RJ), Rio de Janeiro, RJ, Brazil.

*Corresponding author(s). E-mail(s): brunoblanco@macae.ufrj.br;

Abstract

Background: Prolonged surgical waiting lists are a persistent challenge in publicly funded health systems. In Brazil's Unified Health System (SUS), managing elective surgical demand involves complex organizational pressures and competing stakeholder priorities. Soft Systems Methodology (SSM) offers a framework for addressing such situations, yet its application in resource-constrained public health systems in low- and middle-income countries remains limited. This study used SSM to examine the organizational complexities of elective surgical waiting list management at a federal orthopedic hospital in Brazil and to identify systemically desirable and culturally feasible improvements.

Methods: A qualitative case study based on SSM was conducted at the National Institute of Traumatology and Orthopedics (INTO). Data were collected between March and October 2024 through 22 semi-structured interviews, document analysis, and field observations. The six-stage SSM process was used to explore the problem situation, develop conceptual models, and identify feasible improvements.

Results: Three dominant worldviews shaped waiting list management: INTO as a Surgical Executor, focused on productivity and waiting-time reduction; as a SUS Network Actor, concerned with equity and federative coordination; and

as a Center of Excellence, committed to research, teaching, and high-complexity care. The interaction of these institutional logics generated tensions in prioritization, governance, and care pathways. An integrated conceptual model comprising eleven interdependent activities was developed to reconcile these perspectives by linking demand management, prioritization, network coordination, operational performance, and academic objectives.
Conclusions: Surgical waiting list management in large public orthopedic hospitals is a complex organizational problem shaped by competing institutional logics and federative governance constraints, rather than operational bottlenecks alone. SSM made these tensions explicit and supported strategic decision-making by identifying systemically desirable and culturally feasible improvements. The integrated model provides a foundation for future decision-support tools and quantitative modeling, highlighting the value of qualitative systems approaches in resource-constrained health systems.

Keywords: Soft Systems Methodology, Surgical waiting lists, Public health systems, Problem structuring methods, Qualitative research, Health services management, Brazil, Unified Health System

1 Background

Public health systems worldwide face persistent challenges in ensuring timely access to elective surgical care. In Brazil's Unified Health System (SUS — *Sistema Único de Saúde*), prolonged waiting times for elective procedures represent a multi-factorial and structurally embedded problem. In highly specialized federal institutions such as the National Institute of Traumatology and Orthopedics (INTO — *Instituto Nacional de Traumatologia e Ortopedia*), surgical waiting list management involves organizational, operational, regulatory, cultural, and political dimensions that extend beyond purely technical considerations. The social consequences of extended waiting times are substantial, encompassing deterioration of patients' health status, reduced quality of life, loss of productivity, and increased costs for both the healthcare and social security systems.

This problem can be characterized as a complex societal problem, an issue defined by interdependent causes, multiple stakeholders, pervasive uncertainty, and the intertwining of technical, social, and political dimensions [1]. Such problems cannot be adequately addressed through isolated technical interventions or purely quantitative optimization. Instead, they require approaches capable of integrating diverse perspectives, making underlying assumptions explicit, and supporting structured dialogue among stakeholders.

Soft Systems Methodology (SSM) offers a problem-structuring approach designed for situations involving multiple worldviews and ambiguous problem definitions [2, 3]. Rather than seeking immediate technical solutions, SSM emphasizes learning, the exploration of meanings, and the construction of conceptually coherent models of

purposeful human activity. These features make SSM particularly suitable for analyzing organizational challenges in public health systems, where governance structures, institutional missions, and professional cultures interact dynamically.

Although SSM has been applied in healthcare settings internationally, its documented use in structuring complex organizational challenges within the Brazilian public health system remains limited. Empirical applications of problem-structuring methods in low- and middle-income countries are still under-represented in the literature [4, 5]. By applying SSM to surgical waiting list management in a large federal orthopedics hospital, this study aims to contribute both empirically and methodologically. Empirically, it provides an in-depth analysis of the institutional tensions shaping access to elective orthopedic surgery within the SUS. Methodologically, it illustrates how SSM can be operationalized in a resource-constrained, federative health system characterized by overlapping responsibilities and political pressures.

The objective of this study is therefore to structure the problem of surgical waiting list management at INTO using Soft Systems Methodology, identifying dominant worldviews, institutional tensions, and feasible pathways for systemic improvement. In doing so, the research seeks to provide a foundation for future decision-support tools and quantitative modeling initiatives, while reinforcing the relevance of qualitative systems approaches in health services research.

1.1 Literature Review

The Unified Health System (SUS), created more than three decades ago, is one of the largest publicly funded health systems in the world [6, 7]. It significantly expanded universal access to healthcare and contributed to improvements in several population health indicators. However, its sustainability faces increasing pressure, particularly in guaranteeing access to specialized services such as orthopedics and traumatology. Long waiting lists for consultations, diagnostic examinations, and surgical procedures remain one of the principal bottlenecks in service delivery, with direct consequences for patient recovery and social and productive reintegration [8, 9].

The relevance of orthopedics and traumatology extends beyond the Brazilian context. Musculoskeletal disorders account for a substantial proportion of Disability-Adjusted Life Years (DALYs), Years Lived with Disability (YLDs), and Years of Life Lost (YLLs) worldwide. They affect hundreds of millions of individuals and represent one of the greatest demands for specialized care across health systems [10–12].

Rising life expectancy, the growing prevalence of chronic conditions, and the increasing incidence of trauma and accidents have intensified the demand for orthopedics services. Consequently, waiting times for complex elective procedures, such as arthroplasties and spinal surgeries, have lengthened in many settings. Prolonged waiting periods are associated with increased pain, functional decline, psychological distress, and deterioration in quality of life [11, 13, 14].

Within this scenario, referral centers in orthopedics face significant challenges in surgical waiting list management. These challenges are characterized by the absence of consensus regarding causes and solutions, incomplete or inconsistent data, and competing stakeholder priorities. Furthermore, overlapping responsibilities among governmental entities, resource constraints, and institutional pressures for transparency

and equity contribute to the complexity of the problem. Addressing such issues requires structured and participatory approaches capable of accommodating multiple perspectives.

From a theoretical standpoint, General Systems Theory [15] provides a foundational framework for understanding complex and interdependent organizational phenomena. By emphasizing systemic interrelations rather than linear cause-effect relationships, it supports the analysis of dynamic interactions, feedback loops, and emergent behaviors. Building on these principles, several Problem Structuring Methods (PSMs) have been developed to address messy problems involving multiple stakeholders, conflicting objectives, and uncertainty [16].

Among these approaches, Soft Systems Methodology (SSM) [2], Strategic Options Development and Analysis (SODA) [17], System Dynamics [18], and the Complex Holographic Assessment of Paradoxical Problems (CHAP2) [19] illustrate different ways of addressing organizational complexity. SSM, in particular, employs conceptual models to explore alternative worldviews, enabling stakeholders to negotiate meanings, surface implicit assumptions, and identify feasible and desirable changes [3].

The application of SSM has been documented in various international healthcare contexts [5, 20, 21] and, to a lesser extent, in Brazil [22, 23]. These studies demonstrate the flexibility of SSM in both qualitative and mixed-method designs and highlight its potential to support organizational learning and service improvement.

Nevertheless, empirical applications of SSM in low- and middle-income countries remain relatively limited and geographically concentrated. A review of 113 peer-reviewed publications by Van de Water et al. (2007) identified a predominance of applications in high-income countries, with only a single documented case in Brazil at that time [4]. Similarly, the scoping review by Augustsson et al. (2020) did not identify Brazilian healthcare studies applying SSM [5]. More recently, Shafaghsorkh and Ayough (2022), in a systematic review of 69 empirical healthcare studies, reported that applications in low- and middle-income countries remain scarce and dispersed, with only two studies conducted in Brazil [24].

Despite its long-standing theoretical development, the use of SSM as a structured approach to analyzing complex organizational challenges in public health systems such as the SUS remains under-explored. This gap is particularly relevant in contexts characterized by federative governance structures, resource limitations, and high demand for specialized care. By examining surgical waiting list management in a large federal orthopedics hospital, this study seeks to address this gap and extend the empirical literature on the use of problem structuring methods in resource-constrained health systems.

2 Methods

2.1 Study design

This study adopted a qualitative case study design grounded in Soft Systems Methodology (SSM) to structure a complex organizational problem in a large public hospital.

The research was conducted at the National Institute of Traumatology and Orthopedics (INTO), a federal referral center for orthopedics within Brazil's Unified Health System (SUS).

Surgical waiting list management at INTO was identified as a complex organizational challenge due to the involvement of multiple stakeholders (orthopedic surgeons, nurses, administrators, regulators and senior managers), technical constraints (availability of operating rooms, beds, equipment and staff), and institutional pressures for efficiency, equity and transparency.

2.2 Application of Soft Systems Methodology

The application of SSM followed an adapted version of the framework proposed by Checkland and Poulter [3], structured into six interrelated stages:

1. Exploration of the unstructured situation: Identification of sectors directly and indirectly involved in surgical waiting list management, highlighting multiple perspectives and potential areas of conflict. At this stage, two preliminary visual representations were developed: a conceptual map of the initial problem situation and a diagram of the organizational units selected for interviews and their relationships.
2. Expression of the problem situation: Development of graphical representations based on interviews, document analysis and observations. These included a rich picture synthesizing stakeholders' perspectives and a flowchart of the patient journey through the surgical pathway. These representations captured actors, information flows, operational bottlenecks, critical decision points and external influences.
3. Formulation of root definitions and CATWOE analysis: Alternative root definitions were developed to reflect distinct worldviews concerning surgical waiting list management. Each root definition was structured using the CATWOE mnemonic (Customers, Actors, Transformation process, Weltanschauung, Owners and Environmental constraints).
4. Construction of conceptual models: Based on the root definitions, conceptual models of purposeful activity were constructed to represent logically coherent systems aligned with each worldview.
5. Comparison of conceptual models with perceived reality: The conceptual models were systematically compared with empirical data obtained from interviews and institutional documents in order to identify gaps, tensions and areas for potential improvement.
6. Identification of desirable and feasible changes: From this comparison, proposals were formulated that were considered both systemically desirable and culturally feasible within the institutional context.

2.3 Data collection

Data collection took place between March and October 2024 and included 22 semi-structured interviews with professionals at INTO. Participants comprised orthopedic surgeons, nurses, administrative coordinators and senior managers involved directly or indirectly in surgical waiting list management.

The interviews explored participants' perceptions, experiences, challenges and suggestions regarding waiting list processes, prioritization criteria, interdepartmental coordination and interactions with the broader SUS network. Two semi-structured interview guides were developed specifically for this study, one for the heads of the Specialized Care Centers and one for the remaining participants. Neither has been published elsewhere, and English versions of both are provided as Additional file 1. All interviews were audio-recorded with consent, transcribed verbatim and analyzed qualitatively to identify recurrent themes, convergences and divergences.

Documentary sources included internal regulations, management reports, flowcharts, and planning documents related to surgical production and waiting list monitoring. *In loco* observations were conducted to contextualize organizational processes and workflow dynamics.

2.4 Data analysis and validation

The analysis was iterative and interpretive, consistent with SSM principles [3]. Interview transcripts and documentary materials were synthesized into visual artifacts (rich picture and patient flow diagram) and explanatory tables highlighting convergent and divergent viewpoints.

To enhance analytical rigor, data were collected from multiple professional groups and hierarchical levels within the organization. Emerging interpretations were discussed among members of the research team to reduce individual bias and improve credibility [5]. The resulting conceptual model was grounded in empirical findings and iteratively refined during the comparison stage.

3 Results

SSM was applied as a problem structuring and organizational learning approach rather than as an evaluative or optimization tool. The objective was to make explicit the institutional complexity surrounding surgical waiting list management and to explore the multiple perspectives shaping managerial practices. The findings are presented in four interrelated components: institutional context, synthesis of qualitative data, formulation of root definitions and CATWOE analyses, and development of the integrated conceptual model.

3.1 Institutional context and preliminary analysis

An initial interview with the hospital's General Management was conducted in order to obtain a preliminary understanding of the problem situation. Drawing on this interview, a conceptual map was constructed to represent the initial framing of surgical waiting list management (Figure 1). The map was structured as propositions linking concepts through explicit relating phrases, following the concept mapping approach proposed by Novak and Cañas [25]. This preliminary representation supported the selection of interview participants and guided the development of more detailed visual

artifacts in later stages of the study. It also informed the subsequent analysis of institutional documents related to waiting list monitoring and surgical production, which expanded this perspective.

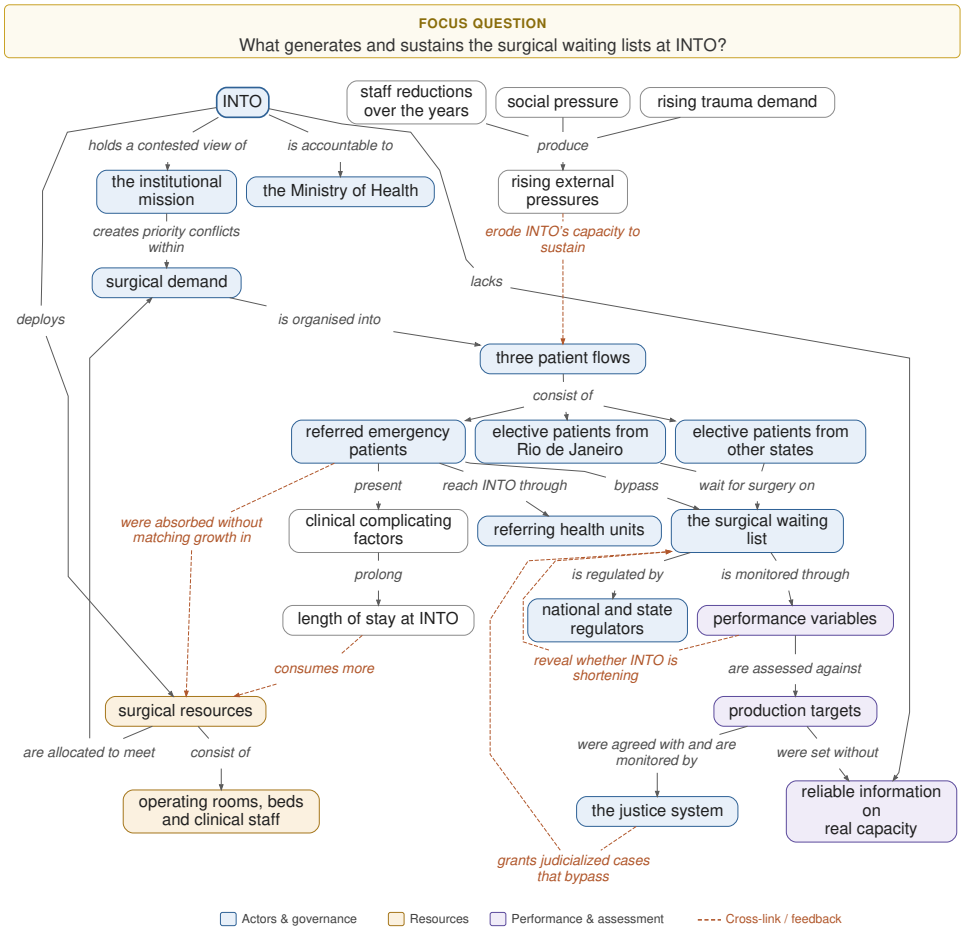


Fig. 1 Conceptual map of the preliminary analysis of surgical waiting list management.

INTO's mission extends beyond surgical and outpatient care. The institution is also responsible for professional training, research activities, and contributions to public policy in musculoskeletal health. This multifaceted role, combined with its operational capacity, positions the hospital as a national reference center within the SUS and a member of the International Society of Orthopaedic Centers (ISOC), which brings together the 24 leading orthopedic centers worldwide [26].

The hospital structure is highly complex, comprising 321 beds, 21 operating rooms, and 40 outpatient care rooms. It is organized into thirteen Specialized Care Centers (SCC), each responsible for a specific orthopedic sub-specialty. Each SCC has its own outpatient, diagnostic, and surgical resources. Surgical waiting lists are structured according to these centers and further subdivided by procedure type and clinical condition.

More than 200 distinct waiting lists coexist within the institution. While this arrangement seeks to prioritize progressive diseases and differentiate clinical conditions, it also generates managerial fragmentation and coordination challenges.

Since its creation, INTO has been among the first institutions in Brazil to implement publicly available surgical waiting lists, a practice that has informed similar initiatives in other areas of the health system. Managing these lists requires balancing numerous resources and decisions, given that procedures vary in complexity, duration, and recovery needs (including intensive care units and ward stays).

For the research, interviews were conducted with the heads of SCC whose waiting lists exceeded three years. These SCC are monitored by the Strategic Planning Coordination and by the Waiting List Monitoring Committee. These SCC use a tool known as the Surgical Menu (cardápio cirúrgico), which suggests a monthly volume of procedures for each specialised centre in order to reduce waiting times, focusing on centres whose lists exceed three years. The suggested volumes are derived from qualitative criteria, such as the waiting time of the last patient on the list and the rate of new entries, classified as low, medium or high.

The organizational units selected for interview and their hierarchical relationships are illustrated in Figure 2. This representation clarifies the interaction between strategic, tactical and operational areas directly involved in surgical waiting list management. Table 1 summarizes the profile of the interviewees.

3.2 Synthesis of qualitative data and expression of the problem situation

Interview transcripts and documentary analysis were synthesized into a rich picture representing the multiplicity of views, conflicts, information flows and institutional tensions identified across stakeholders (Figure 3). The rich picture highlights the coexistence of different interpretations of the waiting list problem, the difficulty in managing internal processes, the absence of clearly defined roles in certain decision points and barriers in communication and organizational culture.

The rich picture consists of a graphic representation containing the main actors involved and highlighting key aspects of the problem based on adapted striking statements. The rich picture was complemented with Table 2, which allows for a more detailed understanding of the interviewees' discourses and their convergences and divergences. These categories correspond to the principal themes represented in the rich picture.

The second analytical artifact focused on the elective surgical pathway. A detailed flowchart was developed to describe the patient journey from entry into the health system to post-operative monitoring (Figure 4). This representation enabled identification of operational bottlenecks, communication failures and cumulative delays across

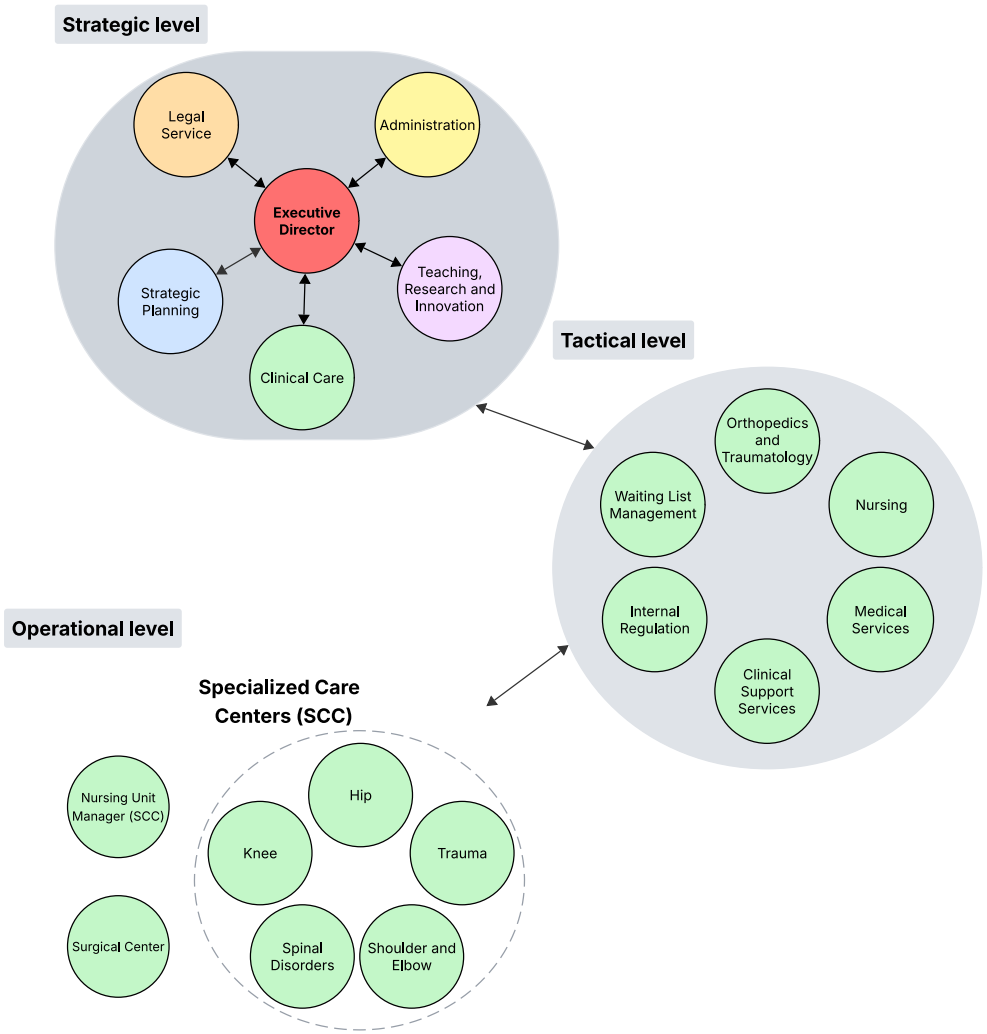


Fig. 2 Organizational units selected for interview and their hierarchical and communication relationships.

stages of care. The stages and associated criticisms identified in the interviews are summarized in Table 3.

3.3 Root definitions and CATWOE analyses

This synthesis enabled the formulation of root definitions and CATWOE analyses, following the Soft Systems Methodology (SSM) framework, capturing different worldviews regarding the function and purpose of surgical waiting list management [3].

Table 1 Professional background and institutional position of interview participants (interviews conducted between March and October 2024)

ID	Professional Background	Institutional Position	Length of experience at INTO (years)
1	Health Administrator	Director of Strategic Planning	1
2	Lawyer	Director of Legal Services	15
3	Orthopedic Surgeon	Director of Clinical Care	20
4	Orthopedic Surgeon	Head of Medical Services	20
5	Orthopedic Surgeon	Care Manager Advisor	19
6	Nurse and Production Engineer	Clinical Operations Specialist	11
7	Social Worker	Clinical Operations Specialist	11
8	Nurse	Head of Waiting List Management	18
9	Nurse	Head of Internal Regulation	18
10	Nurse (Hemotherapy Specialist)	Head of Clinical Support Services	14
11	Nurse	Head of Inpatient Unit	18
12	Psychologist and Public Policy Analyst	Director of Administration	1
13	Nurse	Head of Nursing	17
14	Orthopedic Surgeon	Head of Orthopedic Services and Shoulder and Elbow SCC Manager	21
15	Nurse	Nursing Unit Manager (Specialized Care Centers)	24
16	Nurse	Surgical Center Manager	18
17	Orthopedic Surgeon	Trauma SCC Manager	20
18	Orthopedic Surgeon	Knee Surgery SCC Manager	19
19	Orthopedic Surgeon	Spinal Disorders SCC Manager	14
20	Orthopedic Surgeon	Hip Surgery SCC Manager	22
21	Pediatrician	Hospital Director	19
22	Orthopedic Surgeon	Director of Teaching, Research and Innovation	14

Stakeholders expressed distinct perspectives: some emphasized INTO's role as a service provider for the population; others highlighted its function as a teaching and research center; and others focused on its integration with the broader SUS network. Recognizing these perspectives is essential for developing systemic solutions that are both desirable and feasible [27].

These three perspectives, summarized in Table 4, reflect paradigmatic tensions and highlight the complexity of managing surgical waiting lists within the institution. Their coexistence generates conflicts that manifest at multiple levels of organizational operations and strategy.

The first perspective prioritizes internal efficiency, focusing on maximizing surgical production, reducing waiting times, and optimizing processes. This view reflects pressure to meet production targets and the perception of INTO as a surgical provider. However, this emphasis on productivity can conflict with the institution's broader mission as a center of excellence in teaching and research.

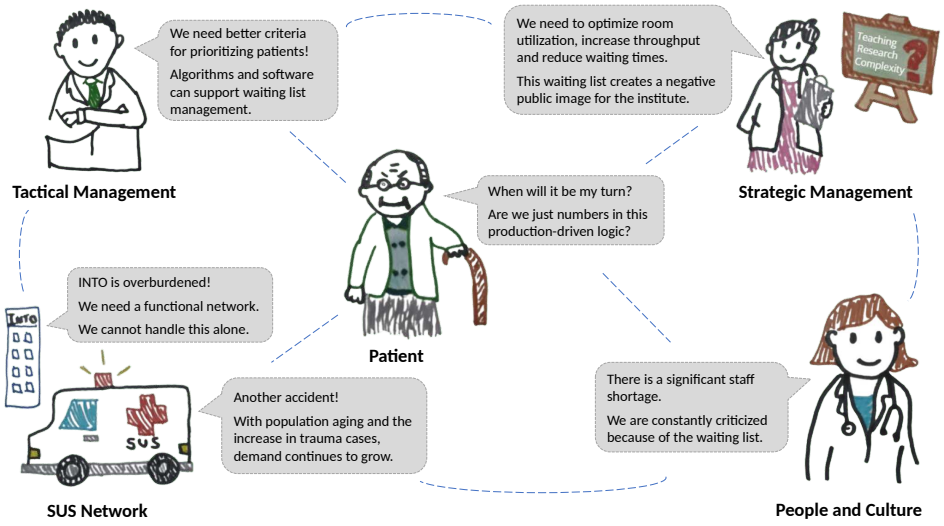


Fig. 3 Rich picture representing stakeholder perspectives, conflicts and institutional tensions in surgical waiting list management.

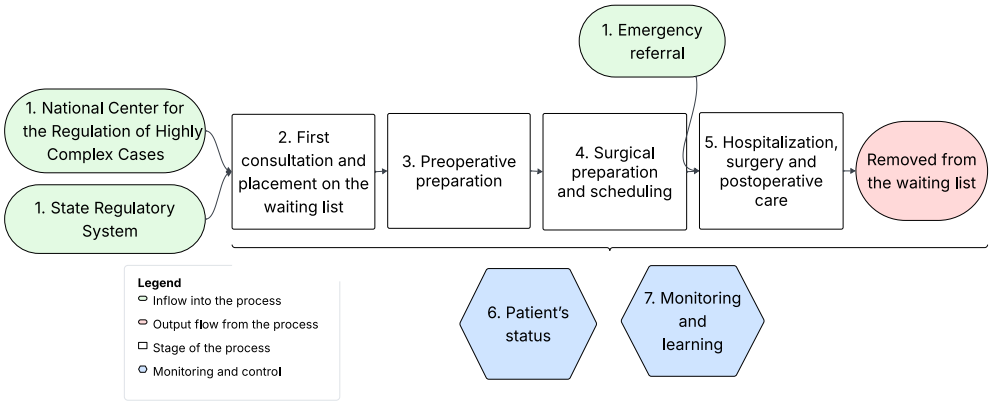


Fig. 4 Elective surgical patient pathway from referral to post-operative monitoring.

The second perspective understands the waiting list as a systemic issue that extends beyond INTO's boundaries, requiring coordination among federal entities and clearer definition of roles within the SUS network to promote equity and transparency [8]. Tensions arise from the perception that INTO absorbs responsibilities from the external network, such as medium- and low-complexity cases, trauma referrals, and judicialized demands (right-to-health litigation, whereby patients obtain court orders granting access to services when administrative channels fail[28]) without adequate coordination. This dynamic often positions the institution as a passive recipient of

Table 2 Key aspects of surgical waiting list management: convergences and divergences across stakeholders

Dimension	Convergences	Divergences
Nature of the waiting lists and patient vision	The problem is recognized as multifactorial and socially impactful, involving multiple stakeholders and gaps in data quality and integration. This problem negatively impacts the institution's image.	Divergence regarding the origin of the problem: some view it as an institutional liability; others interpret it as a systemic deficiency of the SUS network.
Institutional mission	INTO is widely perceived as a high-volume surgical provider and a reference center in complex orthopedic and trauma cases.	Tension between prioritizing production targets and emphasizing research, teaching, high-complexity care, and policymaking.
Human resources and organizational culture	Staff shortages, especially in nursing, are considered a primary constraint on productivity.	Divergent views on managerial openness to change and professional resistance within leadership positions.
Tactical management and internal processes	Fragmentation and communication gaps between departments are broadly acknowledged. The need for transparent prioritization criteria is widely recognized; the surgical menu is seen as an important reference tool. Patient discharge management is a recognized bottleneck, hindering bed turnover.	Some perceive improvements in coordination; others report persistent siloed practices and limited information sharing. Criticism of inconsistent application of the surgical menu and subjectivity in scheduling decisions.
Relationship with the SUS network	Strong external pressure from municipal, state, and federal regulators shapes surgical waiting list management. Judicialization and urgent trauma referrals disrupt elective scheduling by reallocating limited resources. These dynamics indicate that the waiting list problem is not solely institutional, but reflects broader governance constraints within the health system.	The implementation of a single, state-regulated waiting list is advocated as a solution to much of the problem, promoting transparency and organization. However, this proposal is controversial, raising concerns about the loss of patient-institutional ties and the lack of coordination within the SUS network to support such a change.

external pressures, contributing to operational strain and a negative public image. In addition, the absence of clear national policies regarding the role of federal institutes further reinforces this ambiguity.

The third perspective emphasizes a primary focus on research, teaching, and highly complex procedures, aiming to generate knowledge and innovation. The tension lies in the difficulty of reconciling high surgical volume with scientific excellence in the musculoskeletal field, as intensive waiting list management can limit the time and resources

Table 3 Elective surgical pathway, processes, and associated criticisms and impacts

Stage	Description	Criticism and Impacts
1. Entry into the Health System (before INTO)	The patient can access INTO through three main channels: (i) medical referral through primary care or emergency services, regulated at the state level; (ii) referral through national high-complexity pathways, in cases of interstate access; and (iii) emergency referral (trauma), in which the patient is directly referred for hospitalization and surgery following an accident or severe trauma.	Waiting times in this initial stage can exceed three years depending on the specialty, increasing total time to surgery. The expansion of initial consultation capacity increases internal demand, generating overload and long waiting lists. Patients referred via trauma pathways tend to compete with elective cases for the same resources.
2. First consultation and placement on the waiting list	The patient attends an initial consultation at INTO, and a medical record is created. The orthopedic surgeon assesses the clinical condition and determines whether surgery is indicated. When indicated, the patient is allocated to a specific waiting list, divided by SCC, such as knee, spine, hip, and others.	Lack of objective criteria for defining waiting lists leads to heterogeneity among surgeons. Possible distortions in referral flows and accumulation of non-prioritized cases. Establishment of institutional ties and expectation of guaranteed surgery.
3. Preoperative preparation	The patient initially remains in the "Request" status. When called, preoperative tests are performed, and the patient moves to the "Exams" status. If clinical or social issues are identified, the patient is transferred to the "Pending" category. Communication is primarily conducted by telephone.	Many patients present with expired or inadequate tests. Nurses within the SCC are overloaded, limiting patient monitoring. Inadequate preparation leads to surgical cancellations and rework.
4. Surgical preparation and scheduling	Once pending issues are resolved, the patient is classified as "Ready." Management uses the surgical menu as a reference for prioritization. The surgical schedule is defined by the heads of the SCC, with multidisciplinary participation. Cases involving referred trauma and those under legal action are frequently prioritized.	The surgical menu is not consistently applied as a practical standard. The large number of waiting lists makes management difficult. Procurement and material acquisition constraints limit execution. Trauma demand consumes significant resources, compromising elective flow. External interference also influences prioritization decisions.
5. Hospitalization, surgery and post-operative care	The patient is admitted the day before surgery. The procedure is performed, and after discharge, the patient must be formally referred back to the primary care network. The patient is removed from the waiting list only after the procedure is completed. In case of cancellation, the patient returns to the "Surgery Rescheduled" status.	Low bed turnover, particularly for patients from other regions. The external network is insufficient to support post-operative care. The surgical center is underutilized, with approximately half of the rooms in operation. Medical managers are overloaded with administrative tasks.
6. Patient's status	Patients may assume different statuses throughout the waiting period: Request, Exams, Pending, Ready, Surgery Rescheduled, Letter (formal notification due to lack of contact), Not Located, and Inactive (requiring reassessment for reactivation).	Follow-up depends heavily on patients maintaining updated contact information. Communication gaps generate inconsistencies in the waiting list, prolong waiting times, and contribute to a perceived sense of abandonment.
7. Monitoring and learning	INTO collects management data related to surgical production, patient flow, and waiting list dynamics.	Available data are underutilized in decision-making. There are no consistent indicators to monitor quality of life or long-term patient outcomes.

available for academic activities. Furthermore, an internal productivity-oriented culture, combined with limited funding mechanisms, constrains the ability of professionals to dedicate efforts to research and teaching.

These differences are further exacerbated by fragmented processes, communication failures, shortages of human and material resources, and subjectivity in prioritization criteria across more than 200 waiting lists. Together, these tensions highlight the need for an integrated approach that not only proposes technical solutions, but also addresses the political, cultural, and structural dimensions of the problem [1]. They were formalized through root definitions and structured using the CATWOE mnemonic, as presented in Table 5.

Table 4 Dominant worldviews and their main tensions

Worldview	Based on	Main tension
1. Surgical Executor	Internal efficiency and pressure for production	Maximizing surgeries vs. institutional mission
2. SUS Network Actor	Systemic problem, federative articulation	Centralization vs. co-responsibility
3. Center of Excellence	Focus on research, teaching and high complexity	Mass production vs. technical excellence

3.4 Integrated Conceptual Model, Comparison with Reality, and Proposed Changes

An integrated conceptual model was developed to reconcile the three dominant worldviews. Rather than privileging one perspective, the model proposes a sequence of interdependent activities designed to align operational efficiency, network coordination and institutional mission (Table 6).

The proposed model seeks to reconcile three distinct worldviews regarding the role of INTO. While the emphasis on efficiency and productivity can lead INTO to be seen solely as a high-volume executor, the systemic network view emphasizes the sharing of responsibilities, and the academic and scientific view advocates a focus on high complexity, innovation, and knowledge. The proposed conceptual model was then compared with reality, a critical moment advocated by the SSM methodology [3]. A dialogical analysis was conducted to identify gaps, paradoxes, and opportunities for desirable, feasible, and conciliatory change.

Mapping of waiting lists (stage 1) responds to both the executor's needs and the network's vision, aiming to identify bottlenecks by specialty. In practice, this function is compromised by fragmentation across many waiting lists and inconsistent insertion criteria. Calculating operational efficiency (stage 2) provides quantitative evidence to guide decisions, avoiding a purely political or opinionated worldview, creating common ground between internal efficiency and external coordination. Current indicators are underutilized and poorly standardized [26].

Table 5 Comparative CATWOE analysis of dominant worldviews

Element	Surgical Executor	SUS Network Actor	Center of Excellence
Customers	Patients on the surgical waiting list awaiting elective procedures	SUS patients across the country, especially those requiring high-complexity care	Patients with highly complex cases, researchers, specialists, the scientific community, and the SUS
Actors	INTO's medical, nursing, technical, and administrative coordination teams	INTO, state and municipal managers, national regulatory bodies, and the Ministry of Health	Researchers, professors, managers, and specialized clinical staff at INTO
Transformation	Conversion of a long, disorganized waiting list into one managed according to the hospital's optimized production capacity	From a fragmented and centralized waiting list at INTO to an articulated network model with shared responsibilities across the SUS	From a hospital focused on mass surgical production to a specialized center of technical excellence, professional training, and innovation
Worldview	Surgical efficiency and productivity are the primary means to resolve the waiting list problem and improve the institution's public image	The waiting list is a symptom of a systemic problem that requires federative coordination, effective regulation, and a clear definition of roles within the SUS network	The burden of mass waiting list management distances INTO from its institutional mission; the focus should be on research, high-complexity care, and knowledge generation to produce greater systemic value
Owners	Hospital Director and Director of Clinical Care	Ministry of Health, Director of Strategic Planning, and state and municipal regulatory bodies	Ministry of Health and Director of Teaching, Research and Innovation
Environmental constraints	Budget constraints, staff shortages, slow procurement processes, and judicial interference in scheduling	Fragmentation of the SUS, limited federative coordination, and political and institutional resistance to role redistribution	Political pressures, judicialization, a productivity-oriented organizational culture, and the absence of public policies that support research and high-complexity specialization

Table 6 Integrated conceptual model for surgical waiting list management

Stage	Activity	Dominant logic	Purpose
1	Mapping of waiting lists and surgical production	Executor / Network	Identify bottlenecks
2	Measurement of operational efficiency indicators	Executor	Establish performance baseline
3	Definition of transparent prioritization criteria	Executor / Network	Standardize decision-making
4	Capacity planning and monthly targets	Executor	Align resources with demand
5	Coordination with SUS regulatory bodies	Network	Reduce fragmentation
6	Development of allocation tools	Executor	Support data-informed scheduling
7	Scenario simulation modelling	Excellence / Executor	Assess strategic alternatives
8	Continuous dashboard monitoring	Executor	Enable managerial feedback
9	Training and protocol standardization	Excellence	Reduce variability
10	Integration of patient perspective	All logics	Incorporate user-centred indicators
11	Knowledge production and dissemination	Excellence	Strengthen institutional mission

Defining prioritization criteria (stage 3) strengthens the role of the executor and paves the way for the transparent practices required by the SUS network, seeking to establish more objective rules (waiting time, clinical severity, risk of functional loss). In practice, formal instruments are only partially applied, allowing tacit decisions that fuel disputes between sectors. Capacity planning (stage 4) strengthens the operational logic, supported by efficiency metrics and the prioritization criteria previously established, allowing greater balance in the use of human and material resources.

Coordination with the SUS network (stage 5) is essential to achieve better performance as a surgical provider and a more positive institutional image. Even if INTO cannot directly redistribute cases, clearly defining responsibilities helps reduce overload, aligning the provider's perspective with that of the network. The surgery resource allocation tool (stage 6) and the scenario simulator (stage 7) aim to increase efficiency and assess the impact of different decisions, reinforcing both the provider's and the center of excellence's perspectives. However, these steps depend on reliable data input and workforce commitment.

Dashboard monitoring (stage 8) integrates day-to-day management, providing transparency and fostering more practical and visual management, an aspect valued across all perspectives. Training for technical protocols (stage 9) aims to professionalize practices, reduce variability, and strengthen patient safety, though these actions compete with an overloaded operational schedule and limited capacity for ongoing training. Integrating the patient perspective (stage 10) proposes systematically incorporating user experience and preferences into the process. Currently, this dimension

is poorly operationalized, with a shortage of experience metrics and limited patient participation in governance bodies.

Knowledge production and dissemination (stage 11) consolidates the center of excellence's identity, connecting clinical practice with scientific production and innovation. Although the institute generates a wealth of data, the systematic transformation of these inputs into applied evidence and public policy documents is still in its early stages. Thus, the model functions as a dynamic cycle (Figure 5), in which each perspective finds its place without detracting from the others. Tensions remain, but the interconnected sequence and integration of quantitative and qualitative tools can enable INTO to advance toward more balanced, sustainable, and transparent solutions [2, 3].

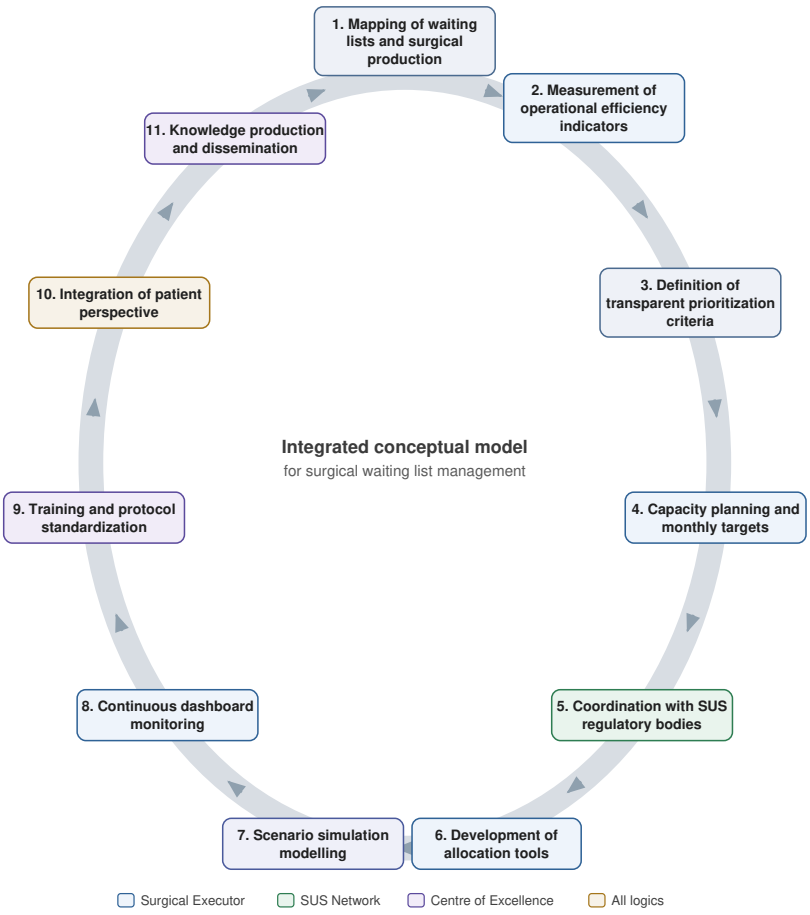


Fig. 5 Integrated conceptual model for surgical waiting list management as a cycle of interdependent activities.

4 Discussion

This study applied Soft Systems Methodology (SSM) to structure the complex organizational problem of surgical waiting list management in a large federal orthopedics hospital within Brazil's Unified Health System (SUS). The findings indicate that prolonged waiting lists cannot be understood solely as a matter of operational inefficiency. Rather, they emerge from the interaction between institutional mission, federative governance structures, professional cultures and structural resource constraints [1, 27].

The identification of three dominant worldviews (Surgical Executor, SUS Network Actor and Center of Excellence) reveals that tensions in waiting list management are not merely technical but paradigmatic. Each perspective embodies a distinct definition of organizational purpose and performance. The Surgical Executor logic prioritizes throughput, operating theater utilization and reduction of waiting times. The SUS Network perspective emphasizes coordination, equity and shared responsibility across levels of care [8]. The Center of Excellence worldview prioritizes high-complexity procedures, research and training. These perspectives coexist within the same institution, generating structural ambiguities in prioritization criteria, allocation of resources and strategic planning.

The findings align with international literature indicating that waiting lists in public health systems are rarely attributable to a single bottleneck. Instead, they reflect systemic interdependencies between referral pathways, regulatory mechanisms, workforce capacity, procurement processes and governance arrangements [11, 13, 14]. In the present case, the existence of more than 200 waiting lists illustrates an attempt to refine prioritization but simultaneously increases fragmentation and managerial burden. This dual effect underscores the paradoxical nature of organizational solutions in complex systems [27].

From a governance standpoint, the study highlights the implications of federative organization within the SUS. Overlapping responsibilities between federal, state and municipal authorities contribute to ambiguity regarding accountability for elective backlogs [6, 7]. Judicialization and trauma referrals introduce additional exogenous pressures that disrupt planned surgical production. These dynamics demonstrate how institutional context reshapes operational capacity, reinforcing the need for systemic rather than purely local interventions.

Methodologically, this research contributes to the relatively limited empirical literature on the application of SSM in low- and middle-income health systems. Although most documented applications originate from high-income settings, particularly the United Kingdom, this study provides empirical evidence of SSM's usefulness in contexts characterized by resource constraints, bureaucratic complexity, and overlapping governance structures [4, 5, 24]. While SSM has been extensively discussed as a problem structuring approach, documented applications in resource-constrained public hospital environments remain scarce [2, 3]. The study demonstrates how SSM can make explicit competing institutional logic and facilitate structured comparison between conceptual models and organizational reality [20, 21]. By doing so, it provides a transparent framework for identifying changes that are not only technically desirable but culturally feasible.

The integrated conceptual model proposed does not advocate a single prescriptive solution. Instead, it articulates complementary activities aimed at reconciling operational efficiency, network coordination, and academic mission. By linking qualitative problem structuring with the prospect of quantitative modeling tools, such as optimization algorithms and simulation models, the study establishes a bridge between organizational diagnosis and decision-support development [26]. This integration is particularly relevant in health services research, where technical modeling detached from institutional realities often fails to achieve sustainable impact.

From a managerial perspective, the findings suggest that improving surgical waiting list management requires simultaneous action at multiple levels. Transparent and standardized prioritization criteria are necessary to enhance legitimacy and reduce discretionary scheduling [11]. Strengthened coordination with regulatory bodies is essential to mitigate fragmentation within the SUS. Moreover, systematic use of performance dashboards and patient-centered indicators may improve accountability and organizational learning. Importantly, clarifying the institutional mission (whether primarily production-oriented, network-coordinated or excellence-driven) emerges as a strategic prerequisite for coherent decision-making.

However, it is important to note that this study has limitations, which should be considered when interpreting its findings. First, participatory workshops, frequently recommended in SSM applications, were not conducted. Data were obtained through 22 semi-structured individual interviews spanning professional categories and hierarchical levels. The reliance of problem structuring methods on face-to-face workshops has itself been questioned, on the grounds that convening stakeholders is difficult to organize and tends to restrict participation to a narrow cross-section of the organization [29]. The trade-off is that meanings were negotiated analytically by the research team rather than directly among stakeholders, which limits collective learning [30].

Second, the study was conducted in a single institution. INTO concentrates the features that make waiting list management difficult: a federal referral center receiving patients from across the country, thirteen specialized care centers, more than 200 parallel waiting lists, and the concurrent pressure of elective demand, trauma referrals and litigation. The mechanisms identified, competing institutional logics, ambiguity of responsibility under federative governance and the displacement of elective capacity by exogenous demand, are analytically transferable to referral centers under comparable governance arrangements, although the magnitudes reported are not generalizable.

Third, the study is primarily qualitative and the integrated model was not empirically tested. Conceptual models in SSM are devices for structured debate rather than validated representations of the system, and their contribution is therefore not measurable by the criteria usually applied to quantitative models. Connell's reflections on an apparently unsuccessful SSM-based implementation illustrate how contested the evaluation of this kind of interventions remains. Establishing whether the eleven activities proposed here reduce waiting times would require quantitative instruments fed by institutional data, together with longitudinal follow-up, which lies beyond the scope of problem structuring [31].

5 Conclusions

In conclusion, surgical waiting list management within a large public orthopedics hospital in the SUS represents a complex organizational challenge shaped by competing institutional logics, federative governance constraints and resource limitations [1]. By applying Soft Systems Methodology, this study made explicit the structural tensions underlying managerial practices and provided a coherent framework for reconciling efficiency, equity and institutional mission [2, 3]. Beyond its empirical contribution, the research underscores the relevance of qualitative systems approaches in health services research, particularly in resource-constrained contexts where purely technical interventions are insufficient [5, 24]. The integrated model developed here offers a foundation for future decision-support initiatives and for more transparent, coordinated and sustainable management of surgical waiting lists.

List of abbreviations

CAAE Certificado de Apresentação de Apreciação Ética (Certificate of Presentation for Ethical Consideration)
CATWOE Customers, Actors, Transformation process, Weltanschauung, Owners, Environmental constraints
CEP Comitê de Ética em Pesquisa (Research Ethics Committee)
INTO Instituto Nacional de Traumatologia e Ortopedia (National Institute of Traumatology and Orthopedics)
ISOC International Society of Orthopaedic Centers
PSM Problem Structuring Method
SCC Specialized Care Center
SSM Soft Systems Methodology
SUS Sistema Único de Saúde (Unified Health System)

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and with Resolution 510/2016 of the Brazilian National Health Council. It was approved by the Research Ethics Committee of the National Institute of Traumatology and Orthopedics (CEP/INTO), under approval number 8.236.962 (CAAE: 70527623.3.0000.5273). All participants provided written informed consent prior to participation.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analysed during the current study are not publicly available due to ethical restrictions and confidentiality commitments made to participants, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Authors' contributions

B.B.B. conceptualized the study, designed the methodology, conducted the interviews, performed data analysis, and led the writing of the manuscript. E.B.B. contributed to data collection, interview conduction, data analysis, manuscript writing and revision. E.A.S. contributed to data collection, interview conduction, and manuscript revision. I.L.S.M. contributed to the conceptualization and supervision of the study, and to manuscript writing and revision. All authors read and approved the final manuscript.

Acknowledgements

The authors would like to thank the Foundation for Heart Support (FUNDACOR) for technical support and the National Institute of Traumatology and Orthopedics (INTO) for the institutional support that enabled this research. We express our gratitude to all participants who voluntarily gave their time and shared their experiences during the interviews. Their contributions were essential to understanding the reality under investigation and achieving the objectives of this study.

References

[1] DeTombe DJ. Complex Societal Problems in Operational Research. European Journal of Operational Research. 2002;140(2):232–240. https://doi.org/10.1016/S0377-2217(02)00066-8.

[2] Checkland P. Systems Thinking, Systems Practice. Chichester: Wiley; 1981.

[3] Checkland P, Poulter J. Learning for Action: A Short Definitive Account of Soft Systems Methodology, and Its Use for Practitioners, Teachers and Students. Hoboken: Wiley; 2006.

[4] Van De Water H, Schinkel M, Rozier R. Fields of application of SSM: a categorization of publications. Journal of the Operational Research Society. 2007;58(3):271–287. https://doi.org/10.1057/palgrave.jors.2602156.

[5] Augustsson H, Churruca K, Braithwaite J. Change and improvement 50 years in the making: a scoping review of the use of soft systems methodology in healthcare. BMC Health Services Research. 2020;20(1):1063. https://doi.org/10.1186/s12913-020-05929-5.

[6] Brazil. Constitution of the Federative Republic of Brazil of 1988. Brasília: Federal Senate; 1988.

[7] Brazil. Law No. 8,080 of September 19, 1990. Provides the conditions for the promotion, protection, and recovery of health, the organization and functioning of the corresponding services, and provides other measures. Brasília: Presidency of the Republic; 1990.

[8] Paim JS. Thirty years of the Unified Health System (SUS). Ciência & Saúde Coletiva. 2018;23(6):1723–1728. https://doi.org/10.1590/1413-81232018236.09172018.

[9] Lara M, Fernandes CMdS, Penteado VP, Serra MdC. Direito à saúde e judicialização no acesso a tratamentos de média e alta complexidade pelo Sistema Único de Saúde (SUS). Research, Society and Development. 2021;10(3):e16010313091. https://doi.org/10.33448/rsd-v10i3.13091.

[10] Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease 2020: Findings from the GBD 2020 Study. Seattle, WA: IHME; 2020. Available from: https://www.healthdata.org/research-analysis/gbd.

[11] OECD. Waiting Times for Health Services: Next in Line. OECD Health Policy Studies. Paris: OECD Publishing; 2020. Https://doi.org/10.1787/242e3c8c-en.

[12] Nguyen AT, Aris IM, Snyder BD, Harris MB, Kang JD, Murray M, et al. Musculoskeletal health: an ecological study assessing disease burden and research funding. The Lancet Regional Health – Americas. 2024;29:100661. https://doi.org/10.1016/j.lana.2023.100661.

[13] Ostendorf M, Buskens E, van Stel H, Schrijvers A, Marting L, Dhert W, et al. Waiting for total hip arthroplasty: avoidable loss in quality time and preventable deterioration. The Journal of Arthroplasty. 2004;19(3):302–309. https://doi.org/10.1016/j.arth.2003.09.015.

[14] Oudhoff JP, Timmermans DRM, Knol DL, Bijnen AB, van der Wal G. Waiting for elective general surgery: impact on health related quality of life and psychosocial consequences. BMC Public Health. 2007;7(1):164. https://doi.org/10.1186/1471-2458-7-164.

[15] von Bertalanffy L. General System Theory: Foundations, Development, Applications. New York: George Braziller; 1968.

[16] Rosenhead J, Mingers J. Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict. Chichester: Wiley; 2001.

[17] Eden C, Ackermann F. Making Strategy: The Journey of Strategic Management. London: Sage; 1998.

[18] Forrester JW. Industrial Dynamics. Cambridge: MIT Press; 1961.

[19] Lins ME, Pamplona L, Lins AE, Lyra K. Metacognitive attitude for decision making at a university hospital. International Transactions in Operational Research. 2023;30(3):1366–1386. https://doi.org/10.1111/itor.12975.

[20] Lamé G, Jouini O, Stal-Le Cardinal J. Combining Soft Systems Methodology, ethnographic observation, and discrete-event simulation: A case study in cancer care. Journal of the Operational Research Society. 2020;71(10):1545–1562. https://doi.org/10.1080/01605682.2019.1610339.

[21] Kotiadis K, Tako AA, Rouwette EAJA, Vasilakis C, Brennan J, Gandhi P, et al. Using a model of the performance measures in Soft Systems Methodology (SSM) to take action: a case study in health care. Journal of the Operational Research Society. 2013;64(1):125–137. https://doi.org/10.1057/jors.2012.21.

[22] Souza FSd, Zeferino ACS, Nunes RTSO, Azevedo Junior CMd, Bergiante NCR. Enhancing healthcare resilience: systemic medication errors debate in emergency departments with Soft System Methodology. Ciência & Saúde Coletiva. 2025;30(6):e20912024. https://doi.org/10.1590/1413-81232025306.20912024.

[23] Costa APdA, Costa VPdA, Pereira DAdM, Costa IPdA, Moreira MÂL, Braga GdO, et al. Machine Learning and Simulation: pathways to efficient emergency care in Brazil. Ciência & Saúde Coletiva. 2025;30(6):e03522025. https://doi.org/10.1590/1413-81232025306.03522025.

[24] Shafaghsorkh O, Ayough A. Application of soft operations research methods in healthcare: A systematic review. Journal of Industrial Engineering and Management Studies. 2022;9(1):136–147.

[25] Novak JD, Cañas AJ. The Theory Underlying Concept Maps and How to Construct and Use Them. Pensacola, FL: Florida Institute for Human and Machine Cognition; 2008. IHMC CmapTools 2006-01 Rev 01-2008. Available from: https://cmap.ihmc.us/docs/theory-of-concept-maps.

[26] Siqueira CL, Arruda EF, Bahiense L, Bahr GL, Motta GR. Long-term integrated surgery room optimization and recovery ward planning, with a case study in the Brazilian National Institute of Traumatology and Orthopedics (INTO). European Journal of Operational Research. 2018;264(3):870–883. https://doi.org/10.1016/j.ejor.2016.09.021.

[27] Rittel HWJ, Webber MM. Dilemmas in a general theory of planning. Policy Sciences. 1973;4(2):155–169. https://doi.org/10.1007/BF01405730.

[28] Lamprea E. The Judicialization of Health Care: A Global South Perspective. Annual Review of Law and Social Science. 2017;13(1):431–449. https://doi.org/10.1146/annurev-lawsocsci-110316-113303.

[29] Morton A, Ackermann F, Belton V. Problem structuring without workshops? Experiences with distributed interaction within a PSM process. Journal of the Operational Research Society. 2007;58(5):547–556. https://doi.org/10.1057/palgrave.jors.2602210.

[30] Franco LA, Montibeller G. Problem Structuring for Multicriteria Decision Analysis Interventions. In: Cochran JJ, Cox LA, Keskinocak P, Kharoufeh JP, Smith JC, editors. Wiley Encyclopedia of Operations Research and Management Science. Hoboken, NJ: John Wiley & Sons; 2011. Https://doi.org/10.1002/9780470400531.eorms0683.

[31] Connell NAD. Evaluating soft OR: some reflections on an apparently 'unsuccessful' implementation using a Soft Systems Methodology (SSM) based approach. Journal of the Operational Research Society. 2001;52(2):150–160. https://doi.org/10.1057/palgrave.jors.2601054.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1Interviewguides.docx