DOI: 10.1590/1413-81232023288.05472023EN

Breast Cancer Care Network coordination: analysis in the light of the lean methodology for early diagnosis

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Abstract *This study aimed to analyze the application of the lean philosophy in the Health Care Network (RAS) for the early diagnosis of breast cancer. This case study was produced with data from interviews, document analysis, and observation and was conducted from June to July 2019. The setting was the seat of the municipality of the North Metropolitan Region, Ceará State, Brazil, involving three points of the RAS (Primary Care Unit, Medical Specialties Center, and Polyclinic). The following issues were identified: long waiting times, first-come-first-served care, and insufficient medical workload. Implementing the theoretical model of lean philosophy would reduce the total process time from 36 days to 15 in the Primary Care Unit/Medical Specialty Center flow and from 33 to 13 days in the Primary Care Unit/ Polyclinic. The presented model is an efficient reference for improving the management and early diagnosis of breast cancer in the RAS.*

Key words *Primary health care, Health Services Network, Lean healthcare, Early diagnosis, Breast neoplasms*

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Introduction

The health-illness process results from multiple complex aspects, and the health sector must make them increasingly visible. From this perspective, health promotion stands out. Within the National Cancer Prevention and Control Policy, it is the principle related to the identification of and intervention on the determinants and conditions of the types of cancer. It is also oriented towards developing intersectoral actions of public responsibility and civil society to promote health and quality of life[1].

To this end, among other actions, we should analyze the Health Care Network (RAS) functioning. The organization of network-integrated health systems is an innovation regarding a care model. The RAS is defined as organizational arrangements of actions and health services with different technological and interdependent densities, which seek to promote comprehensive care and are organized in horizontal relationships between the points of care, whose communication and coordination center is primary health care (PHC)[2].

This study focuses on the breast cancer Care Line, considering that breast cancer is the leading cause of death from cancer in the female population in all Brazilian regions, especially in the South and Southeast, where the higher incidence and mortality rates are recorded. Data from the National Institute of Breast Cancer (INCA) estimate 74,000 new breast cancer cases in Brazil for the 2023-2025 period[3].

Screening mammography is a routine test in women without breast cancer signs and symptoms. It is recommended by the Ministry of Health for the 50-69 years age group every two years. There is greater uncertainty about benefits outside this age range and periodicity, considering the Brazilian Early Breast Cancer Detection Guidelines[4].

When analyzing breast cancer early detection actions, a study that evaluated whether these activities initiated with the medical request for mammography differ between users of the Unified Health System (SUS) and those with a private health plan concluded that women exclusively dependent on the public health system face more significant hurdles to accessing mammography screening tests. The proportion of women who underwent the test was 79.5% among those with a health plan compared to 51% among SUS users[5].

Thus, among other factors, the high mortality curve results from the late diagnosis of the disease[5,6]. The importance of directly articulating Health Promotion is evident under these terms. It contributes to controlling known risk factors and overcoming barriers to reducing mortality from breast cancer in Brazil, in access to screening mammography, and, above all, in structuring the care network for quick and timely diagnostic investigation and access to quality treatment[4].

According to the National Cancer Prevention and Control Policy, primary health care[1] is responsible for coordinating and preserving the care of users with cancer when referred to other points of the Health Care Network. PHC is also responsible for the screenings per federal protocols and guidelines or following local protocols based on scientific evidence and locoregional reality. We would infer, therefore, that PHC integration should be considered one of the strongest predictors in early cancer screening[7].

When we take the daily routine of the family health teams as an object of analysis, we are often faced with increased demands for tests and visits; reduced financial resources and human potential; professionals' dissatisfaction with work overload, and people's lack of recognition; people's dissatisfaction with the PHC services; increased triple burden of disease (acute/infectious, chronic and external causes); need for physical space; and time spent on health activities, which are some of the tensions faced by health care managers and providers.

The lean healthcare philosophy, which comprises a set of concepts, techniques, and tools that seek to improve health service management and organization continuously, emerges in this context. As a management model, it integrates science-based principles and methodologies that analyze processes to reduce waste, waiting times, and errors, favoring a workforce focused on activities that produce value for the users. These are fundamental aspects to consider in developing strategies to improve disease prevention and health care services, especially breast cancer screening.

Faced with this reality, the guiding question of this investigation was: how can the lean philosophy contribute to bringing more effectiveness in improving breast cancer screening in the Health Care Network in the seat of a Metropolitan Region of the State of Ceará?

The essence of lean thinking is continuous improvement, focusing on the high quality of services and the value of the products (or services) delivered to customers (users). With this approach, organizations can curb waste, perform

actions that add value to users, downsize efforts, increase user and employee satisfaction, and achieve lower costs[8].

To achieve these results, one must understand the primary purpose of lean thinking, which far exceeds objective techniques. Some fundamental prerequisites cannot be neglected to face these challenges: [i] employees need to be engaged and committed; [ii] employees must be involved in all decisions; [iii] there must be strong motivation for change; [iv] everyone should know the current situation and what can be improved. Therefore, such principles are aligned with those of interprofessional collaboration[9].

Lean has work organization support tools that achieve significant and systematic improvements. One of the most used is value stream mapping (VSM), which describes the current situation with information and flows through the collective construction of a visual representation by symbols to identify problems and simulate the future situation, proposing possible improvements[10]. The VSM allows participants, in this case, health service professionals, to discuss how they see the flow of a specific process. It leads them to seek consensus on problem resolutions and propose betterments[11].

In Brazil, several hospital network-targeted experiences have adopted lean thinking and disseminated the results. The main sectors investigated were medication preparation and administration, specialized unit, Nursing care, hygiene and disinfection, oncology clinic, specialized medication pharmacy, total quality vs. lean, hospital logistics, lean and health systems, organ donation, chemotherapy, application of tools in the hospital, diabetic foot care, emergency, reception and care, supply management, and test collection logistics.

The lean method was applied in an oncology clinic in Paraíba using the value stream mapping tool, kaizen, 5S, and workload leveling, emphasizing visual management. Through a successful example, it provided support for implementing operations and improving quality and efficiency for other institutions[12].

The Ministry of Health adopted the lean healthcare methodology as a proposal for the reorganization of urgent and emergency care in 16 states and the Federal District, in partnership with the Syrian-Lebanese Hospital, where a 45% reduction in waiting time between screening and the first medical care in the first phase of the project[13] was identified. However, although extensive use of Lean techniques in health care is shown in the scientific literature, they are somewhat restricted to hospital institutions, and studies about applying this management model in primary care are scarce.

A study carried out in Minas Gerais published in production engineering analyzed through the VSM, the routine appointment in a PHC Unit (UBS), in which a new process was suggested to reduce the total cycle time, identifying waste and suggesting improvements[14].

In this context, the present study aimed to analyze the application of the lean healthcare philosophy for the early diagnosis of breast cancer in the seat of a Metropolitan Region of the State of Ceará to identify possible waste and opportunities for improving the process, reducing the waiting time and streamlining health care.

Methods

This case study[15] performed a thorough and exhaustive examination of the entire current process and the future image-objective of implementing the lean healthcare methodology in the health services part of the Breast Cancer Care Network in the seat municipality of the Metropolitan Region of the State of Ceará, whose population is 210,711 inhabitants[16], in the diagnosis of breast cancer: [i] PHC Unit – UBS, linked to the Municipal Health Secretariat/Primary Care Coordination, [ii] Medical Specialty Center (CEM), linked to the Municipal Health Secretariat/Specialized Care Coordination Office; [iii] Type II Polyclinic, linked to the State Health Secretariat of Ceará/Public Consortium of the seat municipality of the Health Region.

The study setting was Sobral, Ceará, where a protocol was developed to define the equipment: a UBS, the CEM, and the Polyclinic. The participants were professionals working in the breast cancer diagnosis sectors with experience equal to or greater than six months (16 in total). Data were collected from June to July 2019 through the observe-plan-develop-check-adjust cycle (OPDCA), where each process step was organized with a lean tool. The Lean Healthcare definition is based on using the lean methodology in health[3].

The lean methodology's theoretical framework is based on five basic principles: [i] the value, [ii] the value stream; [iii] the continuous stream; [iv] pull production; [v] perfection. Following these steps, the VSM was adopted as a methodological reference[17]. This is one of the

lean tools and "visually represents the flow of work and information that links a problem or service to a customer": a simple alignment tool. It identifies the flow to solve problems and make improvements[18].

The UBS has 48 employees and offers primary health care; appointments, home visits; immunization; dental follow-up; scheduling appointments and tests; dressings; fogging; laboratory tests; and dispensing medication, among other primary health care procedures. Its physical structure includes a reception; five offices (medical, nursing, dental); an immunization room; a procedure room; an observation room; a pharmacy; a pantry; a reception, and a meeting room. It is open Monday through Friday from 7:00 am to 5:00 pm by walk-in and appointment demands.

CEM has 40 employees and offers specialized appointments in mastology, gynecology, obstetrics, and other specialties; diagnostic tests: ultrasound; mammography; X-ray; cytopathology laboratory; oncotic cytology, minor surgeries; and dressings, among other women's health services. It has a reception; Statistical Medical Archive Service; 14 medical offices; ultrasound rooms, mammography; mammography processing; dressings; procedures (minor surgeries); preparation of material for sterilization; X-ray room; and cervical cancer prevention laboratory, among others. Its opening hours are from Monday through Friday from 7:00 am to 7:00 pm. It is a reference for the 54 municipalities in the macro-region of the seat of the Metropolitan Region for care by appointment. Referrals are made via the central appointment scheduling service for the UBS in the municipality or those from municipalities in the region in the Integrated Agreed Program.

The Polyclinic has 76 employees. It offers specialized appointments in mastology, gynecology, and other specialties; diagnostic and therapeutic support services such as mammography, radiology, and ultrasound. It has a general reception, reception by sector; multidisciplinary offices; pharmacy; specialized test rooms; collection post; plaster room; diabetic foot room; invasive procedures room; vital signs room; observation beds; administrative areas; bathrooms; pantry, and auditorium. It is open from 7:00 am to 5:00 pm and covers the 24 municipalities of the public consortium of the Health Region of Sobral via the regulation system. Services are offered by appointment.

The following sectors were selected at the UBS: reception, medical outpatient clinic, nursing outpatient clinic, appointment, and test regulation sector. There were seven participants: a manager (1), a system professor (1), a nurse (1), reception administrative workers (3), and an appointment scheduler (1).

The following sectors were selected at the CEM: reception, imaging sector, test analysis sector, report issuing sector, and mastology outpatient clinic. Five professionals participated: a manager (1), reception administrative workers (2), an imaging sector technician (1), and a data reading and typing sector administrative worker (1).

The following sectors were chosen at the Polyclinic: general reception, imaging sector reception, test analysis sector, report issuing sector, and mastology outpatient clinic. There were four participants: the imaging sector manager (1), an imaging sector reception administrative worker (1), an imaging sector technician (1), and a data reading and typing sector administrative worker (1).

The following collection tools were used: unsystematic observations, unstructured interviews, and workshops to map current and future value streams and identify waste in processes and opportunities for improvement, adding process and waiting times.

The VSM was performed through three workshops lasting three hours in each setting. The lean philosophy and the VSM tool were presented in the first workshop; the participants constructed the current VSM in the second; the projected future VSM integrated into the systematic vision of the network was elaborated with the participants of the three sectors in the third.

The Research Ethics Committee (CEP) of the Vale do Acaraú State University (UVA) approved the study under Opinion N° 3.377.690 and is an integral part of the data from the primary author's dissertation developed in the Professional Master's degree in Family Health at Northeast Family Health Training Network (RENASF) at UVA.

Results and discussion

The value map of the care network for the early diagnosis of breast cancer in the central equipment analyzed was designed based on the structuring of the flows from the user's entry into the UBS to the care provided by the triage nurse and the breast cancer screening protocol until diagnostic confirmation with the mastologist at the CEM or the Polyclinic. In this course, the analysis of the process time (PT) in each activity, the wait-

Ciência & Saúde Coletiva, 28(8):2313-2322, 2023

ing time (WT) between these, and the lead time (LT: PT+WT) traveled by the user assisted by this network were calculated.

The results obtained were organized and described according to each unit and corresponding sector studied by elaborating on the current VSM (visual representation of the current process flow) and identification made by the interprofessional team about the main waste. Suggestions for improvements for applying lean philosophy tools were presented, with an estimate of possible results in Charts 1, 2, and 3.

There are four possibilities for the user to start the process of scheduling a mammogram at the UBS: 1) walk-in demand: when she seeks directly to schedule an appointment; 2) external demand: when she brings a request from an external professional to the service; 3) scheduled demand: when requested based on the evaluation of the doctor or nurse at the UBS; 4) active search demand: when the community health worker performs the search in the territory of the woman with a delayed test. The return to the UBS scheduling center can have the following development: 1) authorized: the appointment booker can inform the user of the visit, either to the CEM or the Polyclinic; 2) pending: when the justification for subsequent authorization needs to be improved; 3) denied: when it needs to be reassessed by the doctor.

The main findings in this sector point toward improving the organization of work processes and reducing user waiting times. This inference corroborates a study on user waiting time at a health unit for a routine appointment, in which they applied the lean value stream mapping tool[13]. The total time was reduced from 46 minutes in the current situation to 36 minutes in the future situation, representing about 22%. In the current VSM, the process time was approximately 77 minutes in this flow; the waiting time and the lead time was 20 days. In the future VSM, the PT was 55 minutes; WT and lead time declined to eight days. Such information shows the waiting time as the central issue of the process.

The advantages of Lean are related to considerable reductions in total process times, surveys, waste, quality assessments, increased productivity and profitability, and other benefits that are difficult to measure[19].

The 78-minute PT will decrease to 68 minutes if the suggested improvements based on what is proposed by the lean philosophy are implemented. As a result, the WT would reduce from 15 to 8 days. Similar results were found in a study investigating the application of one of these tools, value stream mapping, in hospitals and how it interfered with patient care processes. The visualization of the implementation time in each process, the time the patient would have to wait to be attended to, and the percentage of times the activity would be performed entirely and correctly[20] was identified through the VSM. The perception of waste allowed proposing improvements, with the potential gain of reducing patient waiting time in the hospital at all stages of the process.

In this flow, the approximately two-hour PT would remain the same; WT and the LT would drop from 13 to six days. Again, the waiting time is the main factor in the process delay. In the flows investigated in this study (Flow 1: UBS/CEM; Flow 2: UBS/Polyclinic) in the current VSM, the process time was approximately three hours (Flow 1) and four hours (Flow 2); the waiting time and the lead time was 36 and 33 days, respectively. Regarding the future projection carried out by the interdisciplinary team, the PT was two hours (Flow 1) and three hours (Flow 2). Both managed to reduce the previous mapping time, with evidence of a shorter route from the UBS to the CEM. The WT was 15 and 13 days in flows 1 and 2, showing a shorter route from the UBS to the Polyclinic.

These metrics showed a considerable difference with an approximate reduction of twenty days from the previous process, and was an efficient process to identify waste and highlight points of improvement, adding value to the user; the complete lead time was slightly higher than the WT, and the percentage reduction in the processes was, on average, 40% in both flows. These results align with the assumptions of the lean philosophy.

With lean critical-reflective thinking, the participants identified 25 non-value-added activities (NVA) in the flows covered in the RAS for early breast cancer diagnosis. These activities were identified as waste and non-essential; they generate increased waiting times and unnecessary procedures; they can be excluded and replaced to streamline the process, speeding up the course taken and adding value to the users of the services vis-à-vis access, quality, and satisfaction.

Waste that should be avoided in production activities was classified into seven categories[21] and adapted[22] 1) overproduction: performing more procedures than necessary; 2) defects: errors, procedures, and activities performed incorrectly, quality control problems, or poor performance;

Chart 1. Lean tools applied by sectors and main results – UBS. Municipality of the Northern Metropolitan Region of the State of Ceará, Brazil, 2022.

Sectors	Current VSM (Waste)	Application of lean techniques	Future VSM (improvements)	Number of improvements	Results
Reception	First-come-first-served care - Pre-established professional schedules and no slots available for acute situations; - Administrative workers with the same attributions in the SAME	VSM, Gemba, kaizen, 5S, standard work, teamwork, multifunctional workers, work according to takt time (standard time), sector layout.	Appointment scheduling by hour blocks; - Flexible professional schedules, alternating walk-in and scheduled appointments; - Distribution of administrative workers' attributions.	3	Reduction of user waiting time at reception from 30 minutes to 15 minutes
Nursing outpatient clinic	A day reference nurse does screening.	*VSM, Gemba, kaizen, standard work, work according to takt time (standard time).*	The nurse in the assigned area must do the screening	1	Reduction of waiting time from 120 minutes to 30 minutes
Medical outpatient clinic	Referred from screening or prior scheduling	*VSM, work according to takt time (standard time).*			The 35-minute *lead time* was maintained
Appointment and test regulation sector	- Forms and requests manually to be delivered to the booking center; - Disqualified specialty waiting lists; - Appointments communicated through the community health worker; - Reassessment appointment, in case of denial, within three days; - The appointment scheduler inserts requests into the system, monitors appointments, and communicates them to the health worker	VSM, Gemba, kaizen, 5S, standard work, teamwork, multifunctional workers, kanban, work according to takt time (standard time), autonomation	- Forms and orders entered into the system in the office; - Qualification of specialty waiting lists; - Implementation of tele-scheduling for scheduling communication; - Expedite appointment in up to 24 hours for reassessment; - Current appointment scheduler function replaced with regulation and tele-scheduling assistant	5	Reducing waiting time for the delivery of the test request in the sector (variable time, considering the waiting line and minimum of 15 minutes) for immediate insertion during the medical appointment; Standard work eliminates pending issues and waiting time

* Processes whose results needed to be more detailed.

Source: Authors.

3) unnecessary inventories: excessive storage and waiting times, low level of service to the user, results to be analyzed and patients waiting for diagnoses; 4) unexpected processing: inappropriate implementation to the detriment of more straightforward and more efficient approaches;

Chart 2. Lean tools applied by sectors and main results – CEM. Municipality of the Northern Metropolitan Region of the State of Ceará, Brazil, 2022.

Sectors	Current VSM (Waste)	Application of lean techniques	Future VSM (improvements)	Number of improvements	Results
Reception	First-come-first-served care - Two waiting stages: reception and test room; - Incomplete or incorrect forms received from the UBS.	VSM, kaizen, 5S, standard work; Work according to takt time (standard time), and cellphone layout	- Service carried out by scheduling by hour blocks (blocks of appointments scheduled by hour); - Requiring complete and correct completion of UBS requests	2	Waiting time reduction of 180 minutes. Avoid rework
Imaging sector	- Excess of sheets and worksheets with the same purpose; -Conventional mammography device.	VSM, kaizen, 5S, standard work; Zero defect quality control	- Reduction of sheets and worksheets; - Replacement of the conventional mammography device with the digital one	2	Reduction of waiting time (from 55 minutes to 40), improved image quality, investment return, increased image quality, reduced steps in the work process, and increased user and technician satisfaction
Report analysis sector	The doctor comes once a week to do the tests	VSM, work according to takt time (standard time)	Availability of daily medical workload	1	- Accumulation of tests to analyze and delay in issuing reports; - The daily availability of physicians to carry out reports would imply an impact on reducing the LT from seven days to 24 hours
Report issuing sector	- Insufficient number of computers; - User is notified when the test is ready to be received; - Does not provide UBS with information about users who underwent tests; - Administrative agent informs the user when the test is altered and about scheduling with a mastologist	VSM, Gemba, kaizen, 5S, standard work, teamwork, multifunctional workers, work according to takt time (standard time)	- Acquisition of a computer; - Deadline for receiving the test already defined and informed to the user when the test is performed; - UBS receives information about users who underwent tests for better follow-up; - Establishment of a protocol that guarantees humanized and receptive diagnostic communication	3	- Acquisition of a computer for typing reports would take LT from two days to 24 hours; Lead time of two days. - Work backlog due to waiting for the test and computer unavailability; - Time reduction and care coordination by the PHC
Specialist/ mastologist outpatient clinic	Appointments with specialists scheduled for users with tests moved to the nearest available date.	VSM, work according to takt time (standard time)	Protected slots in specialists' agendas daily for users with altered tests	1	Scheduling from 72 to 24 hours

*** Processes whose results needed to be more detailed.**

Source: Authors.

5) excessive transport: can also be considered for users, tests, documents, non-streamlined physical arrangement; 6) excessive movement: related to professionals due to a non-rationalized work organization; 7) waiting: long periods of inactivity, resulting in poor flows and long lead times,

Chart 3. Lean techniques applied by sectors and main results – Polyclinic. Municipality of the Northern Metropolitan Region of the State of Ceará, Brazil, 2022.

Sectors	Current VSM (Waste)	Application of lean techniques	Future VSM (improvements)	Number of improvements	Results
Reception	- The user enters two receptions: the general reception and the imaging reception	VSM, kaizen, 5S, standard work; Work according to takt time (standard time)	The user directly applies to the imaging reception, which receives the agenda from the regulation center	1	Reducing waiting time by 60 minutes by eliminating the general reception (Does not add value)
Imaging sector	- High process time to fill out incomplete and incorrect forms; - Excess files and spreadsheets with the same purpose, waiting until the quality of the images is checked	VSM, kaizen, 5S, standard work; zero defect quality control	- Complete and correct forms received from the UBS through the checklist; - Streamlining processes by reducing files and spreadsheets with the same utility	2	Reducing waiting time by 30 minutes; streamlining for test room entry and a more positive user experience
Report analysis sector	The radiologist doctor attends two shifts a week to report	VSM, work according to takt time (standard time)	The radiologist doctor reorganizes the work process and shows up daily to report	1	Reduction from 72 hours to 24 hours
Report issuing sector	- The user does not know the exact date that the test will be ready; - Information on users who underwent tests at the UBS is unavailable	VSM, Gemba, kaizen, 5S, standard work, teamwork, multifunctional workers, work according to takt time (standard time)	- The user knows the exact date of receiving the test result; - UBS receives information about users who underwent tests for better follow-up	2	Reduction from 72 hours to 24 hours
Mastology outpatient clinic	Specialist appointments are scheduled for the closest available slot	VSM, work according to takt time (standard time)	Reserved slots in specialists' agendas daily for users with altered tests	1	Scheduling from 72 to 24 hours

* Processes whose results needed to be more detailed.

Source: Authors.

time in which the user waits for a bed, appointment, test, and treatment.

Among the waste found, waiting stands out as the main point of improvement, considering saving time in this race to diagnose breast cancer as early as possible, providing opportunities to increase cure possibilities if identified timely and treated appropriately and early. The improvements obtained from implementing this method were presented in all the workshops with the participants and the then management of the municipal health system, who showed interest in networking and developing the new flow in the line of care for women with breast cancer.

This study's results are supported by another conducted in California, USA, which evaluated changes in redesigns after introducing the Lean system in 46 primary care departments in 17 different clinical sites[23]. They observed system-wide improvements in workflow efficiency and medi-

cal productivity without adverse effects on clinical quality and increased patient satisfaction with access to care. Departmental costs declined, and staff satisfaction levels hiked. These findings conclude that lean designs can benefit patients and teams without negatively affecting clinical care quality.

The application of Lean thinking has been echoed in studies that report on the existing pressure on health services, the scarcity of resources, cost reduction, and people's demand for care quality[24]. Thus, it becomes imperative to adopt efficient management tools, such as those applied in the Lean philosophy, which eliminate waste and satisfy the customer with simple methods.

Final considerations

The efficiency of the lean philosophy and its respective tools for organizing lean production in the health sector was verified, under the systemic view of primary care as coordinator of the RAS, improving user experience quality. The application with multidisciplinary teams displayed great potential for reflecting on the flows developed in the services, identifying movements, processes, unnecessary waiting, and, consequently, waste elimination. From the teams' perspective, such analyses provide opportunities for awareness, engagement, and possibilities for improving and strengthening interprofessional collaboration in care production and work management.

The processes of the sectors that underpin the Breast Cancer Care Network were analyzed within the scope of diagnosis. We identified that some central issues contribute to the prolonged user waiting time to enter the UBS for the appointment with a mastologist at the CEM or Polyclinic for the diagnosis of breast cancer: 1) long waiting time; 2) service on a first-come-first-served basis; and 3) insufficient medical workload.

The study metrics for time calculations (process, waiting, and lead time) were estimated from reports and preliminary observations about the professionals' work process. However, we suggest monitoring and timing these metrics in real-time for future studies to ensure greater reliability. We stress that the potential gains pointed out by the study will be obtained without any cost increase. According to Lean thinking, there is no need for significant investments to transform processes. The idea is to do more and better with less.

There was evidence of advances in incorporating collaborative practices within the Health Care Network and appreciating the management of health processes toward efficient results for Health Promotion and, consequently, improved care quality.

When considering the results obtained, we suggest conducting complementary studies that can incorporate collaborative practices and Lean thinking into the production of care and work management from the perspective of health promotion, comprehensiveness, and care coordination by the Family Health Strategy.

Collaborations

AGSR Gurgel, JMN Aragão and MIO Vasconcelos worked on the conception, design, and data analysis and interpretation; on the article drafting or critical review; and on the approval of the version to be published. ALP Magalhães, G Cristino Filho and JRF Parente worked on the article drafting or critical review and on approving the version to be published.

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Article submitted 29/10/2022
Approved 28/03/2023
Final version submitted 19/04/2023

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva

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