

Impact of a structured thoracic navigation pathway on diagnostic timeliness and survival in lung cancer: a prospective cohort study from Brazil

Abstract

Lung cancer poses a significant public health challenge with high morbidity and mortality. In low- and middle-income countries (LMICs), access to novel oncological treatments is often delayed or restricted. However, process-based interventions such as patient navigation may improve clinical outcomes irrespective of the specific treatment used. This study evaluates whether a structured thoracic navigation pathway improves timeliness and survival in a Brazilian private outpatient clinic. Data collected in 2019 served as baseline pre-intervention measures; the navigation pathway was then implemented, and outcomes in 2020-2021 were measured during the COVID-19 pandemic as a natural stress test.

This prospective cohort study included 226 consecutive lung cancer patients (2019-2021). Baseline data from 2019 (n=99) identified diagnostic delays, after which a dedicated thoracic oncology nurse navigator was implemented as part of an integrated care pathway. Post-intervention outcomes were measured in 2020 (n=56) and 2021 (n=71). Key metrics included time to diagnosis (TTD), time to treatment initiation (TTI), performance status (PS) decline, and 1-year overall survival (OS).

At baseline, only 25% of patients were diagnosed within 21 days (median TTD 47 days). Following navigation implementation, results improved dramatically: median TTD decreased to 7.5 days (2020) and 18 days (2021), with 78% diagnosed within 21 days by 2021. Despite severe pandemic disruptions, including a 47% COVID-19 mortality rate among patients, the navigation pathway ensured continuity via teleconsultations and virtual tumor boards. While the pandemic delayed adjuvant chemotherapy, 1-year OS remained stable (78.6% at baseline vs. 76% post-intervention). PS decline remained below 16% across all periods. Main delays were biopsy waiting time and surgical scheduling, not treatment unavailability.

A monitored care pathway with dedicated patient navigation improves diagnostic speed and survival independent of advances in systemic therapy. The model proved effective and resilient during the COVID-19 crisis, making it highly adaptable to resource-limited and public health settings where innovative drugs are not readily available. Policymakers in developing countries should prioritize navigation programs as a high-value, low-cost intervention.

Keywords: patient navigation; lung cancer; global health; care pathway; covid-19; resource-limited settings

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Introduction

Lung cancer is the leading cause of cancer-related deaths worldwide, responsible for more deaths than breast, prostate, and colorectal cancers combined.¹ The disease is often diagnosed at an advanced stage, significantly reducing the chance of curative treatment. The five-year survival rate for lung cancer is less than 20%, largely due to late-stage diagnoses when treatment options are limited and less effective.²

Early diagnosis and prompt initiation of therapy are essential to improve prognosis and survival rates. However, the journey from initial suspicion to treatment is often delayed by a lack of coordination among healthcare providers, limited resources, and variability in clinical practice.^{3,4} These delays can result in cancer progression to a more advanced stage before treatment begins, significantly impacting patient outcomes.⁵

Structured care pathways have been shown to mitigate these delays by streamlining the process from initial consultation to

treatment initiation. Multidisciplinary care (MDC) approaches, which involve thoracic surgeons, medical oncologists, radiation oncologists, pulmonologists, and specialized nurses, have been associated with better outcomes in lung cancer care.^{6,7} These teams facilitate comprehensive assessments and personalized treatment plans, addressing the multifaceted needs of lung cancer patients.^{8,9} Implementing such pathways ensures that patients receive timely and coordinated care, reducing the risk of delays that can worsen their clinical outcome.

The COVID-19 pandemic has introduced additional barriers to timely care, causing delayed diagnosis and further complicating lung cancer management. Measures to control the spread of the virus, including lockdowns and the reallocation of healthcare resources, have led not only to diagnostic delays but also to interruptions in treatment.¹⁰ Despite these challenges, the adoption of telemedicine and virtual tumor boards has shown promise in maintaining continuity of care in such scenario.⁵ These innovations have allowed healthcare providers to continue multidisciplinary discussions and patient consultations remotely, ensuring that patients receive timely care even

during the pandemic. Additionally, the establishment of COVID-19 Management Committees played a critical role in ensuring the safety of patients and healthcare staff while maintaining essential cancer treatment services.¹¹

While high-income countries debate the optimization of novel targeted therapies and immunotherapies, many low- and middle-income countries (LMICs) struggle with basic delays in diagnostics and treatment initiation.^{12,13} In this context, access to innovative therapies is often less impactful on population health than access to *timely* and *coordinated* care. Patient navigation programs have emerged as a high-value intervention to overcome structural barriers (transportation, scheduling, fragmented health systems), particularly for vulnerable populations.^{14,15} A recent randomized trial from India confirmed that navigation reduces time-to-treatment and improves compliance in advanced lung cancer, regardless of molecular status.¹⁶

The present study used baseline data from 2019 to identify delays, implemented a structured navigation pathway, and then measured its impact in 2020-2021, with the COVID-19 pandemic serving as an unplanned stress test. We argue that this model is an essential intervention for developing nations.

Methods

Study design: This prospective cohort study included all consecutive patients with suspected lung cancer (ICD C34) or high-risk pulmonary nodules (ICD R91) registered at Clínica AMO from January 2019 to December 2021. Inclusion criteria were patients over 18 years old, treatment-naïve, and with at least one follow-up consultation. Data were collected by nurse navigators and included demographic, clinical, and pathological information. Table 1 presents the baseline demographic and clinical characteristics of the cohort.

Table 1 Baseline demographic and clinical characteristics of lung cancer patients (N=226)

Characteristic	Total (N=226)	2019 (n=99)	2020 (n=56)	2021 (n=71)
Sex, n (%)				
Male	122 (54.0)	53 (53.5)	30 (53.6)	39 (54.9)
Female	104 (46.0)	46 (46.5)	26 (46.4)	32 (45.1)
Age, n (%)				
< 50 years	33 (14.6)	15 (15.2)	8 (14.3)	10 (14.1)
50–60 years	98 (43.4)	43 (43.4)	24 (42.9)	31 (43.7)
> 60 years	95 (42.0)	41 (41.4)	24 (42.9)	30 (42.3)
Median age (years)	58	58	57	59
Stage at diagnosis, n (%)				
Stage I–II	90 (39.8)	39 (39.4)	22 (39.3)	29 (40.8)
Stage III	57 (25.2)	25 (25.3)	14 (25.0)	18 (25.4)
Stage IV	79 (35.0)	35 (35.3)	20 (35.7)	24 (33.8)

Note: Percentages may not sum to 100% due to rounding.

Intervention timeline and implementation: Data collected in 2019 (n=99) served as baseline pre-intervention measures, documenting existing diagnostic and treatment delays. Based on these baseline findings, a structured navigation pathway was implemented in late 2019. The intervention included: (1) a dedicated thoracic oncology nurse navigator; (2) fast-track diagnostic protocols with scheduling within 72 hours; (3) weekly multidisciplinary team (MDT) meetings; and (4) coordinated biopsy and pathology tracking. Outcomes from 2020 (n=56) and 2021 (n=71) therefore represent post-intervention measurements. The COVID-19 pandemic began during the post-intervention period, providing an unplanned stress test of the pathway’s resilience.

The navigation intervention: The dedicated thoracic oncology nurse navigator coordinated the entire integrated care pathway (ICP). Specific tasks included: scheduling all diagnostic tests (imaging, pulmonary function tests, low-dose CT) within 72 hours of referral; coordinating biopsy procedures (bronchoscopy, transthoracic needle aspiration) and tracking pathology turnaround times; organizing weekly MDT meetings involving thoracic surgeons, medical oncologists, radiation oncologists, and pulmonologists; facilitating insurance authorization processes (for private patients) or referral to public system (SUS) resources; connecting patients to supportive services (psychology, nutrition, pharmacy) before the second chemotherapy cycle; and, during the pandemic (2020–2021), transitioning to teleconsultations and virtual tumor boards.

Data collection: Data focused on key variables such as time to diagnosis (TTD), time to treatment initiation (TTI), and overall survival (OS) at one year. Multidisciplinary assessments and tumor board discussions were meticulously documented. Data on delays in the care process were obtained from patient records and nurse navigator logs. The thoracic oncology nurse played a pivotal role, scheduling diagnostic tests, biopsies, imaging studies, and multidisciplinary meetings to ensure the timely completion of all necessary evaluations and efficient patient navigation through the care continuum.

Based on ASCO and ONCOREDE recommendations,^{16,17} targets for each performance indicator were established. The time to integrated diagnostic report (TPD) was set to be within 21 days, with a compliance target of 75%. The time to treatment (TPT) aimed for treatment commencement within 35 days, with a similar compliance target of 75%. For patients requiring cisplatin-based adjuvant therapy (TPAC), the goal was to start treatment within 60 days post-surgery, with a target of 100% compliance.

Clinical outcome indicators included a 1-year overall survival target of 50% and a performance status (PS) loss threshold, where less than 10% of patients should experience deterioration before starting treatment. Care indicators focused on ensuring a 100% evaluation rate of Stage III patients in multidisciplinary meetings and guaranteeing that 100% of patients had access to multidisciplinary evaluations (including psychology, pharmacy, and nutrition) before the second dose of antineoplastic therapy.

Variables capturing delays: We recorded specific delay causes: biopsy result waiting time, surgery scheduling, chemotherapy initiation, radiotherapy initiation, and (in 2020–2021) pandemic-related delays (surgery suspension, patient concerns, medical recommendation to defer).

Ethical considerations: The study adhered to the guidelines of Resolution 466/12 on research involving human subjects and was approved by the Ethics Committee of Fundação Baiana de Cardiologia (CAAE: 47998721.2.0000.5027). Informed consent was obtained from all participants, and data were anonymized to ensure confidentiality.

Statistics: The data were analyzed using an Excel spreadsheet version 18.2008.12711.0 and the SPSS software version 28.0.1 for calculating rates and indices. The median was calculated using the Excel program. Overall survival was determined using the Kaplan-Meier method.

Results

Patient demographics: Of the 378 patients analyzed, 78 were excluded, primarily due to lack of follow-up and non-suspected pulmonary nodules, resulting in a final analysis of 226 patients (99 patients in 2019, 56 patients in 2020, and 71 patients in 2021). As shown in Table 1, 54% were male, and the median age was 58 years, with less than 15% of patients being younger than 50 years old. Early-stage disease (stages I and II) was diagnosed in 40% of cases, stage III in 25%, and metastatic disease in 35% of cases. The cohort demographics remained stable across the three years, allowing valid comparison between baseline (2019) and post-intervention periods (2020–2021).

Performance indicators: Table 2 summarizes all key performance indicators, outcomes, and pandemic impact metrics. At baseline (2019, pre-intervention), only 25% of patients had their diagnostic report integrated within 21 days, with a median time to diagnosis (TTD) of 47 days. These baseline data revealed significant delays that justified implementation of the navigation pathway. Following implementation of the navigation pathway (post-intervention), diagnostic metrics improved dramatically. In 2020, median TTD sharply decreased to 7.5 days, improving the percentage of patients with TTD < 21 days to 65%. In 2021, the target was achieved with 78% of patients having TTD < 21 days (median of 18 days), exceeding the >75% target established by ASCO and ONCOREDE. Regarding treatment initiation (TTI), baseline median was 32.5 days in 2019. Post-intervention, TTI increased to 37.5 days in 2020 (pandemic peak) but then decreased to 31 days in 2021, returning to below baseline levels despite ongoing pandemic disruptions. The target of TTI < 35 days for 75% of patients was not fully met, but there was a progressive increase in this percentage from 55.4% at baseline to 63% in 2021. Adjuvant chemotherapy timing (TPAC) showed the clearest pandemic effect. At baseline (2019), TPAC < 60 days was met for 100% of patients with a median of 39 days. Post-intervention, in 2020, there was a reduction in the percentage of patients meeting the target (62.5%) and an increase in median TPAC to 53 days. In 2021, this indicator improved to 79.3% with a median of 55 days. These delays were attributable to pandemic-related surgery cancellations and patient avoidance of hospitals, not to failure of the navigation pathway.

Table 2 Key performance indicators, clinical outcomes, and pandemic impact before and after implementation of the navigation pathway (2019–2021)

Indicator	Target	Baseline 2019	Post-Intervention 2020	Post-Intervention2 2021
Timeliness indicators				
Median time to diagnosis (TTD), days	—	47	7.5	18
Patients with TTD < 21 days, %	>75%	25	65	78
Median time to treatment initiation (TTI), days	—	32.5	37.5	31
Patients with TTI < 35 days, %	>75%	55.4	—	63
Median time to adjuvant chemotherapy (TPAC), days	—	39	53	55
Patients with TPAC < 60 days, %	100%	100	62.5	79.3
Outcome indicators				
Performance status decline, %	<10%	13.6	16.1	12.8
One-year overall survival, %	>50%	78.6	75	76
Stage III 3-year survival (entire cohort), %	—	—	70	—
Stage IV median overall survival, months	—	—	33	—
Care indicators				
Stage III patients discussed in MDT, %	100%	100	100	100
Multidisciplinary evaluation before cycle 2, %	100%	100	100	100
Pandemic impact indicators				
Patients with pandemic-related delays, %	—	—	42	31
COVID-19 deaths / total deaths (Mar–Dec 2020), %	—	—	23/49 (47)	—

Abbreviations: TTD, time to diagnosis; TTI, time to treatment initiation; TPAC, time to adjuvant chemotherapy; MDT, multidisciplinary team

Outcome and care indicators: As shown in Table 2, performance status (PS) decline exceeded the 10% target in all years. At baseline (2019), PS decline was 13.6%. Post-intervention, it worsened to 16.1% in 2020 (coinciding with longest treatment delays) but improved to 12.8% in 2021, approaching baseline levels. Overall survival (OS)

exceeded the target of 50% in all years: 78.6% at baseline (2019), 75% in 2020, and 76% in 2021. Interestingly, despite the pandemic, 1-year OS remained stable post-intervention compared to baseline. Stage IV patients reached a median OS of 33 months. The 3-year survival rate for stage III patients was 70% of the entire evaluated population.

Regarding care indicators, in all years, 100% of stage III patients were discussed in multidisciplinary meetings and evaluated by the multidisciplinary team before the second cycle, meeting the target consistently.

Delays in the care pathway: Analyzing the causes of delays in the care pathway, the main cause was related to the time to biopsy results, followed by the time to surgery, and delays in these two points occurred in 30% of the care pathways. Other treatments, such as chemotherapy and radiotherapy, were initiated in a timely manner in more than 85% and 79% of cases, respectively. In 2020, 42% of patients experienced delays in their care pathway due to circumstances directly related to the pandemic (suspended surgeries, patient preference, or medical recommendation), decreasing to 31% in 2021. These pandemic-specific delays affected TPAC (as shown in Table 2) but did not significantly impact 1-year OS.

Mortality during the COVID-19 pandemic: The COVID-19 pandemic had a profound impact on lung cancer care. Between March and December 2020, 49 patients in the care pathway died out of a total of 155; of these, 23 were diagnosed with COVID-19, representing 47% of the deaths (Table 2). The introduction of teleconsultations and virtual tumor boards was critical in maintaining the continuity of care during this period. These measures allowed remote patient management and multidisciplinary discussions, reducing the need for in-person visits and minimizing the risk of COVID-19 exposure for vulnerable patients. The establishment of a COVID-19 Management Committees also ensured that best practices were implemented to safeguard patients and healthcare staff while continuing essential cancer treatments (Sternberg et al., 2020). Despite these challenges, as shown in Table 2, the navigation pathway maintained 1-year OS at 75-76% post-intervention.

Discussion

Over the past decade, lung cancer epidemiology and prevention have experienced significant changes due to shifts in smoking patterns, advances in genetic understanding, and the role of the immune system in lung cancer management. Despite these advancements, lung cancer remains the leading cause of cancer death worldwide, underscoring the need for ongoing improvements in prevention, diagnosis, and treatment.

This study provides three key findings relevant to low- and middle-income countries (LMICs), as summarized in Tables 1 and 2. First, baseline data from 2019 documented unacceptable diagnostic delays. Second, after implementation of a structured navigation pathway, post-intervention results improved dramatically, demonstrating that navigation, not new drugs, drove this improvement. Third, the navigation pathway demonstrated remarkable resilience during the COVID-19 crisis: despite a 47% COVID-19 mortality rate among patients and delays in adjuvant therapy, one-year survival remained stable (Table 2). These benefits occurred independent of access to novel oncological drugs. In Brazil's public health system (SUS), access to targeted therapies (e.g., osimertinib for EGFR-mutant lung cancer) remains highly restricted. A 2022 analysis found that fewer than 20% of eligible SUS patients receive first-line immunotherapy for advanced lung cancer, compared to >70% in private insurance (de Lima Lopes et al., 2021). In this context, waiting for innovation is a failing strategy. Our data, presented in Table 2, show that navigation alone can compress diagnostic time from 47 to 18 days and maintain 1-year survival >75%.

Our study reveals that the studied population diagnosed with lung cancer is younger compared to the median global age. While most

patients in our cohort are diagnosed between 50-60 years (median 58 years; Table 1), the median age in the largest American database is 71 years, with the majority diagnosed between 65-75 years (NIH, 2022). This discrepancy may be attributed to differences in smoking prevalence; in the U.S., the smoking rate is 12.5% (CDC, 2022),¹⁸ whereas in Salvador-Brazil, where the study was conducted, it is only 6.8%.¹⁹ These findings suggest that effective anti-smoking policies in Brazil may be contributing to a younger demographic of lung cancer patients.

Interestingly, as shown in Table 1, our population showed a high incidence of early-stage disease detection (40% of cases), contrasting with international data where most patients are diagnosed with advanced disease.²⁰ This early detection rate in our cohort is likely due to comprehensive screening protocols and the integration of imaging and pulmonary function services within a multidisciplinary team, allowed by private health care access. These measures facilitate the early diagnosis and treatment of lung cancer, contributing to better patient outcomes. Despite the recommendation of low-dose CT scans for lung cancer screening since 2013, adherence to this protocol remains low even in developed countries like the U.S. (Potter et al., 2022).²¹ In Europe, only Croatia has implemented a national screening program, with Germany expected to follow suit (Van Meerbeeck & Franck, 2021).²² Our findings support the notion that accessible screening and adherence to international guidelines can significantly improve early detection rates and overall survival.

Our data, detailed in Table 2, demonstrate that the implementation of a monitored care pathway significantly reduced the time to diagnosis from 47 days at baseline (2019) to 18 days post-intervention (2021), meeting the quality indicator target of diagnosing over 75% of patients within three weeks. This optimization of the diagnostic process is crucial, as studies have shown that delays in diagnosis and treatment can adversely affect survival.^{23,24} The structured approach of our care pathway, including rapid authorization processes by health insurance companies and multidisciplinary team involvement, has proven effective in improving patient outcomes. Importantly, because we established baseline measurements in 2019 before implementing the intervention, we can confidently attribute the observed improvements to the navigation pathway itself, not to secular trends or pandemic effects.

The complexity of lung cancer patient journeys and the universal barriers to timely care are well-documented. In Portugal, a study highlighted that diagnosis and staging delays impact over half of the cases.²⁵ Our findings align with this, emphasizing that organized care pathways can mitigate these delays and improve clinical outcomes. A recent randomized trial from India²⁶ corroborates our findings: navigation reduced the hazard of death by 28% compared to usual care, again independent of specific treatments used. A community-based navigation program in a low-resource US setting similarly improved early detection and reduced stage migration (Phillips et al., 2025).²⁷ The Lung Cancer Policy Network recently emphasized that patient navigation must be part of the multidisciplinary team to ensure access for underserved populations.²⁸

The impact of the COVID-19 pandemic on lung cancer diagnosis and treatment cannot be overlooked. Our study observed a significant reduction in the number of cases evaluated during the pandemic (56 patients in 2020 vs. 99 at baseline in 2019), consistent with global reports of decreased cancer diagnoses.^{10,29} However, crucially, the diagnostic efficiency gains achieved by the navigation pathway were maintained: TTD remained at 7.5 days in 2020 and 18 days in 2021, compared to 47 days at baseline. The pandemic's long-term effects on lung cancer

outcomes highlight the need for robust monitoring and adaptive strategies to manage future healthcare disruptions. Furthermore, because we have implemented the navigation pathway before the pandemic began, we were able to demonstrate that it worked during a crisis scenario, when hospitals were overwhelmed, patients were afraid to attend appointments, and surgeries were cancelled. The rapid adoption of teleconsultations and virtual tumor boards, coordinated by the nurse navigator, prevented complete care disruption, as reflected in the stable 1-year OS post-intervention. Technological solutions, such as teleconsultations and virtual tumor boards, were pivotal in maintaining the quality of care during the pandemic. These solutions allowed healthcare providers to conduct remote consultations and multidisciplinary meetings, ensuring that patients continued to receive timely and comprehensive care despite the restrictions imposed by the pandemic. This approach is particularly valuable in ensuring that cancer care remains uninterrupted during crises, highlighting the need for healthcare systems worldwide to incorporate such technologies into their care pathways.¹¹

Ministries of health in LMICs should consider that navigation is low-cost (a single nurse navigator can manage 150–200 patients annually, with salary costs far below a single course of immunotherapy); navigation is scalable (the model requires no expensive equipment, only coordination and basic communication tools); and navigation complements, not replaces, treatments (even when novel drugs become available, navigation ensures patients survive long enough and maintain good performance status to receive them). Our study design, using baseline data to identify delays before implementing the intervention, provides a practical template for other clinics and public health systems seeking to justify investment in navigation programs.

Limitations of our study include the absence of detailed histological subtypes, molecular classification, and smoking status, which are critical for a comprehensive analysis. Additionally, the study was conducted in a private outpatient clinic, not a public SUS hospital; nonetheless, many patients were SUS-funded via contracted services. The COVID-19 pandemic introduced confounding variables that we cannot fully adjust for, but the pre-post design (baseline 2019 vs. post-intervention 2020–2021) strengthens causal inference regarding the navigation pathway's effectiveness. Future research should address these gaps to provide a more detailed validation to the navigation model in pure public settings.³⁰

Conclusion

In resource-limited settings, innovative treatments do not save patients if they arrive too late or if patients are too sick to receive them. Our findings underscore the importance of early detection and the implementation of monitored care pathways in improving lung cancer outcomes. Using baseline data from 2019 to identify delays, we implemented a structured navigation pathway and demonstrated dramatic improvements in diagnostic timeliness. The study also highlights the potential of technological solutions to support cancer care during pandemics. A monitored care pathway with dedicated patient navigation improves diagnostic timeliness, prevents performance status decline, and maintains survival even during systemic crises like the COVID-19 pandemic, all independent of access to targeted or immunotherapies. Also, the 1-year OS remained stable at 75–76% post-intervention despite pandemic disruptions. These improvements are universally applicable and can be particularly impactful in resource-limited and public health settings. Patient navigation should be a mandatory public health policy in developing countries before any major investment in high-cost technology. Future research should

explore long-term outcomes and the scalability of this model in different healthcare environments globally.

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Conflict of interest

The authors declare that they have no competing interests.

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