Pesquisa Operacional (2023) 43: e275528 p.1-30
doi: 10.1590/0101-7438.2023.043.00275528

Printed version ISSN 0101-7438 / Online version ISSN 1678-5142
www.scielo.br/pope
ARTICLES

PROPOSING A NOVEL CONCEPTUAL MODEL FOR THE MEDICAL CLINIC WITHIN A MID-SIZED HOSPITAL THROUGH THE APPLICATION OF SOFT SYSTEM METHODOLOGY (SSM)

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Received June 13, 2023 / Accepted September 19, 2023

ABSTRACT. The paper presents a structured approach to address decision-making challenges within the medical clinic service of a mid-sized hospital located in Brazil, using Soft System Methodology (SSM). Its application extends to the medical clinic, a previously unexplored domain within the hospital. Within this context, we introduce a novel conceptual framework for healthcare, wherein we integrate Plan-Do-Check-Act (PDCA) tool into SSM framework. The overarching goal is to rectify the pivotal issue of excessive workload allocation among the medical clinic staff. The developed model effectively addresses this issue by optimizing task allocation. It achieves this by designating primary and auxiliary nursing staff for specific sets of tasks, taking into consideration the necessity for displacement and ensuring a fair distribution of workloads. Furthermore, our model incorporates PDCA into the implementation phase of SSM, thereby establishing a mechanism for ongoing improvement in the initial equilibrium achieved in terms of staff deployment and task distribution.

Keywords: Soft System Methodology (SSM), public health, medical clinic.

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1 INTRODUCTION

The 1988 Constitution of the Federative Republic of Brazil established health as a universal right and imposed upon the State the obligation to ensure its provision (Cornwall & Shankland, 2008). Subsequently, in 1990, Law 8080 was enacted to govern health services, whether public or private, on a permanent or occasional basis, across the national territory (*Brasil,* 1990).

Consequently, the Brazilian healthcare system is characterized by the coexistence of direct service procurement, insurance-based mechanisms, complementary healthcare, and the Unified Health System (Da Silva et al., 2011), which is a universal public funding-based system grounded in the principles of rights (Cornwall & Shankland, 2008).

Despite the Ministry of Health receiving a budget of approximately BRL 138 billion in 2019, ranking as the third-largest budget among Brazilian ministries (*Portal da Transparência*, 2019), hospitals frequently grapple with inadequate funding. As a result, there is a compelling need for enhanced efficiency in their operational processes to prevent diminishing service quality (Eiro & Torres-Júnior, 2015). This challenge is further exacerbated by the intricate nature of the modern healthcare system (Warburton, 2005), as well as hospitals themselves, owing to the diverse expertise of their professionals, the intricate network of knowledge domains they encompass, and their intricate decision-making processes (Karamitri et al., 2017).

Problems of this nature, characterized by multifaceted stakeholders, conflicting interests, intangible importance, and inherent uncertainties, fall under the category of unstructured problems. To address and comprehend such issues, Problem Structuring Methods (PSMs) are employed. According to Mingers & Rosenhead (2004), PSMs offer a means to represent a situation, enabling participants to clarify the situation, converge on mutual problems or aspects within it, and reach commitments while partially resolving them.

One such Problem Structuring Method applicable to the representation and analysis of the situation under study is known as the Soft System Methodology (SSM). SSM serves as a problem structuring approach for redesigning systems, wherein the conceptual models held by participants are juxtaposed with their perception of the existing system to engender discussions on feasible cultural changes or systemic desirability (Rosenhead, 1996). As highlighted by Lamé et al. (2020) and Lehaney & Paul (2017), SSM provides a systematic approach to analyzing problematic situations, seeking improvements, and identifying and structuring issues without a predetermined planning framework.

Within the domain of healthcare, specific utilizations of Problem Structuring Methods (PSMs) have been observed, wherein the Soft System Methodology (SSM) is applied within hospital environments. Particularly noteworthy is an instance in which a study, initially directed towards integrating both quantitative and qualitative methodologies of Operational Research (OR) to comprehend a particular concern, underwent a transformation into a PSM application. This transformation entailed an examination of the efficacy of SSM, achieved through the creation and utilization of an all-encompassing diagram derived from consultations held within the English National Health Service, with a focus on congenital heart disease. (Crowe et al., 2017).

Similarly, another case involved a multidisciplinary healthcare team addressing colorectal cancer, wherein SSM was applied with an emphasis on performance metrics. The resultant proposal involved stakeholder engagement in the application of a performance measurement model (Kotiadis et al., 2013). These referenced cases, as discovered through literature research, underscore the utilization of SSM for problem structuring in hospital contexts, ultimately guiding the decision to adopt SSM for the current research endeavor.

The case study presented in this paper revolves around a three-story hospital situated in Brazil, notable for its unique design featuring exclusive ramps and biometrically secured staircases intended solely for employee access. The focal point of the analysis is the patient circulation dynamics within the medical clinic wing, encompassing various phases such as reception, triage, and the admission procedures. The hospital operates on a schedule of 12-hour shifts for staff, followed by 36-hour intervals off-duty. These shifts are divided into two evening shifts and two-night shifts.

The triage department within the hospital is managed by a team of nurses and technical assistants, while the medical clinic segment is characterized by a distribution of beds across rooms, each accommodating 2 to 3 beds. This arrangement culminates in a total of 28 beds, thoughtfully allocated in a gender-balanced manner. Moreover, the medical clinic area incorporates designated rooms for record-keeping purposes and storage of medical supplies. Based on previous works in which, through prior visits and interviews conduct with hospital personnel, an evident lack of tools and methodologies conducive to efficient management of work process was identified (Martins Drei & Sérgio de Arruda Ignácio, 2022; Drei et al., 2021). Consequently, challenges emerged including a lack of clarity in task division, excessive workloads, and overall dissatisfaction among employees. As a result, this study takes on a profound societal significance, focusing on the ongoing improvement of operational processes within the medical clinic of a public hospital within the Brazil.

Clearly, there is a discernible requirement for a methodology that fosters active involvement of stakeholders, thereby facilitating a transparent process for generating alternative solutions, ultimately leading to the formulation of novel scenarios aimed at enhancing the comprehensibility of team roles, tasks, and proficiencies. The objective of this research is to introduce a well-organized method for addressing the intricacies inherent in the medical clinic of a hospital of medium size. This comprehensive approach entails several key steps, including delineating the relevant stakeholders, identifying pertinent activities, leveraging the Soft System Methodology (SSM) to attain equilibrium in task allocation and alleviate employee burdens, formulating a meticulously crafted solution proposition, and ultimately presenting the research findings to the responsible governing entities. The incorporation of the SSM is underpinned by two principal considerations.

Firstly, from a theoretical perspective, despite the widespread utilization of PSMs in healthcare —SSM included—no instances of its application within the realm of the Internal Medicine division have come to light – as it will be clarified in the literature review, thereby establishing the foundational premise of this research. Secondly, from a pragmatic standpoint, the study's concentration on a public hospital situated in the interior of Minas Gerais, Brazil, encapsulates

a context where precise managerial metrics are lacking and substantial resources for elaborate implementations are scarce. Consequently, the operational processes within the medical clinic persist in their lack of clarity and inadequately incorporate the contributions of employees.

In view of these factors, the adoption of the Soft System Methodology (SSM) is discerned as a fitting choice, attributable to its alignment with the specific requisites of the present medical wing. The approach SSM employs in tackling problems, characterized by an active and engaged involvement of stakeholders, ensures that the resultant solutions not only exhibit contextual relevance but also command a higher degree of acceptance due to the direct contributions of those individuals most directly impacted (Checkland, 1981). Notably, the iterative nature inherent to SSM fosters a tailored development of solutions, concurrently nurturing a process of organizational learning. Through the assimilation of a multitude of perspectives and the acknowledgment of human intricacies, SSM is adeptly equipped to address intricate predicaments, while simultaneously nurturing a deeper comprehension of the socio-cultural and human dimensions that frequently underlie complex organizational challenges (Checkland, 1981).

This manuscript is systematically structured in the ensuing manner: initially, in this preamble section the research problem is elucidated. Subsequently, the second segment exposes the literature review, encompassing PSMs, PSM applied to the domain of healthcare, and Soft System Methodology (SSM). The subsequent division, denoted as the third section, explains the research methodology. Moving forth, the fourth section is dedicated to present the empirical applications and the outcomes derived therefrom. The penultimate section, namely the fifth, encapsulates the concluding insights drawn from the study's findings. Ultimately, the paper culminates in the citation of references.

2 LITERATURE REVIEW

2.1 Problem Structuring Methods (PSMs)

The initial Operational Research (OR) methods conceived in the 1940s embodied pragmatic and multidisciplinary endeavors aimed at resolving predicaments employing available methods and data. Subsequently, within academic spheres, an increasing prevalence of mathematical techniques overshadowed these methods (Mingers, 2011).

From the 1960s onwards, a discourse among analysts unfolded, highlighting the limitations of traditional OR methods confined to well-structured problems. Such problems adhere to predetermined and consensus-based factors, constraints, and objectives (Rosenhead, 1996).

Churchman (1967) posited that social systems problems, denoted as wicked problems, manifest ill-defined formulations, intricate information landscapes, multifarious stakeholders, divergent values, and convoluted systemic repercussions. Analogously, unstructured problems are typified by the presence of multifaceted stakeholders, disparate perspectives, incommensurable or conflicting interests, salient intangibles, and foundational uncertainties (Mingers & Rosenhead, 2004).

In response to these exigencies, the domain of soft problem structuring methods (PSMs) emerged, engendered by practitioners and academics to cater to the exigencies of authentic predicaments (Mingers, 2011). Consequently, the genesis of ”soft” methodologies ensued from the realization that ”hard” methodologies, tailored to lucidly demarcated problems, encountered limitations in resolving certain quandaries (Wang et al., 2015).

Problem Structuring Methods serve as vehicles to employ models for the depiction of a given situation, facilitating participant comprehension, convergence upon mutual predicaments or underlying issues, and fostering consensus on commitments aimed at resolving the problem, even partially (Mingers & Rosenhead, 2004). In the context of wicked problems, problem structuring methods inherently surpass traditional OR techniques (Rosenhead, 1996).

According to the delineations of Hanafizadeh et al. (2021), Mingers (2011), and Forrester (1961), a plethora of problem structuring methods exists, including but not limited to Strategic Options Development and Analysis (SODA), Soft System Methodology (SSM), Strategic Choice Approach (SCA), Value-Focused Thinking (VFT), and System Dynamics (SD).

2.2 PSMs in the health sector

To discern the literature that employs structuring methods within the healthcare domain, a systematic review of literature was undertaken through the adaptation of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework (Page et al., 2021). The PRISMA methodology facilitates transparent reporting of the procedural facets inherent to systematic literature reviews, elucidated through a flowchart encompassing three cardinal stages: identification, selection, and inclusion (Page et al., 2021).

The initial phase of identification necessitates a determination of the databases instrumental for sourcing pertinent papers. Subsequently, the formulation of search terms and the application of filters that demarcate the search scope are executed (Page et al., 2021). In this particular inquiry, the SCOPUS and Web of Science (WoS) repositories were selected owing to their amalgamation of high-impact journals spanning diverse domains. The designated search terms, ”Problem Structuring Methods” and ”Health,” were chosen to encompass papers exclusively addressing Problem Structuring Methods and situated within the healthcare sector.

Notably, no constrictive filters were imposed to ensure a comprehensive review. Consequently, a total of 48 papers was acquired, with 19 sourced from SCOPUS and 29 from WoS. Redundant entries were subsequently eliminated. Evidently, of the 48 papers culled from the SCOPUS and WoS repositories, 10 were duplicative, consequently resulting in a refined corpus of 38.

The Selection phase entailed a canvassing of the papers premised upon availability and adherence to structural conventions. Within this context, it was ascertained by the authors that exclusively papers would be regarded as works of interest, given its congruence with the format of the present study and its facilitation of enhanced comprehension concerning content and structure. This process led to the exclusion of 5 papers, culminating in a total of 33.

Ultimately, for the papers to be deemed eligible, each document underwent comprehensive scrutiny, with a specific focus on whether the thematic content explicitly addressed the intricacies of structuring complex problems within the healthcare domain. In light of these criteria, 8 out of the 33 articles were found to lack direct pertinence to the prescribed theme, rendering them inapplicable within the healthcare domain. Consequently, these articles were expunged, resulting in a total of 25 papers.

The final step, termed ”included,” pertains to articles that conform to the exigencies of the research. In line with this objective, all 25 remaining papers were incorporated. This decision emanated from the research's overarching intent to comprehensively evaluate all papers relevant to the application of PSMs within the healthcare sphere, precluding the necessity for segmentation of the papers. Figure 1 furnishes a visual representation of these distinct phases as encapsulated within the present inquiry.

With these 25 identified papers at hand, the need arose to construct a tool facilitating the exposition and comparative analysis of their principal tenets. This would furnish a theoretical foundation underpinning their respective claims. To this effect, a tabular representation was devised, meticulously delineating the authors, paper titles, publication years, stated objectives, targeted healthcare subfields, and methodological approaches adopted in each study (Table 1).

Table 1 – Papers that use PSMs in the healthcare environment.

N	Reference	Objective	Context	PSM(s) used
1	Shaw & Blundell (2010)	Propose and apply a new methodology for waste control	nuclear facilities	Waste And Source-matter Analyses (WASAN)
2	Small & Wainwright (2018)	Develop a multimethodology in surgical areas	Hospital	SSM
3	Ufua et al. (2018)	Explore Community Operational Research together with Lean	food production company	-
4	Midgley et al. (2018)	Discuss the differences between operational community research and others	Theoretical - No application	-
5	Gomes et al. (2018)	Outline a community OR approach for participatory institutional analysis of local problems	Water supply	-
6	Martins et al. (2020)	Develop a method based on artificial intelligence (based on AI) to assess the quality of service in the dental sector	Dentistry	SODA
7	Thunhurst & Barker (1999)	Present approaches to problem structuring that have been used to derive planning guidelines as part of a comprehensive strategic planning process	Strategic planning in the health area	-

Continued on next page

Table 1 – continued from previous page

N	Reference	Objective	Context	PSM(s) used
8	Cambrainha & Fontana (2018)	Propose a model to help a group of decision makers to establish a portfolio of viable actions (alternatives) capable of balancing water supply and demand strategies.	Water supply	SODA
9	Crowe et al. (2017)	Combine qualitative and quantitative OR methods to scale up and inform an improvement initiative for infants with congenital heart disease	Hospital	SSM
10	Thunhurst (2003)	To present and discuss the value of adopting formal problem structuring methods as part of the health strategic planning process.	Strategic planning in the health area	-
11	Thunhurst (2012)	Explore the role of systems thinking and operations research in deepening our understanding and control over complex public health systems.	Control of public health systems	-
12	Sepehrirad et al. (2017)	Defining the framework and designing a framework for the Ministry of Petroleum workers' cancer control problem as the first step to improve the current situation.	Oil workers health	SSM
13	Lamé et al. (2020)	Describe a project where discrete event simulation is combined with SSM and ethnographic observation to support the improvement of patient flows in an outpatient chemotherapy unit and a chemotherapy preparation pharmacy unit	Hospital	SSM
14	Thunhurst (2007)	Examine the potential for applying OR methods to "upstream" problems in healthcare planning	Strategic planning in the health area	-
15	Kotiadis & Mingers (2006)	Reflect on the barriers of combinations between hard OR and soft OR that can be seen at the philosophical and cognitive levels.	Example of combination between hard OR and soft OR	-
16	Edwards et al. (2005)	Advocate for the adoption of a systemic view of knowledge management in healthcare delivery, focusing on the emergency care process in the UK National Health Service	Hospital	SSM
17	Rees et al. (2017)	Check the thinking of seven senior health experts in New Zealand, using cognitive mapping, on key implementation challenges to improve primary health systems.	Theoretical - No application	-

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Table 1 – continued from previous page

N	Reference	Objective	Context	PSM(s) used
18	Jun et al. (2011)	Provide a mechanism for decision makers in health care planning and management to compare a wide range of modeling and simulation methods so they can better select and use them or better commission relevant modeling and simulation work.	Theoretical - No application	-
19	Lins et al. (2019)	To present a mixed quantitative and qualitative methodological approach to help formulate and structure health performance measures in 5,565 Brazilian municipalities.	Health database of Brazilian municipalities	-
20	Hindle & Franco (2009)	Describe a mixed methods approach using problem structuring methods to conduct applied research on fitness to drive arrangements at the UK Department of Transport	Department of Transport	SSM
21	Thunhurst et al. (2007)	To present the Primary Health Care Approach to the development of health care, in order to explain the critical importance given to building partnerships in health care planning	Theoretical - No application	-
22	Duryan et al. (2015)	Reflect on the effectiveness of soft operational research techniques in understanding the dynamics of a complex system, such as caregivers with intellectual disabilities	Service provider	SODA
23	Assunção et al. (2020)	Develop a new, holistic perspective on urban sustainability.	Urban sustainability	SD
24	Kotiadis et al. (2013)	Explain how a performance measurement model can lead to debate and action in Soft System Methodology (SSM) in the health field	Hospital	SSM
25	Kotiadis (2007)	Demonstrate, through a healthcare case study, that Soft Systems Methodology (SSM) can be used to determine the most important component of the conceptual model, the simulation study objectives.	Intermediate care for the elderly	SSM

A discernible pattern emerges upon reviewing the 25 surveyed studies, wherein a mere 5 studies are centered within the confines of hospital contexts. Notably, Edward, Hall & Shaw (2005) inaugurate this subset, elucidating a systemic framework for knowledge management within the healthcare sector in the United Kingdom. Furthermore, the work by Kotiadis et al. (2013) assumes a more theoretical stance, offering an exposition on how performance measures can culminate in the application of structuring methodologies in healthcare contexts.

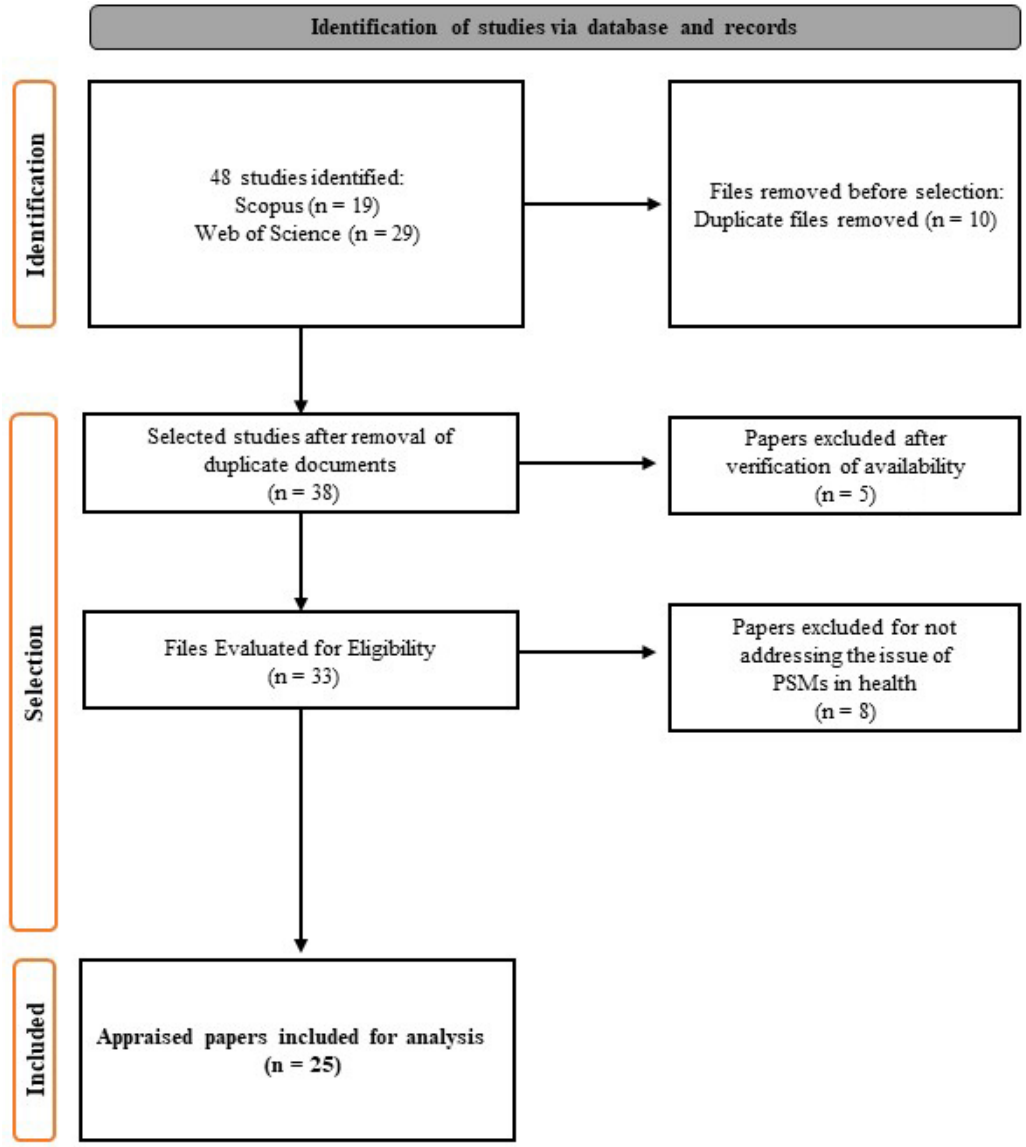

Figure 1 – Identification of papers on PSM in the health area.

Source: Adapted from Page et al. (2021).

Crowe et al. (2017) uses a combined methodology - quantitative and qualitative - aimed at congenital heart diseases in babies, clearly inserted in a method of structuring a decision problem. s A Rich Picture – feature of SSM – was developed capturing the main features of services for infants with congenital heart diseases helping the service improvement.

Furthermore, Small & Wainwright (2018) also used PSM, but with an approach focused on the surgical clinic. The authors pointed out that adopting the SSM can enable, and enhance, stakeholders' knowledge and learning about the unforeseen organizational consequences.

Finally, Lamé et al. (2020) presented a simulation in conjunction with PSM in the preparation of the chemotherapy ward. The authors highlighted that SSM has arguably a lot to offer to help identify and accommodate diverging objectives.

In addition to these works being linked by the hospital environment, it is possible to notice another similarity between them, which occurs through the use of the same method of structuring decision problems – SSM In addition, these papers clearly point out that the use of SSM has brought improvements to the health environment, especially when it has complex processes and few resources. Given that, of all selected articles, those working in hospital wards themselves used this approach, obtaining satisfactory results, the present study used the SSM in clinical medicine, in order to have a theoretical basis in line with that found in the literature.

Finally, it is also possible to notice that, among the applications in the hospital environment, none of them are in the clinical medicine ward, there being, therefore, a possible gap in the literature to be explored and possibly answered with the results of this paper. Thus, the choice of the wing is theoretically justified, since there is a strengthening of innovation at paper, in line with the use of real data.

2.3 Soft System Methodology (SSM)

As posited by Checkland (1981) and affirmed by Lamé et al. (2020), the SSM is fundamentally rooted in the notion that reality is a composite synthesis of diverse perspectives. Consequently, SSM serves as a systemic approach to probe and comprehend these multifarious interpretations and perceptual nuances surrounding events.

The genesis of this methodology is attributed to Checkland (1981), with its inaugural comprehensive iteration documented within the seminal publication "Systems Thinking, Systems Practice." The pivotal aim of SSM is the establishment of a shared consensus predicated on a unified comprehension of intricate predicaments (Van De Water et al., 2007).

Central to SSM's ethos is the primacy accorded to apprehending the problem itself, transcending a direct pursuit of solutions for the complex conundrum (Lunardi & Henrique, 2013). As a corollary, SSM doesn't inherently proffer solutions to the encountered quandaries; rather, it steers the conventional problem-solving approach toward this ultimate objective (Bellini et al., 2004).

Notably, the SSM methodology's most prevalent and recognized configuration is the seven-step framework. This model incorporates a spectrum of tools including rich figures, which serve as visual depictions of intricate issues, relevant systems for contextual understanding and diverse viewpoints, and conceptual models (Bellini et al., 2004; Georgiou, 2015; Lamé et al., 2020).

According to the explications of Checkland & Scholes (1990), Georgiou (2015), and Lamé et al. (2020), two principal applications of SSM emerge: Mode 1 entails interventions within prob-

lematic scenarios, adhering to the prescribed seven-step process, while Mode 2 revolves around interactions among stakeholders enmeshed in such scenarios. The latter embodies an internalized model guiding actions in a situation-centric manner. The ensuing section outlines the sequential stages of the SSM methodology (Checkland, 1981; Checkland & Scholes, 1990; Mingers et al., 2009; Sepehrirad et al., 2017).

- Step 1 - Exploration of the Problematic Situation: This phase entails the identification of the specific problematic scenario under scrutiny, grounded in the actual reality. The group collectively discerns the genuine nature of the issue.
- Step 2 - Articulation of the Problematic Situation: Here, the necessity arises to articulate the complex problem in a manner conducive to its profound comprehension. Rich figures serve as vehicles to encapsulate problem nuances, although no formal technique presides over their composition (Bell et al., 2016).
- Step 3 - Formulation of Succinct Definitions of Pertinent Systems: Following the creation of rich figures, this phase involves crafting succinct definitions as the bedrock for systemic problem understanding (Checkland, 1981). According to Checkland (1981), these definitions can be fashioned utilizing the mnemonic CATWOE: Customer, Actor, Transformation, World view, Owner, and Environment.
- Step 4 - Development of Conceptual Models: This stage embodies systemic thinking, necessitating the incorporation of elements that align with the previously established succinct definitions (Gregory & Lau, 1999).
- Step 5 - Comparative Analysis of the Conceptual Model and Reality: This step engages in a comparison between the real-world observations (steps 1 and 2) and the constructed conceptual model (step 4) (Checkland, 1981).
- Step 6 - Synthesis of Potential and Desired Changes: In this stage, proposals outlining potential courses of action to address or ameliorate the identified problem are advanced, considering the contextual milieu and the disparity between the envisaged solutions and the observed reality.
- Step 7 - Proposition of Measures to Transform the Problematic Situation: Culminating the sequence, this stage encompasses the implementation of measures proposed in the preceding phase. Checkland (1981) asserts that the chief value derived from SSM is the knowledge acquisition of actionable endeavors, thereby embedding desired changes within the final product of this approach.

Consequently, the application of SSM aligns aptly with addressing intricate predicaments prevalent in hospital settings. This methodology accords primacy to diverse stakeholders, fostering a collective ethos wherein perspectives converge to engender a holistic comprehension of complex scenarios, ultimately culminating in the formulation of proposals tailored to resolve the existing situation.

3 METHODOLOGY

The methodological approach encompassed two primary pillars, each delineated by distinct objectives. The first pillar was designated as (i) Theoretical Foundation, while the second was termed (ii) SSM Application Proposal (Figure 2).

In relation to the first pillar, as the nomenclature suggests, an exhaustive theoretical exploration was undertaken, marshaling the key facets germane to the research. This entailed a comprehensive examination of decision problem structuring methodologies, synergized with the healthcare domain, with a specific emphasis on their relevance within hospital processes. The outcomes of this comprehensive exploration were synthesized and incorporated into the antecedent section, denominated as the literature review.

Furthermore, this exploration functioned as a compass in pinpointing the optimal locus for the method's application. Consequently, the intervention within a medical clinic emerged as the chosen arena, given the conspicuous absence of works focused on this specific ward. The resolution to concentrate on data sourced from a medical clinic within a medium-sized hospital in the interior of Minas Gerais was driven by the intent to ground the proposed model in practical data.

Lastly, the survey's findings proved instrumental in selecting the most appropriate PSM for adoption. Within the context of the hospital domain, the SSM emerged as the comprehensive choice, evident from its unanimous endorsement across the surveyed literature, thereby underscoring its adaptability to this sector.

Subsequently, the study's second pillar, the SSM Application Proposal, came to fruition. This phase encompassed the systematic execution of the PSM step-by-step, meticulously aligned with Checkland's framework (1981), albeit adapted to the specific healthcare context—namely, the medical clinic within the focal hospital. The sequential deployment unfolded as follows:

1. Exploration of the Problematic Situation: A comprehensive delineation of the hospital's medical clinic processes, along with the pertinent personnel and decision-makers, was executed through a three-month period of observations. This observational phase was meticulously documented, underpinning the study's validity and reliability (Martins Drei & Sérgio de Arruda Ignácio, 2022; Drei et al., 2021).

2. Articulation of the Problematic Situation: In the aftermath of the comprehensive investigation, the intricate dynamics of the medical clinic were encapsulated through a rich picture, chosen due to its universal applicability in operational research (Checkland, 1985). This stage was enacted through collaborative meetings held over a two-week period, each session extending for approximately an hour.

3. Formulation of Succinct Definitions of Pertinent Systems: A pluralistic perspective was engendered through unstructured meetings with shift-based employees, eliciting insights from diverse viewpoints. The CATWOE framework—Customer, Actor, Transformation, Worldview, Owner, and Environmental Restrictions—conceived by Checkland (1981) was

employed. Following these interactions, three pertinent systems were distilled, with a focus on addressing the observed lack of balance within employee activities, a concern unanimously regarded as paramount.

4. Development of Conceptual Models: Synthesizing insights garnered from the preceding steps; a coherent conceptual model emerged. Anchored in the core issue of activity imbalances within the medical clinic, this model factored in activities necessitating displacement to other hospital wards.

5. Comparative Analysis of the Conceptual Model and Reality: Reengaging with the involved stakeholders, a follow-up series of meetings—spanning a total of two hours and forty minutes—elicited perspectives on existing hospital practices and projected improvements.

6. Identification of Possible and Desirable Changes: Building upon the interactions conducted in the preceding phases, unexplored facets of the conceptual model were introduced to stakeholders, resulting in a collaborative identification of changes considered both feasible and imperative. This identification was facilitated through two primary methods. The first method involved a comprehensive examination of the procedural aspects within the medical clinic wing, scrutinizing the unfolding activities and processes, as is, i.e., as they are performed. The second approach encompassed engagement with the staff, particularly the nursing personnel and support staff, achieved through a series of consultations throughout the research endeavor. This interaction enabled the establishment of a consensus with the staff regarding which actions should be enacted and their respective timelines, had these actions not been implemented in practice. Moreover, it ensured the continuity of existing wing activities.

7. Formulation of Action Plans for Transformation: Drawing from the proposed changes, a PDCA (Plan, Do, Check, Act) Cycle was meticulously crafted to govern the ongoing processes. This cyclical control mechanism was iteratively employed to steer change management within the hospital, bolstered by the establishment of a comprehensive control guideline (Quinquiolo, 2002). It is worth mentioning that the execution mode of the propositions established is not defined in the SSM, therefore the inclusion of the PDCA is valid.

   The integration of the PDCA cycle with SSM attests to the synergy between these methodologies, with SSM elucidating the mapping aspects while PDCA provides a concrete framework for hospital staff. Notably, the extant literature underscores the pertinence of combining SSM with other tools within the complex healthcare milieu (Crowe et al., 2017; Small & Wainwright, 2018; Lamé et al., 2020).

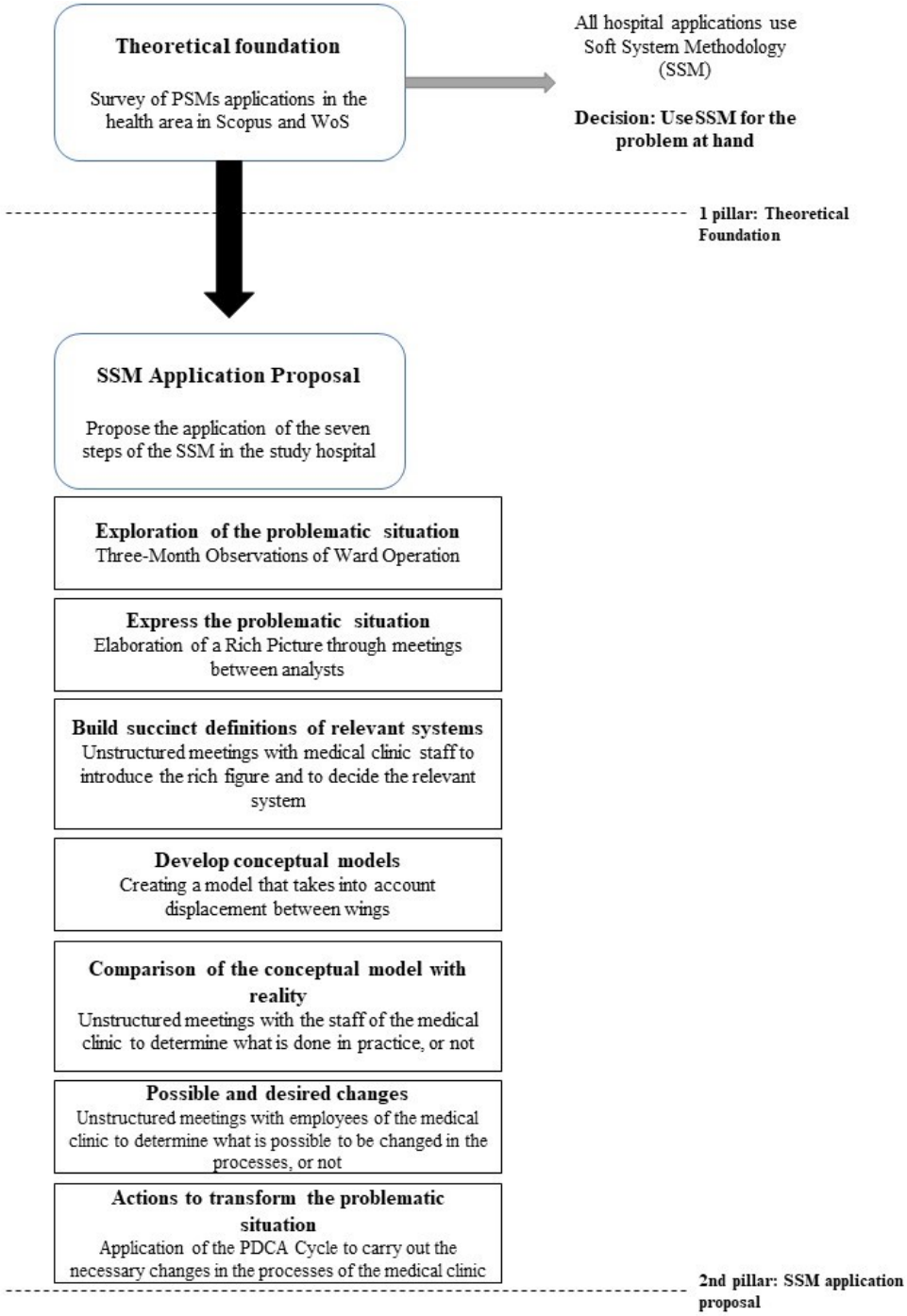

Figure 2 – Methodology of the conceptual model proposal for the medical clinic.

4 APPLICATION AND RESULTS

4.1 Context description: Brazilian hospital scenario

The subject of investigation encompasses a hospital situated within a municipality in the state of Minas Gerais, Brazil, catering to a wide catchment area of 28 neighboring cities in addition to the host city's population. The hospital exhibits a dual character, offering both public and private services, though the current study focused solely on the public healthcare aspect. With a three-story architectural configuration, the hospital provides access via ramps, omitting the presence of elevators. Furthermore, biometrically secured staircases exclusively accessible to personnel serve as the conduit between floors.

The Medical Clinic, operating within the same temporal framework of the hospital's shifts (12 hours on duty followed by 36 hours off), employs a staff contingent of 4 nurses during afternoon shifts and 2 during night shifts. Positioned on the third floor, the clinic comprises a constellation of beds distributed across rooms accommodating 2 to 3 beds each, culminating in a total of 25 beds. Supplementary to this inventory are 3 emergency beds designated to address exigent cases, sited within a designated room on the second floor.

The inclusion of this emergency provision stems from an agreement between the hospital and the Psychosocial Care Center, a facility chiefly tasked with catering to individuals grappling with mental health issues, inclusive of those precipitated by substance misuse. Within this arrangement, the hospital reserves 5 beds as an obligatory allotment for the Psychosocial Care Center's emergencies. Consequently, in such exigencies, the existing hospitalized patients are redeployed to the second floor.

In the context of hospitalization at the Medical Clinic, the 28 beds are symmetrically apportioned between genders, with 14 designated for male patients and an equivalent number for female patients, predicated upon biological sex rather than gender identity. Deviations from this parity arise only in exceptional circumstances, such as emergencies or isolation requirements. Furthermore, the patient quarters remain unoccupied in their entirety when not in use.

Within the Medical Clinic's confines, two distinct chambers are allocated to the nursing staff, each serving distinct administrative purposes. The administrative chamber is earmarked for patient records, inter-departmental communication, and scheduling coordination. Conversely, the supplies room is designated for the organization of materials, sterilization processes, and other related functions.

Internally, the Medical Clinic orchestrates a multitude of interrelated processes that span various hospital divisions, thereby engaging disparate elements like personnel, equipment, and workflows. These processes have been categorized into two principal groups: (i) general processes and (ii) specific processes. The former, conducted under the exclusive purview of the Medical Clinic, necessitate no external assistance and merely require approval from the attending physician. They are standard procedures administered to most hospitalized patients, encompassing

activities such as Medication Administration, Blood Pressure Monitoring, Bathing, and Diaper Change.

Conversely, the category of specific processes primarily comprises diagnostic examinations proffered by the Medical Clinic, including X-rays, electrocardiograms, endoscopy, blood sample collection, and ultrasounds. The nomenclature ”specific” reflects their selective application, targeting patients whose medical conditions warrant the administration of such diagnostic procedures.

4.2 SSM application

4.2.1 Exploration of the Problematic Situation

With regard to the operations within the medical clinic, specifically focusing on general procedures, the administration of medication to patients serves as an illustrative example. The medication administration process initiates with the transmission of the medication order to the responsible nurse. Subsequently, the nurse identifies the designated patient and establishes communication with the pharmacy to ascertain the medication's availability.

Upon receiving the order, a pharmacy staff member cross-references the hospital's inventory to verify the availability of the prescribed medication. In case of a positive match, the pharmacy staff contacts the medical clinic to communicate the confirmation. The nurse then traverses to the pharmacy, situated on the first floor, retrieves the medication, and returns to the medical clinic.

The subsequent phase entails the preparation of the medication for patient administration, encompassing the collection of requisite tools such as syringes, cotton, and other essentials. Ultimately, the nurse proceeds to the patient's bedside, where the medication is administered. This delineation of medication administration exemplifies a broader sequence of operational activities within the medical clinic.

In an alternate context, when examining specific procedures involving patient transportation, consider the case of an X-ray examination. The procedure commences with the arrival of a requisition for an X-ray examination at the medical clinic. The designated nurse then identifies the patient slated for the examination and coordinates with the stretcher team to facilitate transportation.

However, the procedure of calling the stretcher is not devoid of complexities, primarily due to the limited availability of stretchers, with only one operational during the daytime and none during the night. This singular stretcher is entrusted with hospital-wide tasks, extending beyond the confines of the medical clinic. Upon the stretcher's arrival, the requisition is handed over to the nurse, and the patient is transported to the X-ray facility located on the first floor, utilizing the hospital's access ramps.

Upon reaching the X-ray facility, the patient is handed over to the X-ray personnel, who proceed to set up the examination equipment and position the patients accordingly. The stretcher assumes a waiting position in the anteroom and, upon the conclusion of the examination, escorts the pa-

tients back to their room. This cycle continues for subsequent patients, with the stretcher playing a pivotal role in ensuring the seamless progression of the examination procedure.

Collectively, the examination of these operational processes underscores the pivotal roles played by the medical clinic's personnel, primarily the attending nurses, in tandem with the stretcher personnel. Additionally, the doctors overseeing both direct and indirect patient care within the hospital's medical facility contribute significantly to the operational dynamics.

In the quest for operational efficiency, it becomes evident that a considerable portion of the tasks executed within the medical clinic necessitates physical movements across the hospital's premises, facilitated predominantly through ramps to access lower floors. This applies to instances such as patient transportation to the X-ray facility and the retrieval of medications. Notably, both these activities converge on the first floor, mandating the deployment of the sole available stretcher during the day shift and the participation of a nurse for medication retrieval.

These processes, though intrinsically interwoven, exhibit an element of complexity that often compels the involvement of more than one personnel, typically a stretcher operator in tandem with a nurse on duty, even amidst simultaneous execution of parallel activities. Given the hospital's environment, especially within the medically sensitive context of the clinic, unexpected scenarios frequently emerge, ranging from an influx of critically ill patients to communication challenges across various departments. These factors occasionally lead to an uneven distribution of workload among nurses.

4.2.2 Articulation of the Problematic Situation

In light of the identified problematic scenario, the construction of a Rich Picture, as depicted in Figure 3, proved instrumental in providing a visual representation of pivotal junctures within clinical processes, along with their respective stakeholders.

Furthermore, it is noteworthy that the workflow managed by the nursing staff is subject to the concurrent presence of external individuals, including patients' relatives, friends, and visitors. These individuals not only seek interaction with patients but also necessitate attention, explanations, and monitoring, a challenge further exacerbated by the ongoing COVID-19 pandemic.

In response to the problem scenario depicted in the rich picture, a comprehensive exploration of pertinent systems was undertaken. Adhering to the principles of SSM, meetings were conducted with involved personnel to solidify the constructed framework. Considering the hospital's operational structure involving four distinct shifts, a total of four sessions were held, each dedicated to a specific shift, lasting approximately 1 hour and 15 minutes each. This cumulative interaction time amounted to 5 hours. The unstructured meetings occurred on-site within the medical clinic's wing, coordinated within the designated hours prescribed by the management. This engagement culminated in the identification of three initial relevant systems:

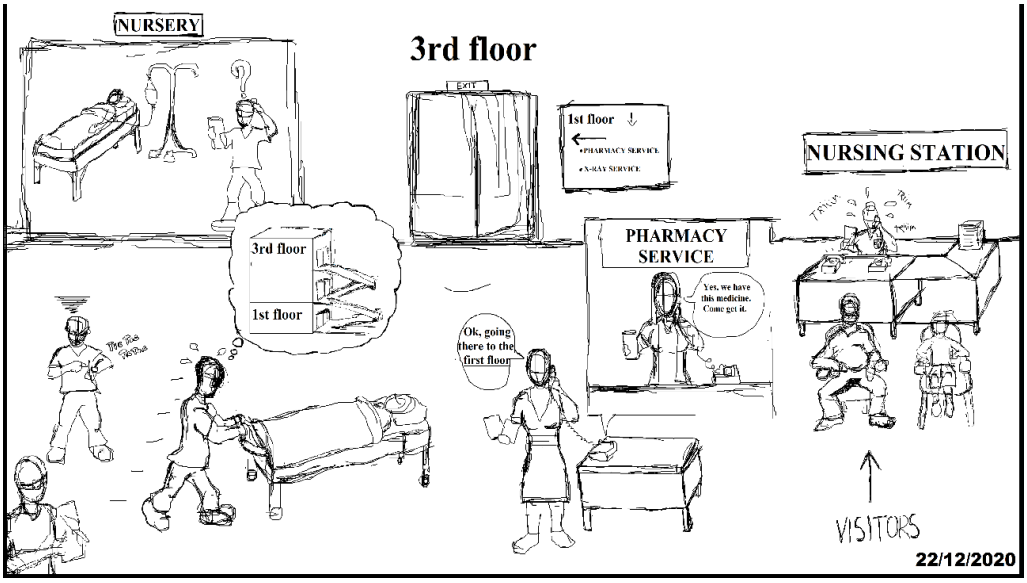

Figure 3 – Structured Rich Picture of the medical clinic.

Source: Authors.

1. Balancing responsibilities undertaken by medical clinic employees, particularly nurses, between tasks carried out within the clinic and those necessitating movement across different wings.

2. Establishing an improved protocol for supporting caregivers of patients in critical condition.

3. Developing an efficient communication and information dissemination system with administrative departments within the hospital.

4.2.3 Formulation of Succinct Definitions of Pertinent Systems

Following the exploration of these identified systems, the first system garnered significant attention and consensus among the personnel, being collectively perceived as the most crucial. Despite the existence of these activities, there had been no prior initiatives to achieve such balance. Consequently, the modeling objective was formulated to address the task of achieving balance, succinctly defined by the authors as ”a system approved by the directors of the medium-sized hospital located in the interior of Minas Gerais, the focal point of this study. This system, co-managed by analysts and medical clinic personnel, is geared towards equitably distributing the workload of medical clinic employees. It takes into account activities necessitating inter-departmental travel as well as those conducted within the clinic itself, while adhering to financial limitations and healthcare regulations prevalent in the hospital environment.” This definition encompasses the following key components:

1. Clients: Patients and their families;
2. Actors: Employees and analysts;
3. Transformation: Devising a methodology to balance employee workloads by factoring in activities with and without inter-departmental travel; Mitigating undue strain on personnel; Addressing diverse needs that cannot be promptly addressed due to the current lack of activity balance;
4. World View: The balancing approach should exhibit efficiency across varying timeframes without imposing excessive financial burdens on the hospital;
5. Owners: Analysts and Directors;
6. Environmental Restrictions: Adhering to prevailing healthcare and hygiene standards within hospitals, while considering the well-being of patients and their families involved.

4.2.4 Development of Conceptual Models

The pivotal system within clinical medicine revolves around the equilibrium of employee activities, with a particular focus on nurses. In alignment with this perspective, a conceptual model was formulated, depicted in Figure 4, characterized by its primary objective of enhancing the allocation of tasks among nurses. This allocation aimed to achieve an improved workload distribution without inadvertently escalating costs for the clinic.

In this context, the nursing activities within the medical clinic were categorized into three distinct blocks. The first block encompasses activities that a single nurse can undertake, encompassing tasks such as verifying medication orders, procuring medications from the Pharmacy, administering medications to patients, and engaging in administrative responsibilities. The second block of activities is designed to be executed by two nurses during the day shift and one nurse during the night shift.

These activities encompass the execution of general processes, excluding medication administration, and tasks within the supply room. On the other hand, the third block, exclusively applicable during the day shift, entails responsibilities that can be carried out by a single nurse. These duties encompass preparing patients for medical examinations and providing assistance to the stretcher during patient transportation.

Moreover, in conjunction with the division of activities into these three blocks, a rotation scheme was proposed, entailing a shift every 3 hours during the daytime and a shift every 6 hours during the nighttime. Nevertheless, it is important to note that this rotation framework does not preclude nurses from engaging in tasks from other activity blocks, contingent upon their availability.

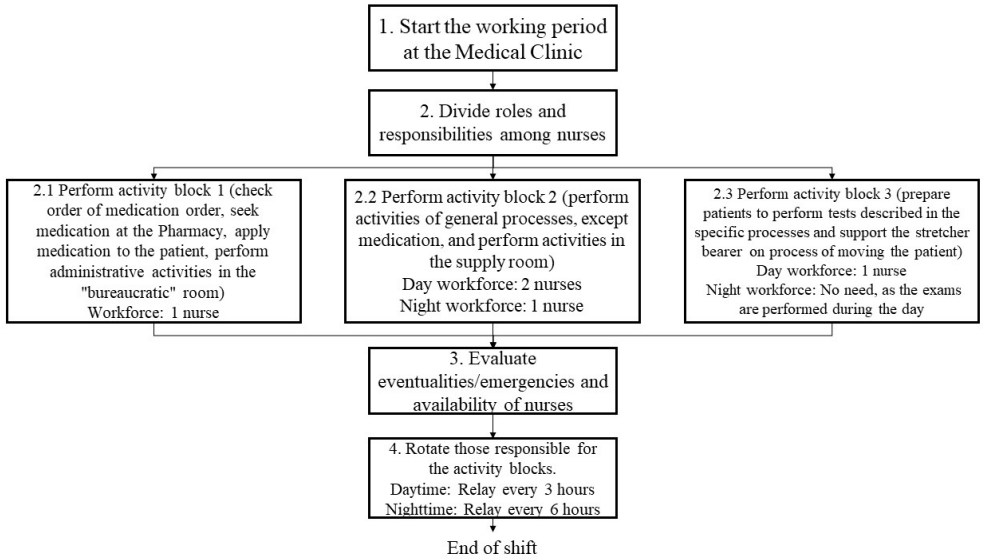

Figure 4 – Proposed conceptual model.

Source: Authors.

4.2.5 Comparative Analysis of the Conceptual Model and Reality

In continuation, the proposed conceptual model was presented to the medical clinic staff during meetings held with each shift, adhering to the same format employed in previous interactions, with a slight adjustment in the duration – approximately forty minutes per session. Consequently, a cumulative interaction time of two hours and forty minutes was achieved during this phase. During these meetings, the employees were apprised of the conceptual model and the existing hospital practices were examined vis-à-vis the model's recommendations, elucidating the areas that necessitated implementation. Subsequent to this assessment, a succinct comparative table, delineated in Table 2, was meticulously compiled to encapsulate the key insights.

Following the outlined procedural sequence, the personnel actively participated in a series of sessions, during which they were invited to identify the congruence of their real-world activities with the envisaged conceptual model, as generated from the collaborative interactions. Subsequently, a comprehensive comparison between the constituents of the conceptual model and the tangible operational reality was meticulously established:

- The first activity (numbered as 1), as delineated in the conceptual model, is already firmly embedded in practice, reflecting the habitual starting point of each shift in the hospital's medical clinic. This observation has emerged as a result of the comprehensive meetings and interactions previously conducted with employees from all shifts. During these meetings, it was possible to effectively map and validate the presence of this activity within the operational routine. The continuous integration between the practitioners and the staff in

Table 2 – Comparison of the conceptual model with reality.

Activity	Conceptual Model	Description	Reality
1	Start the working period at the Medical Clinic	Collective start of the shift of those responsible for the medical clinic	Made in reality, as proposed in the model
2	Divide roles and responsibilities among nurses	Division of responsibilities that the medical clinic ward has among the available nurses per shift	A division is made, but it is not structured, constant and often not fulfilled
2.1	Selection of a nurse for activity block 1	Select a nurse - in the afternoon and night shifts - to be the primary responsible for the activities present in the proposed block 1	It's not done in reality
2.2	Selection of two nurses for activity block 2	Select two nurses in the afternoon shift and one in the night shift to be the primary person(s) responsible for the activities present in the proposed block 2	It's not done in reality
2.3	Selection of a nurse for activity block 3	Select a nurse in the afternoon shift to be the primary responsible for the activities present in the proposed block 3	It's not done in reality
3	Evaluate eventualities/emergencies and availability of nurses	Evaluate the other nurses, who are not primarily responsible for a given block, in order to assist in it, if the responsible nurse is allocated to an emergency	It's not done in reality
4	Rotate those responsible for the activity blocks	Determine the shift, so that it follows a sequence, outlining each employee as the primary responsible for a period of 3 hours in 3 hours for the afternoon shift and 6 hours in 6 hours for the night shift	It's not done in reality

the development of the SSM has proven to be paramount, in line with its central recommendation in this point, to compare the conceptual model with reality in order to identify which activities are being performed and thus should be retained, and which are not yet implemented and are candidates for future incorporation. This interactive and participatory approach has yielded a dependable guide for delineating the conceptual model;

- Regard the second activity (numbered as 2), as outlined in the conceptual model, it is indeed suggested that the distribution of responsibilities be effectively carried out at the beginning of each shift. However, this suggested allocation is not consistently adhered to, due to the absence of a standardized metric applicable to all shifts on a daily basis. The analysis of the application of the conceptual model revealed that, although Activity 2 takes place in practice, it does not strictly adhere to the guidelines proposed by the model. This fundamental discrepancy was identified and substantiated during the detailed meetings and interactions with the employees of the hospital's medical clinic, as previously discussed.

These interactions underscored that the approach outlined in the conceptual model offers a more balanced and effective distribution of responsibilities for the employees, thus addressing the central issue of unequal task burden. The comparison between the model and reality exposes the need for a more structured and coherent approach to responsibility allocation. The ongoing interaction between employees and practitioners of the SSM emerges as a recommended method to bring the conceptual model closer to the ideal practice. Through this collaboration, it becomes possible not only to maintain existing activities but also to implement significant improvements in responsibility distribution, ensuring a more efficient and satisfactory work environment for all parties involved;

- Finally, with regard to Activities numbered as 3 and beyond, as defined in the conceptual model, they are not yet part of the daily operations. However, it is worth noting that the conceptual model offers an approach that can be highly beneficial for the medical clinic, particularly in terms of improving the distribution of responsibilities among employees. The implementation of these proposed activities (to be carried out using the PDCA methodology) can not only alleviate the unequal workload but also pave the way for continuous improvement of processes within the clinic. The absence of these activities as delineated in the model has been confirmed through interactions and detailed meetings with the medical clinic's staff, highlighting the need for a more structured and efficient approach in their operations. Therefore, the ongoing collaboration seen in the SSM is highly recommended, not only for identifying areas of improvement and implementing the missing activities but also for fostering a more participative and effective organizational culture that will ultimately result in a more efficient and satisfactory work environment for all involved. It is important to highlight that the use of PDCA is made in this research as a proposed approach, which will be, in the future, developed by the employees of the medical clinic, thus it is only elucidated in this paper.

4.2.6 Identification of Possible and Desirable Changes

The modifications proposed by the conceptual model, presently not manifested within the operational flow of the hospital, hold the potential for alteration and assimilation into the procedural framework of the medical clinic. This adaptability and alignment to the medical clinic's workflow were perceived as plausible by both the personnel involved and the overseeing medical practitioners.

4.2.7 Formulation of Action Plans for Transformation

Consequently, in pursuit of effectuating the conceptual model delineated for clinical medicine, a series of sequential measures were recommended to optimize the allocation of resources and temporal resources of the stakeholders. These actions were orchestrated through the application of the PDCA Cycle, as elucidated in Figure 5.

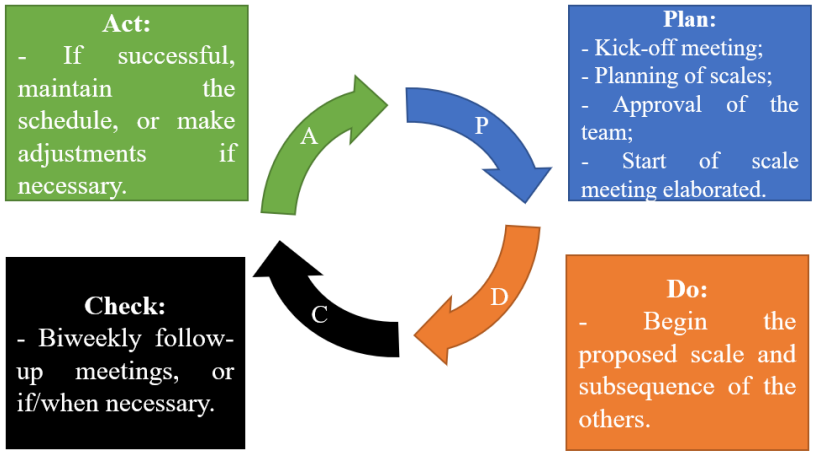

Figure 5 – PDCA Cycle for implementing the proposed conceptual model.

Source: Authors.

Hence, to orchestrate the implementation of the conceptual model, a kickoff assembly is recommended to inaugurate the proposal, apprising all pertinent stakeholders, encompassing staff members and supervisory medical personnel. Subsequently, the suggestion entails formulating shift schedules, initiating with an inaugural schedule among the nurses of each shift, subsequently spawning sequential schedules that evolve from the initial one, aimed at achieving workload equilibrium. Consequent to this, a subsequent meeting is convened to ascertain the commencement date of the initial schedule, thus paving the way for the actual implementation of the conceptual model.

Subsequent to the planning phase, the execution stage is initiated, during which the conceptual model is translated into practice, assimilated into the daily regimen of the medical clinic involving both staff members and patients. In the verification phase, biweekly meetings convene to proffer adjustments to the initially prescribed models and, if exigent, emergent meetings are convened to address ideas or predicaments that manifest during execution. Ultimately, in the action phase, upon successful outcomes, maintaining the schedule as is, or introducing modifications if deemed necessary, is recommended.

4.3 Impacts of SSM on the medical clinic process

After the proposed application of the SSM outlined in this study, it's important to highlight the impacts and perceptions from the main collaborators of the medical clinic process studied – the hospital directors, and primarily, the nurses and hospital stretcher bearers.

Considering the typical steps of applying the SSM, used in the design of this paper, four distinct moments emerge where perceptions about the SSM stood out.

Initially, during the first step of applying the method – exploring the problem situation – it became evident that the introduction of the SSM in the medical clinic, which suggested significant changes in the way activities like medication application were carried out, was met with resistance and not well received by nurses and stretcher bearers.

However, a significant shift in collaboration among hospital employees occurred during the second step of the SSM application – expressing the problem situation. Constructing the Rich Picture, with input from the hospital staff, became a pivotal turning point in the application of SSM. It vividly illustrated the dissatisfaction with the existing process and outlined the positive impacts that changes could bring.

This collaborative creation of the Rich Picture marked a transition point, fostering a more positive reception of the method. Employees felt heard and engaged, and this momentum continued through subsequent steps, particularly steps three to six, where interactions with managers and employees were increasingly fluid.

As the SSM's final step was reached – suggesting actions to transform the problem situation through the PDCA approach – employees showed strong acceptance and willingness to implement the proposed changes. This study demonstrated the importance of maintaining employee engagement throughout the SSM application for favorable outcomes.

This approach yielded notable benefits for employees involved in daily clinic activities. By utilizing the SSM, operational steps were meticulously outlined, granting employees a deeper and clearer comprehension of their workflow and interactions.

Moreover, the application of the SSM not only provided a clearer perspective on activities but also holds potential for fostering collaboration and knowledge exchange, as indicated by team members. Additionally, for professionals, this enhanced understanding of workflow and interactions within the medical clinic could lead to increased operational efficiency and a stronger sense of involvement and recognition.

For the authors, the thorough application of this methodology facilitated a comprehensive analysis of the activities, serving as a valuable tool to delineate each procedural step. An important aspect of this endeavor was the active participation of key stakeholders, including nurses, stretcher bearers, and other relevant professionals, who displayed genuine enthusiasm for the approach.

Through the use of the SSM, intricate workflow patterns within the Medical Clinic were effectively mapped, promoting collaboration and engagement among team members. The positive outcomes underscore the relevance of the SSM as an effective tool for addressing complex challenges in the hospital setting. The enthusiastic reception by professionals reinforces that the SSM goes beyond optimization, acting as a catalyst for ongoing and sustainable improvements in clinical and operational practices.

5 CONCLUSIONS

The hospital environment encompasses a multitude of activities and professionals, rendering its decision-making processes intricate. Predominant issues within this context are classified as unstructured problems, stemming from the presence of multiple stakeholders, divergent viewpoints, conflicting interests, and uncertainties. Thus, the utility of PSMs is evident in such an environment characterized by unstructured predicaments. PSMs facilitate a shared comprehension of the context and problem at hand, enabling stakeholders to mutually agree on resolutions.

This study employed the SSM, a problem structuring method, within the medical clinic ward of a hospital. As discerned from the literature review, SSM has been employed in analogous hospital case studies and serves as an organized framework for addressing intricate situations and incorporating input from stakeholders. The application of SSM in this study fostered nurse engagement and a deeper understanding of the predicament. This led to the proposal of solutions to balance nurses' activities and extend potential solutions to other identified systems.

Moreover, SSM's appropriateness in this context is accentuated by its inherent approach. The method encourages interactions with employees, allowing their perspectives to shape the problem-solving process. This inclusive methodology aids in representing multifaceted issues. In a scenario like the one examined here, where familiarity with external healthcare tools is limited, an approach catering to unstructured problems enhances mutual understanding.

Furthermore, the second interaction stage advocated by SSM is crucial. Starting with the initial meeting, employees become more involved in the addressed problem, voicing challenges they encounter. This familiarity streamlines subsequent meetings, promoting productive discussions and integrating analysts' and employees' ideas for optimal outcomes.

Nonetheless, it's worth highlighting that those initial interactions between analysts and employees, due to the lack of familiarity of the staff with the method, experienced delays in aligning proposed solutions with feasible actions within hospital constraints. To mitigate this, pre-establishing limitations is advisable to enhance the initial interaction.

Employing OR tools, specifically the soft OR tool SSM, offers a comprehensive approach to recognizing and addressing intricate challenges. It facilitates active involvement of healthcare professionals in identifying and understanding operational hurdles. By embracing healthcare practitioners' perspectives, SSM not only meticulously delineates operational steps but also furnishes a profound comprehension of clinic interactions and workflows. This direct collaboration uncovers bottlenecks, inefficiencies, and avenues for improvement, culminating in more efficient processes, heightened employee contentment, and elevated healthcare quality.

Some limitations characterize this study, including restricted hospital access due to the COVID-19 pandemic, time constraints for interviews, and logistical challenges for analysts' site visits. This study highlights opportunities for applying improvement tools and identifies multiple areas necessitating enhancements.

It is pertinent to underline that this research represents an approach wherein SSM was deployed within the medical clinic ward, utilizing real data. However, the PDCA cycle was only proposed, necessitating subsequent implementation.

Hence, future research should consider employing proposed tools for problem structuring, along with the identification and application of other techniques, to deepen understanding of medical clinic activities. Potential avenues include detailed process mapping, workload allocation models, and traditional operational research methods such as Data Envelopment Analysis (DEA), simulations, or multicriteria approaches.

Acknowledgements

The authors would like to thank the Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

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How to cite

DREI SM, MIRANDA EG, PAZ TSR, MOTA VRR & BERGIANTE NCR. 2023. Proposing a novel conceptual model for the medical clinic within a mid-sized hospital through the application of Soft System Methodology (SSM). *Pesquisa Operacional*, **43**: e275528. doi: 10.1590/0101-7438.2023.043.00275528.