REVIEW ARTICLE

Does Multidisciplinary Team Management Improve Clinical Outcomes in NSCLC? A Systematic Review With Meta-Analysis

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ABSTRACT

Introduction: The implementation of multidisciplinary teams (MDTs) has been found to be effective for improving outcomes in oncology. Nevertheless, there is still a dearth of robust literature on patients with NSCLC. The aim of this study was to conduct a systematic review regarding the impact of MDTs on patient with NSCLC outcomes.

Methods: Databases were systematically searched up to February 2023. Two reviewers independently performed study selection and data extraction. Risk of bias was evaluated using the Newcastle-Ottawa and certainty of evidence by the Grading of Recommendations Assessment, Development and Evaluation approach. Overall survival was the primary outcome. Secondary outcomes included mortality, length of survival, progression-free survival, time from diagnosis to treatment, complete staging, treatment received, and adherence to guidelines. A meta-analysis with a random-effect model was performed. Statistical analysis was performed with the R 3.6.2 package.

Results: A total of 22 studies were included in the systematic review. Ten outcomes were identified, favoring the MDT group over the non-MDT group. Pooled analysis revealed that patients managed by MDTs had better overall survival (three studies; 38,037 participants; hazard ratio 0.60, 95% confidence interval [CI]: 0.49–0.75, $I^2 = 78\%$), shorter treatment time compared with patients in the non-MDT group (six studies; 15,235 participants; mean difference = 12.20 d, 95% CI: 10.76–13.63, $I^2 = 63\%$), and higher proportion of complete staging (four studies; 14,925 participants; risk ratio = 1.36, 95% CI: 1.17–1.57, $I^2 = 89\%$).

Conclusions: This meta-analysis revealed that MDT-based patient care was associated with longer overall survival and better quality-of-care–related outcomes.

Keywords: Lung cancer; Multidisciplinary team; Outcomes; Overall survival; Prognosis

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Introduction

Lung cancer (LC) accounts for 11.4% (2.206 million) of cancer cases and 18% of cancer deaths worldwide, making it the most frequent cause of cancer death among men and the third-leading cause among women.[1] According to estimates, more than 130,000 people will die from LC this year, with cigarette smoking being the direct cause in most cases.[2] Nevertheless, the percentage of people living with LC has increased in the past decade, reflecting advances in early diagnosis and improved treatment options.[3,4]

NSCLC is the most frequent form of LC and responsible for 85% of cases in the United States.[5] NSCLC management is challenging owing to the biological complexity of the disease and the diverse range of active treatment options. These therapeutic approaches include different combinations of surgery, radiation therapy, and systemic therapies in the form of chemotherapy, immunotherapy, or targeted therapies.[4] Optimal staging is crucial for disease management because treatment recommendations for NSCLC are stage specific.[3]

The NSCLC treatment landscape has evolved rapidly in the past decade, with the introduction of immune checkpoint inhibitors and targeted therapies. These developments mean treatment recommendations are dependent not only on stage, histological types, and performance status but also on tumor biomarker characteristics.[5] Although many recommendations can be protocolized, the wide range of treatment modalities requires collaboration among multiple specialists to develop management strategies for individual patients and provide optimal staging in the complex NSCLC setting.[6,7]

To deal with this complexity, multidisciplinary teams (MDTs) have been implemented in health services toward improving the patient treatment journey, such as diagnosis, treatment, and palliative care.[8] LC MDT usually comprises a medical oncologist, thoracic surgeon, pulmonologist, and radiation oncologist, but it may also include a diverse roster of specialists such as radiologists, pathologists, nurse navigator, nutritionists, nuclear medicine specialists, molecular biologists, and psychologists. The implementation of MDTs has been found to be effective for improving outcomes in patients with breast,[9] gastric,[10] prostate,[11] and rectal[12] cancers. The main outcomes investigated are changes in the patient management plan,[13] treatment received (chemotherapy or radiotherapy),[14] treatment intent (curative or palliative),[15] time from diagnosis to treatment,[16] psycho-oncologic distress,[13] adherence to guidelines,[16] and survival.[17] In this regard, many international organizations and societies, such as the National Comprehensive Cancer Network, the European Society for Medical Oncology, and the Pan-Asian Guidelines Adaptation, have begun recognizing MDT-based approaches as a standard for high-quality NSCLC care and emphasizing the importance of case-by-case evaluation in a multidisciplinary setting.[5,18,19]

Although observational studies have indicated that patients with NSCLC managed by MDT have higher survival rates, extensive data supporting the beneficial outcomes of MDT management are still lacking.[20,21] The aim of this study was to systematically review the evidence of the impact of MDTs on patient outcomes.

Materials and Methods

Design and Registration

A systematic review evaluating the impact of MDTs on outcomes of a patient with NSCLC was carried out. The review study was registered on the PROSPERO database (CRD42022347408) and conducted in accordance with the Cochrane Handbook for Systematic Reviews.[22] The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guideline was followed.[23]

Literature Search Strategy

This systematic review sought to answer as to whether patients with NSCLC managed by MDTs have better outcomes compared with patients managed without MDTs. The PE/ICOS (Participants, Exposure/Intervention, Comparison, and Outcomes) criteria adopted are outlined in Table 1. Regarding the included patients, the primary focus of this review was on patients diagnosed with having NSCLC. MDT outcome studies have included more patients with NSCLC than other types of LC, hence the focus on NSCLC. For completeness, however, studies that included other types of LC have been included in the analysis. Nevertheless, studies encompassing patients with other types of LC, predominantly patients with NSCLC, were deemed eligible for inclusion.

A search strategy was applied to the MEDLINE/PubMed, EMBASE, Cochrane Library, Web of Science, and LILACS databases, using a combination of Medical Subject Headings terms (or Emtree terms in EMBASE) and free words from the inception date of each database up to February 2023. No time, geographic, or language restriction was applied. The full-search strategies for all databases are available in Supplementary Appendix 1. The reference lists of included studies and systematic reviews were checked for potentially relevant citation listings. Zotero software was used to manage records retrieved from searches of the electronic databases.

Eligibility Criteria

Randomized controlled trials and observational (cohort and case-control) studies were included. All

Table 1. Study Inclusion Criteria

Parameter	Criteria
Participants	Patients diagnosed with lung cancer, mainly NSCLC
Exposure/intervention	MDT assistance
Comparison	No MDT assistance
Outcomes	Primary outcome: overall survival Secondary outcomes: progression-free survival, % radical treatment rate, % complete staging evaluation, time to first treatment, time to complete staging, adherence to guidelines, and treatment receipt

MDT, multidisciplinary team.

articles that evaluated associations between multidisciplinary management of NSCLC and outcomes of interest were considered potentially relevant. Overall survival (OS) was the primary outcome. Secondary outcomes included mortality, length of survival, progression-free survival, time from diagnosis to treatment, complete staging, treatment received, and adherence to guidelines. Studies that failed to report the number of patients included, or had fewer than 50 patients, narrative and systematic reviews, case reports, qualitative studies, editorials, abstracts without full text articles, and opinion articles were excluded. In addition, studies that associated MDT with other interventions were excluded.

Study Selection

All titles and abstracts retrieved by electronic searching were downloaded. After removal of duplicates, all references were transferred to Rayyan Systematic Review Software.[24] Two review authors (J.L. and L.P.B.) independently screened titles and abstracts for inclusion of studies, and those that clearly did not meet the eligibility criteria were excluded. Disagreements were resolved by a third reviewer (G.C.J.). The full texts of potentially eligible studies were then reviewed by two independent investigators (C.T. and G.F.P.).

Data Extraction

The authors of the present study (J.L. and L.P.B.) independently extracted relevant data from the studies (author, year, design, number of patients in the MDT group and non-MDT group, team members of the MDT and meeting frequency, and outcomes evaluated), along with patient characteristics (sex, age, and NSCLC stage) using a piloted data collection form. The authors of primary studies were contacted by e-mail to provide information on missing data; in the event of no reply, the information in question was considered not reported (NR) and the presentation of outcomes was limited to narrative form.

Assessment of Risk Bias and Certainty of Evidence

The risk of bias in primary studies was evaluated by two review authors independently (J.L. and F.H.S.) using the New Castle-Ottawa Scale for cohort and case-control studies.[25] Studies scoring less than seven were defined as high risk of bias (median score of included studies in absence of recommended cutoff for this classification). Specific criteria were standardized to assign points within each domain, as follows: (1) In the selection domain, multicenter studies or those conducted at a single center with different stages of the disease were considered representative of the population of patients with patients with NSCLC. (2) For the study to be scored on the selection of the nonexposed cohort, it had to include patients drawn from the same community during the same period. (3) The study had to describe the MDT team and/or frequency of meetings to be scored for ascertainment of exposure. (4) On the comparability domain, the study had to report the association between the MDT team and outcome of interest, adjusted by disease stage, to obtain one point and by any other confounder for two points. (5) On the outcome domain, the authors had to have performed an independent blind assessment or reported that outcomes were drawn from medical records. (6) Regarding follow-up time, a period of at least 5 years was deemed sufficient for the OS outcome.

To assess the overall certainty of evidence across outcomes, guidance from the Grading of Recommendations Assessment, Development and Evaluation framework was adopted.[26] The five Grading of Recommendations Assessment, Development and Evaluation domains (study limitations, consistency of effect, imprecision, indirectness, and publication bias) were evaluated and classified as “high,” “moderate,” “low,” or “very low.” Each study was initially rated as “low” owing to the observational nature of the studies included and upgraded to “moderate” or “high” or downgraded to “very low,” as applicable.

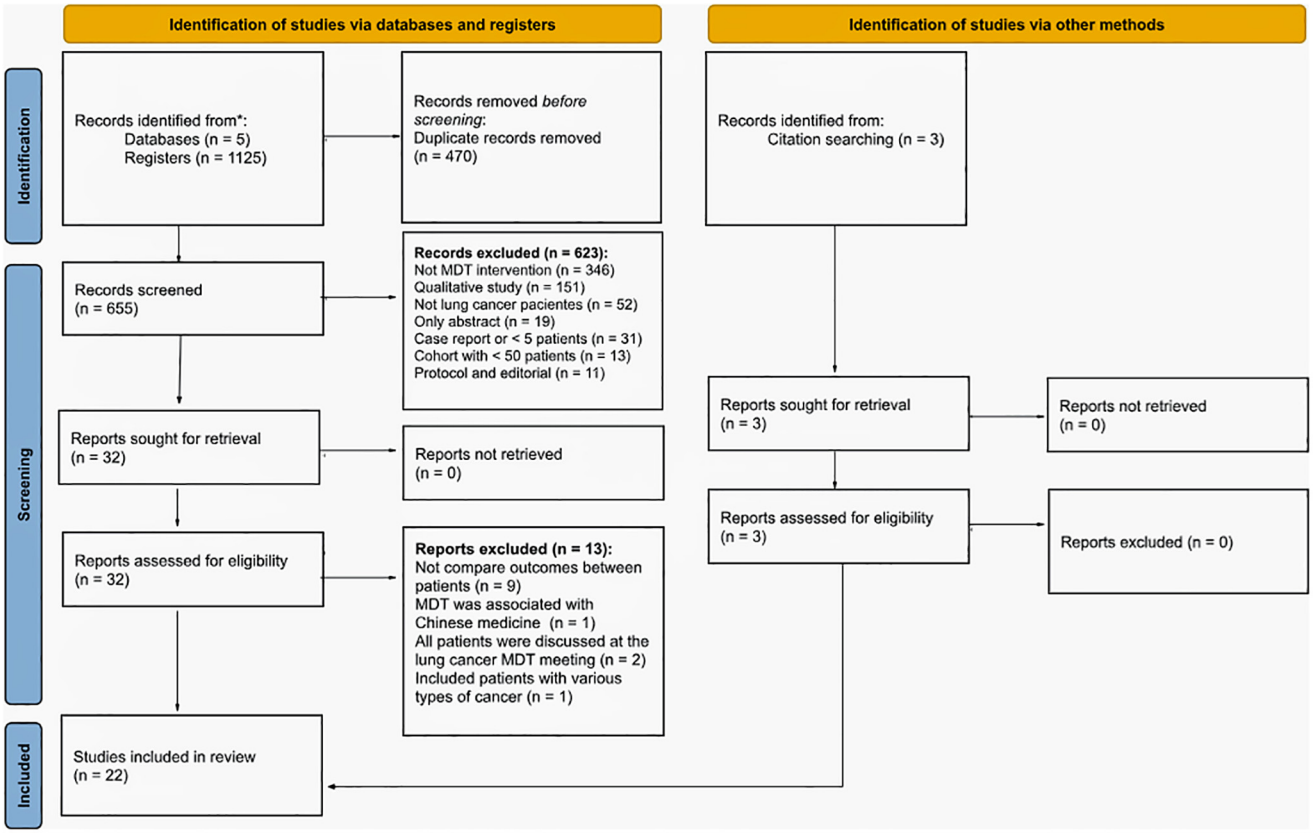

Figure 1. Flow chart of study search and selection.

Data Synthesis and Analysis

The association between MDTs and OS was summarized by pooling adjusted hazard ratio (HR) with 95% confidence intervals (CIs) for the MDT group versus the non-MDT group. The difference between time from diagnosis to first treatment in the MDT group compared with the non-MDT group was reported as the mean difference (MD). MD was used as a summary statistic so that outcome measurements were expressed in the same unit of measurement (d) across all studies. Heterogeneity across studies was assessed using the I^2 statistic, classified as not important (0%–40%), moderate (30%–60%), substantial (50%–90%), or considerable (75%–100%).[22] All the forest plots contained fewer than 10 studies, precluding analysis of publication bias.

Results

Selection and General Characteristics of Studies Reviewed

A total of 1125 references were identified from the combined searches. After removal of 470 duplicate references, titles and abstracts of 655 references were screened, of which 623 were subsequently excluded for not meeting the inclusion criteria. The full texts of the remaining 32 references that potentially met the inclusion criteria were read, resulting in 19 studies for inclusion. After review of reference citation listings, three additional studies were identified, giving a final total of 22 studies[14–16,21,27–44] for inclusion in the systematic review. The PRISMA flow diagram is depicted in Figure 1.

An overview of the results of the studies included in the review is given in Table 2. Regarding study design, there were 17 retrospective cohort studies,[16,21,28–34,36–41,43,44] three prospective cohort studies,[14,15,35] one case-control study,[27] and one retrospective audit.[42] The studies were conducted between 2004[34] and 2021,[27] mostly in the United States of America (n = 12)[16,27,31,33,35–37,39–41,43,44] and Australia (n = 4).[14,15,29,38] A total of 61,278 patients were included across all studies, comprising 41,784 in the MDT group and 19,494 in the non-MDT group. Among the study samples, most patients were male (range 46.9%[41] to 100%[43]), and mean age was 66 plus or minus 15 years. There were 15 studies that exclusively focused on including patients with NSCLC.[14,16,21,27,28,32–40,42] In addition, six studies primarily included patients with NSCLC but also included other types of LC within their study sample.[15,29–31,43,44] One study did not clearly report the specific types of LC included in their analysis.[41] There were

Table 2. General Characteristics of Eligible Studies

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
Huang et al., 2021[27]	Case-control USA	77 879	47.9% ≥75 y = 45%	Exclusively NSCLC I = 17.8% II = 8.1% III = 12.5% IV = 58.9% Unknown = 2.4%	Medical oncology, surgical oncology, pathology, radiology, genetic counseling, and pharmacology; Meetings occur twice a mo.	Overall survival was substantially improved in MDT group HR = 8.15 (95% CI: 3.64-18.25)	None
Friedman et al.[35]	Cohort prospective USA	52 57	NR NR	Exclusively NSCLC III = 100%	Thoracic surgery, medical oncology, radiation oncology, diagnostic radiology, respirology, palliative medicine, and nutrition; Meetings occur weekly.	*Median time from diagnosis to treatment* ($p = 0.043$) MDT group = 19.85 ± 13.8 dNon-MDT group = 29.09 ± 27.3 d *Median overall survival* ($p = 0.054$) MDT group = 17 mo Non-MDT group = 14 mo *Clinical pathway adherence* ($p < 0.001$) MDT group = 88.5% Non-MDT group = 35.1% *Complete staging ($p < 0.001$)* MDT group: 30 patients Non-MDT group: 14 patients	None
Boxer et al.[15]	Cohort prospective Australia	504 484	60.6% >60 y: 81.2%	NSCLC = 80.2% SCLC = 19.8% NSCLC: I = 9.9% II = 6.1% III = 31.7% IV = 52.1% SCLC: Limited stage = 18.9% Extensive stage = 40.3% Unknown = 40.8%	Medical oncology, radiation oncology, respirology, cardiothoracic surgery, radiology, nuclear medicine, palliative medicine, lung cancer care coordination, and trainee specialists; Meetings occur weekly.	*Surgery* ($p = 0.84$) MDT group = 12% Non-MDT group = 13% *Radiotherapy* ($p < 0.001$) MDT group = 66% Non-MDT group = 33% OR = 2.64 (95% CI: 1.96-3.56) *Chemotherapy* ($p < 0.001$) MDT group = 46% Non-MDT group = 29% OR = 1.30 (95% CI: 1.01-1.84) *Referral to palliative care* ($p < 0.001$) MDT group = 66% Non-MDT group = 53% OR = 2.03 (95% CI: 1.48-2.79) *Mean time from diagnosis to treatment:* *Surgery* ($p = 0.49$) MDT group = 42 d	Patient age, tumor histological types (SCLC vs. NSCLC), tumor stage, and ECOG status

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
						Non-MDT group = 50 d *Radiotherapy - curative* ($p = 0.65$) MDT group = 106 d Non-MDT group = 91 d *Radiotherapy - palliative* ($p = 0.89$) MDT group = 87 Non-MDT group = 89 *Chemotherapy - curative* ($p = 0.97$) MDT group = 45 Non-MDT group = 45 *Chemotherapy - palliative* ($p = 0.03$) MDT group = 60 Non-MDT group = 44 *Referral to palliative care* ($p = 0.37$) MDT group = 110 Non-MDT group = 100 MDT discussion had no impact on survival: OR = 1.0 (95% CI: 0.86–1.17)	
Bydder et al.[14]	Cohort prospective Australia	81 17	67.3% >60 y: 82.6%	Exclusively NSCLC III = 39.7% IV = 61.2%	Respirology, cardiothoracic surgery, medical oncology, radiation oncology, palliative care, radiology, pathology, nuclear medicine and nurse; Meetings occur weekly.	*Treatment:* *Radical RT or Chemo-RT* ($p = 0.318$) MDT group = 10% Non-MDT group =6% *Chemotherapy* ($p = 0.141$) MDT group = 42% Non-MDT group = 29% *Palliative RT only* ($p = 0.152$) MDT group = 25% Non-MDT group = 35% *Palliative care only* ($p = 0.204$) MDT group = 23% Non-MDT group = 29%	None

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
						Mean survival ($p = 0.0478$) MDT group = 280 d Non-MDT group = 205 d *1-y survival* (p = NR) MDT group = 33% Non-MDT group = 18%	
Wah et al.[38]	Cohort retrospective Australia	1876 1454	57% >60 y: 81.7%	Exclusively NSCLC I = 9% II = 7% III = 22% IV = 38.1% Unknown = 23.6%	NR; NR.	*Died 2 y from diagnosis* ($p < 0.001$) MDT group = 55.8% Non-MDT group = 65.4% MDT group presents an independent association with lower likelihood of 2-y all-cause mortality: OR = 0.74 (95% CI: 0.59–0.93)	Important individual- and area-level risk factors
Hung et al.[28]	Cohort retrospective Taiwan	242 273	67.5% 68 (20–95) y	Exclusively NSCLC III = 100%	Chest medicine, surgery, medical oncology, radiation oncology, radiology, nuclear medicine, pathology, nurse, psychology, and nutrition; Meetings occur weekly.	*Median length of survival* ($p = 0.018$): MDT group = 39.6 (95% CI: 23–56.2) mo Non-MDT group = 25.7 (95% CI: 27.1–40.7) mo HR = 0.184 (95% CI: NR)	Sex, staging, T status, and N status, smoking, performance status, histological types, and whether surgery was performed.
Thalanayar Muthukrishnan et al.[44]	Cohort retrospective	55 106	54.6% NR	NSCLC = 86.3% SCLC = 13.6% I = 26% II = 10.5% III = 16.7% IV = 46.5%	Radiology, medical oncology, radiation oncology, and respirology; Meetings occur every other week.	*Treatment received:* *Surgery:* MDT group = 16.4% Non-MDT group = 17% *Radiation:* MDT group = 20% Non-MDT group = 17.9% *Chemotherapy:* MDT group = 18.2% Non-MDT group = 14.2% *Chemoradiation:* MDT group = 32.7% Non-MDT group = 28.3% *Time from diagnosis to therapy* ($p = 0.06$) MDT group = 53.13 ± 72.88 d Non-MDT group = 37.2 ± 58.56 d	None

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
Stone et al.[30]	Cohort retrospective Canada	114 78	NR NR	NSCLC = 91.1% SCLC = 9.9% I = 29.6% II = 7.2% III = 14% IV = 42.7% Unknown = 6.2%	Respirology, medical oncology and radiation oncology; Meetings occur weekly.	*Mean time from diagnosis to first cancer treatment:* MDT group: 15 d Non-MDT group: 39.5 d	None.
Voong et al.[40]	Cohort retrospective USA	136 161	58% 65 (58-72)	Exclusively NSCLC I = 20.8% II = 30.3% III = 19.5% IV = 26.6%	Thoracic surgery, medical oncology, radiation oncology, radiology, pathology, social assistance and pharmacology; NR	*Median time from first oncologic visit to treatment ($p < 0.001$):* MDT group = 24 (19-34.5) d Non-MDT group = 34 (21-50) d *Mean of total charges* ($p < 0.001$) MDT group = $19,994 ($17,315-$22,673) Non-MDT group = $25,833 ($22,528-$29,137)	None.
Bilfinger et al.[41]	Cohort retrospective USA	1956 2315	46.9% 67 ± 11.3 y	NR LC type I = 27.1% II = 7.8% III = 22.9% IV = 42%	Thoracic surgery, interventional pulmonology, medical oncology, radiation oncology, nurse, interventional radiology, radiation therapy, chest radiology, social assistance and nutrition; A minimum of one clinical meeting.	*Treatment received:* *Surgery* ($p < 0.001$): MDT group = 39.8% Non-MDT group = 15.8% *Radiation* ($p < 0.01$): MDT group = 46.9% Non-MDT group = 50.7% *Chemotherapy* ($p < 0.001$): MDT group = 42.5% Non-MDT group = 50.4% *1-y survival - all stages* ($p < 0.001$) MDT group = 72.6% Non-MDT group = 44.8% HR = 0.49 (0.41-0.57)	Age at diagnosis, sex, race, marital status, smoking status, alcohol consumption, history of diabetes, history of hypertension, family history of cancer, tumor stage, histologic type, and date of entry to registry
Stone et al.[29]	Cohort retrospective Australia	295 902	60% 70 (62-78)	NSCLC = 87% SCLC = 13% I = 12.9% II = 6.1% III = 16.3% IV = 51.9% Unknown = 12.7%	Medical subspecialties, nursing and allied health; Meetings occur weekly.	*Survival in MDT group:* HR = 0.7 (95% CI: 0.58-0.85)	Age, sex, performance status, pathology, stage of disease and year of diagnosis

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
Peckham and Mott-Coles[36]	Cohort retrospective USA	35 (2013-2014) 48 (2014-2015)	NR NR	Exclusively NSCLC NR	Thoracic surgery, radiation oncology, and medical oncology; Meetings occur weekly.	*Treatment received:* *Surgery* (p = NR): MDT group = 79% Non-MDT group = 74% *Diagnosis of early stage NSCLC* (p = 0.01) MDT group = 48% Non MDT group = 35%	None
Tamburini et al.[32]	Cohort retrospective Italy	170 170	73% 68.8 ± 8.15 y	Exclusively NSCLC I and II = NR III and IV = 19.7%	Surgery, pulmonary oncology, radiation oncology, radiology, nuclear medicine, pulmonology, pathology, lung cancer care coordinators and trainees; Meetings occur weekly.	Patients undergoing MDT discussion were found to have better 1-y survival (OR 0.48; 95% CI: 0.25-0.92) *One-y mortality* (p = 0.006) MDT group = 8% Non-MDT group = 18%	None
Pan et al.[33]	Cohort retrospective USA	27,937 4632	64.5% >75 y: 29.4%	Exclusively NSCLC I = 10.8% II = 3.3% III = 28.7% IV = 57%	NR; NR.	*Survival for all patients:* HR 0.49 (95% CI: 0.41-0.57) *Survival - stages I and II:* HR 0.89 (95% CI: 0.78-1.01) *Survival - stages III and IV:* HR 0.87 (95% CI :0.84-0.90)	Sex, age at diagnosis, CCI, catastrophic illness or injury, level of hospital, ownership of hospital, annual service volume of hospital, and cancer stage
Freeman et al.[39]	Cohort retrospective USA	6627 6627	67.5% 61 ± 19.5	Exclusively NSCLC I = 17.6% II = 31.7% III = 51.4%	Thoracic surgery, radiation oncology, and medical oncology; Meetings occur at least every 2 wks.	*Chemotherapy and/or radiotherapy without tissue diagnosis* ($p < 0.0001$): MDT group = 3 Non-MDT group = 5 *Nontherapeutic surgical intervention* ($p < 0.0001$): MDT group = 2 Non-MDT group = 4 *Days from diagnosis to treatment* ($p < 0.0001$): MDT group = 19 ± 8 Non-MDT group = 32 ± 11 *Complete staging* ($p < 0.0001$): MDT group = 91% Non-MDT group = 67% *Adherence to NCCN guidelines* ($p < 0.0001$):	None

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
						MDT group = 88 Non-MDT group = 71 *Mean cost of care, diagnosis and staging ($)* ($p < 0.0001$): MDT group = $7212 Non-MDT group = $10,213	
Alsamarai et al.[37]	Cohort retrospective USA	189 163	97% 69 ± 10	Exclusively NSCLC I = 33% II = 8% III = 26% IV = 33%	NR; Meetings occur weekly.	*Time from imaging to diagnosis (d)* ($p = 0.016$) MDT group = 53 d Non-MDT group = 76 d *Time from diagnosis to treatment (d)* ($p = 0.60$) MDT group = 43 d Non-MDT group = 46 d *Time from imaging to treatment (d)* ($p = 0.015$) MDT group = 101 d Non-MDT group = 126 d	Stage migration, histological types, initial image reason, and presence of a primary care provider
Osarogiagbon et al.[31]	Cohort retrospective USA	235 141	58% 59 (25 - 88) y	NSCLC = 52% SCLC = 4% Nonlung primary = 23% Benign = 9% Unknown = 13% I = 21% II = 6% III = 43% IV = 29%	Thoracic surgery, radiology, pulmonology, medical oncology, radiation oncology, palliative care, nurse coordinator, nurse, and a clinical research coordinator; Meetings occur one period twice a mo and other weekly.	*Median time to clinical intervention* ($p < 0.002$): MDT group = 14 d Non-MDT group = 25 d *Median overall survival* ($p < 0.001$) MDT group = 2.1 y Non-MDT group = 1.3 y HR = 1.7 (95% CI: NR) *Progression-free survival* ($p < 0.005$) MDT group = 1.3 y Non-MDT group = 0.8 y HR = 1.4 (95% CI: NR)	Stage of disease
Freeman et al.[16]	Cohort retrospective USA	687 (2005-2007) 535 (2001-2004)	NR 66 ± 30.5	Exclusively NSCLC I = 28.3% II = 26.9% III = 26.5% IV = 17.8%	Thoracic surgery, pulmonology, medical oncology and radiation oncology; NR.	*Chemotherapy:* MDT group = 359 Non-MDT group = 258 *Surgical staging:* MDT group = 489 Non-MDT group = 179 *Surgical resection:* *Curative intent* ($p = 0.17$)	None

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
						MDT group = 451 Non-MDT group = 330 *Mean time from diagnosis to treatment (d)* ($p < 0.0001$): MDT group = 17 ± 11 Non-MDT group = 29 ± 17 *Complete staging* ($p < 0.0001$) MDT group = 93% Non-MDT group = 79% *Adherence to NCCN guidelines* ($p < 0.0001$): MDT group = 97% Non-MDT group = 81% *Operative mortality:* MDT group = 2.4% Non-MDT group = 2.1%	
Riedel et al.[43]	Cohort retrospective USA	244 (1999-2002) 101 (2002-2003)	100% ≥65 y: 63.4%	NSCLC = 80.7% SCLC = 11% Other = 8.1% NSCLC: I or II = 35.9% IIIa or IIIb = 21.7% IV = 25.5% SCLC: Limited stage = 42.1% Extensive stage = 57.9%	Pulmonology, medical oncology, and radiation oncology; Meetings occur weekly.	*Time to diagnosis* ($p = 0.09$) MDT group = 48 d (95% CI: 37-61) Non-MDT group = 47 d (95% CI: 39-55) *Time to treatment* ($p = 0.71$) MDT group = 22 d (95% CI: 20-27) Non-MDT group = 23 d (95% CI: 20-34) *Median survival* ($p = 0.99$) MDT group = 1.3 y (95% CI: 0.92-1.71) Non-MDT group = 1.2 y (95% CI: 0.91-2.12)	None
Forrest et al.[21]	Cohort retrospective UK	126 (2001) 117 (1997)	62.5% >60 y: 81.8%	Exclusively NSCLC III = 28.3% IV = 71.6%	Respirology, surgery, medical oncology, clinical oncologist, palliative care, radiology and nurse. NR	*Radical radiotherapy* MDT group = 2% Non-MDT group = 5% *Chemotherapy* MDT group = 23% Non-MDT group = 7% *Palliative radiotherapy* MDT group = 30% Non-MDT group = 30% *Palliative care only*	None

(continued)

Table 2. Continued

Study Features						Study Results	Adjusted Analysis
Author, Year (Ref)	Study Design Country	MDT Group (n) Non-MDT Group (n)	Male (%) Age (y)	LC Type and Stage	Team Members MDT and Frequency	Results	Confounders
						MDT group = 44% Non-MDT group = 58% *Median survival (mo)* ($p <$ 0.001) MDT group = 6.6 (3.7-9.5) Non-MDT group = 3.2 (2.4-4.1)	
Martin-Ucar et al.[34]	Cohort retrospective UK	65 (1994-1996) 175 (1997-1999)	NR 68 (40.5 - 81)	Exclusively NSCLC I = 47.5% II = 28.3% III = 21.2% IV = 1.2%	Physician, oncology, radiology and pathology; Meetings occur weekly.	*Resection rate* ($p < 0.001$) MDT group = 23.4% Non-MDT group = 12.2% *5-y survival* ($p > 0.05$): MDT group = 32% Non-MDT group = 31% *In-hospital mortality* ($p > 0.05$) MDT group = 5.5% Non-MDT group = 7.7%	None
Stevens et al.[42]	Retrospective audit New Zealand	81 59	51% ≥80 y: 18%	Exclusively NSCLC I and II = 100%	Cardiothoracic surgery, pulmonology, medical oncology, radiation oncology and radiology; NR.	*Curative anticancer* MDT group = 24% Non-MDT group = 76% *Palliative anticancer* MDT group = 57% Non-MDT group = 43% *Supportive care* MDT group = 22% Non-MDT group = 78%	None

CCI, Charlson Comorbidity Index; CI, confidence interval; ECOG, Eastern Cooperative Oncology Group; HR, hazard ratio; LC, lung cancer; MDT, multidisciplinary team; NR,: not reported; Ref, reference; USA, United States of America.

Table 3. Risk of Bias of Primary Cohort Studies in Systematic Review According to Newcastle-Ottawa Scale

	Selection					Comparability		Outcome					
	Representativeness of exposed cohort			Ascertainment of exposure				Assessment of outcome			Adequacy of follow-up of cohorts		
Author (y)[Ref]	Truly representative	Somewhat representative	Selection of nonexposed cohort: drawn from same community as exposed cohort	Secure record	Demonstration that outcome of interest was not present at start of study	Study controls for stage of disease	Study controls for any additional factor	Independent blind assessment	Record linkage	Follow-up long enough for outcomes to occur	Complete follow-up—all subjects accounted for	Subjects lost to follow-up unlikely to introduce bias: small number lost (<80%)	Total Score
Friedman et al.[35]			★	★	★					★	★		5
Boxer et al.[15]		★	★	★	★	★	★		★		★		8
Bydder et al.[14]			★	★	★				★				4
Wah et al.[38]		★	★		★	★	★		★		★		7
Hung et al.[28]			★	★	★	★	★		★	★	★		8
Thalanayar Muthukrishnan et al.[44]		★	★	★	★				★		★		6
Stone et al.[30]		★	★	★	★					★			5
Voong et al.[40]		★	★	★	★				★	★			6
Bilfinger et al.[41]		★	★	★	★	★	★		★	★	★		9
Stone et al.[29]		★	★	★	★	★	★		★	★			8
Peckham and Mott-Coles[36]				★	★						★		3
Tamburini et al.[32]		★	★	★	★				★		★		6
Pan et al.[33]		★	★		★	★	★		★	★	★		8
Freeman et al.[39]	★		★	★	★				★	★	★		7
Alsamarai et al.[37]		★	★		★	★	★		★	★	★		8
Osarogiagbon et al.[31]		★	★	★	★	★			★	★	★		8
Freeman et al.[16]		★		★	★				★	★	★		6
Riedel et al.[43]		★		★	★				★	★	★		6
Forrest et al.[21]		★		★	★					★	★		5
Martin-Ucar et al.[34]		★		★	★				★	★	★		6
Stevens et al.[42]		★	★	★	★				★		★		6

Ref, reference.

Table 4. Risk of Bias of Primary Case-Control Study Included in Systematic Review According to Newcastle-Ottawa Scale

	Selection					Comparability		Exposure			
	Adequacy of case definition			Selection of controls	Definition of controls			Ascertainment of exposure			
Author (y)[Ref]	Independent validation	Record linkage or based on self-reports	Consecutive or obviously representative series of cases	Same period	Non-MDT	Study controls for stage of disease	Study controls for any additional factor	Secure record	Structured interview where blind to case or control status	Same method of ascertainment for cases and controls	Same nonresponse rate for case and control groups	Total Score
Huang et al. 2021[27]		★	★	★	★	★	★	★	★	★	★	7

MDT, multidisciplinary team; Ref, reference.

16 studies that included patients with all LC stages,[15,16,27,29–34,37–41,43,44] two included only stages III and IV,[14,21] two included stage III only,[28,35] one included stages I, II, and III,[39] and one study included stage I and II patients.[42]

The composition of MDTs was heterogeneous among the studies. All study MDTs included medical oncologists, whereas surgeons, radiologists, pulmonologists, pathologists, radiation oncologists, and nuclear medicine physicians were present in most MDTs. Five studies included nurses,[14,21,28,31,41] three included dietitians,[28,35,41] and two included social workers.[40,41] Most MDTs met weekly (n = 12).[14,15,28–32,34–37,43]

Risk of Bias of Studies Reviewed

The detailed report of risk of bias assessment of cohort and case-control studies is summarized in Tables 3 and 4, respectively. Median score of the New Castle-Ottawa Scale ranged from 3[36] to 9.[41] There were 12 studies classified as having high risk of bias (<7 points),[14,16,21,30,32,34–36,40,42–44] whereas 10 were deemed having low risk of bias.[15,27–29,31,33,37–39,41]

Impact of MDTs on Clinical Outcomes

Ten reported outcomes were identified in the studies, most favoring MDT than non-MDT groups, as summarized in Figure 2.

Overall Survival. Nine studies evaluated the OS outcome by performing regression analysis. Huang et al.[27] revealed that OS was substantially improved in the MDT group on crude analysis. On Cox regression analysis, adjusted for several confounding factors, Hung et al.[28] found that MDT discussion prolonged the length of survival of patients with stage III NSCLC. In a study conducted by Osarogiagbon et al.,[31] the HR for OS in the MDT was 1.7 (95% CI: NR) on stage-adjusted analysis. Patients undergoing MDT discussion were found to have better 1-year survival by Tamburini et al.[32] and likewise in the study of Wah et al.,[38] where the MDT group had an independent association with lower likelihood of 2-year all-cause mortality. Conversely, Boxer et al.[15] found no impact of MDT discussion on survival on the adjusted analysis.

The remaining three studies[29,33,41] reported OS using HR to estimate effect and considered MDT as a reference group for pooling in a meta-analysis. A important difference was found between the MDT group and non-MDT groups (HR = 0.60, 95% CI: 0.49–0.75, I^2 = 78%). These results suggested that the MDT group was associated with better OS. Nevertheless, the certainty of evidence was very low

Table 5. Summary of Findings: Association Between MDT and Outcomes in Patients With Lung Cancer

Outcomes	Number of Studies; Number of Patients	Compiled Studies	Heterogeneity (I^2), %	Effect size: HR, MD, or RR (95% CI)	Quality of Evidence (GRADE)
Overall survival	3; 38,037	27, 31, 39	78	HR 0.60 (0.49-0.75)	Very low[a] ⨁◯◯◯
Time from diagnosis to first treatment	6; 15,235	16, 28, 33, 37, 38, 42	63	MD 12.41 (11.16-13.65)	Very low[a,b] ⨁◯◯◯
Complete staging	4; 14,925	16, 30, 33, 37	89	RR 1.36 (1.17-1.57)	Very low[a,b] ⨁◯◯◯

Note: GRADE approach to assess quality of evidence
[a]Inconsistency: downgraded one level due to inconsistency.
[b]Risk of bias: downgraded one level due to within-study risk of bias classified as high in most studies.
CI, confidence interval; HR, hazard ratio; GRADE, Grading of Recommendations Assessment, Development and Evaluation; MD, mean difference; MDT, multidisciplinary team; RR, risk ratio.

owing to inconsistency and high heterogeneity (Fig. 3 and Table 5).

Two studies compared the rate of survival among MDT and non-MDT groups. A study conducted by Martin-Ucar et al.[34] found no difference in 5-year survival between MDT and non-MDT groups. By contrast, Bydder et al.[14] revealed higher 1-year survival in the MDT group compared with the non-MDT group.

Mortality. Tamburini et al.[32] found higher 1-year mortality in the non-MDT group compared with the MDT group, as did the study conducted by Wah et al.[38] investigating deaths 2 years after diagnosis. Martin-Ucar et al.,[34] however, failed to find any group difference in mortality. Freeman et al.[39] reported operative mortality as 2.4% in the MDT group and 2.1% in the non-MDT group.

Length of Survival. Six studies evaluated length of survival in MDT and non-MDT groups. Hung et al.[28] found a higher median length of survival in the MDT group compared with the non-MDT group, as well Osarogiagbon et al.,[31] Forrest et al.,[21] and Bydder et al.[14] Nevertheless, both Friedman et al.[35] and Riedel et al.[43] found no difference in survival between MDT and non-MDT groups. Differences in the analyses performed (mean, median, without measures of dispersion) precluded pooling of the data in a meta-analysis.

Progression-Free Survival. Only one study reported progression-free survival. Osarogiagbon et al.[31] found higher progression-free survival in the MDT group compared with the non-MDT group.

Time From Diagnosis to Treatment. Nine studies evaluated time from diagnosis to first treatment for MDT versus non-MDT groups. Osarogiagbon et al.[31] found higher median time from diagnosis to treatment in the non-MDT group relative to the MDT group. Nevertheless, Boxer et al.[15] found no difference in time from diagnosis to several types of treatments, such as surgery, curative and palliative radiotherapy, curative and palliative chemotherapy, or in referral for palliative care between the MDT and non-MDT groups. Similarly, Alsamarai et al.[37] detected no difference in time from diagnosis to treatment in MDT versus non-MDT groups.

The remaining six studies,[16,29,35,39,40,44] involving 15,235 patients, reported mean and SD for time from diagnosis to treatment in MDT and non-MDT groups and were pooled in a meta-analysis. The results revealed longer time to treatment for patients in the non-MDT group compared with those in the MDT group (MD = 12.20 d, 95% CI: 10.76–13.63, I^2 = 63%) (Fig. 4 and Table 5). The certainty of evidence was very low owing to inconsistency and risk of bias.

Rate of Complete Staging. Four studies[16,32,35,39] involving 14,925 patients reported the number of patients with complete staging of NSCLC in the MDT and non-MDT groups and were pooled in a meta-analysis. The results revealed that the MDT group was associated with a higher proportion of complete staging (risk ratio = 1.36, 95% CI: 1.17–1.57, I^2 = 89%) (Fig. 5 and Table 5). The certainty of evidence was very low owing to inconsistency and risk of bias.

Treatment Received. *Surgery.* Five studies compared the frequency of patients who had undergone surgery in MDT versus non-MDT groups. Boxer et al.15 found no difference in the rate of surgery between MDT and non-MDT groups, regardless of LC stage. Similarly, Freeman et al.[16] also failed to reveal a important difference in surgical treatment between MDT and non-MDT groups. Nevertheless, on separate analysis of stage III patients alone, the number undergoing surgery was higher in the MDT group compared with the non-MDT group. Peckham et al.[36] reported that 79% of patients in the MDT group underwent surgery, compared with 74% in the non-MDT

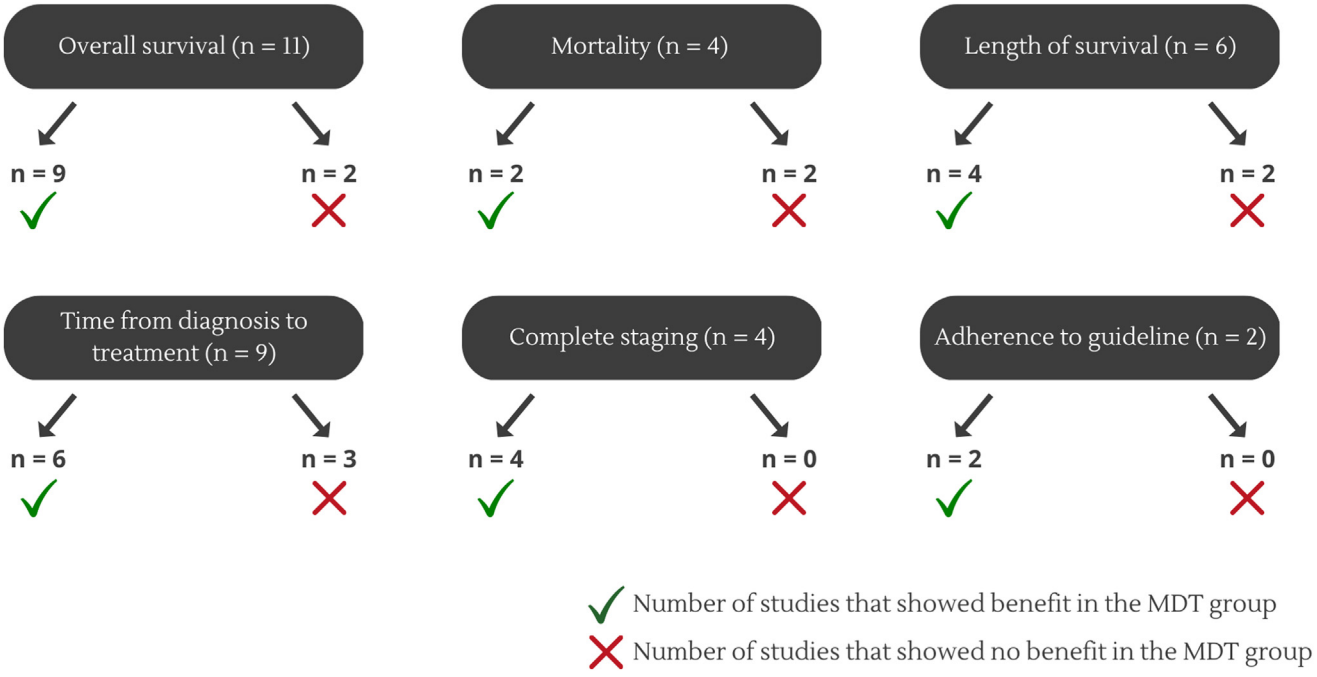

Figure 2. Summarized results of outcomes evaluated in primary studies.

group (p = NR). Muthukrishnan et al.[44] revealed that 16.4% of the patients in the MDT group underwent surgery versus 17% in the non-MDT group (p = NR). Bilfinger et al.,[41] evaluating a sample comprising predominantly patients at stages III and IV (64.9% of total sample), revealed a higher rate of surgery in the MDT group than the non-MDT group. Given that surgery is indicated mainly at the initial stages of NSCLC and most studies did not report subgroup analysis by disease stage, a meta-analysis was not carried out.

Chemotherapy. Six studies compared the rate of patients receiving chemotherapy treatment in MDT and non-MDT groups. Bydder et al.[14] included only patients at stages III and IV, reporting no important group difference. Forrest et al.[21] also included stage III and IV patients only and found a chemotherapy rate of 23% in the MDT group and 7% in the non-MDT group (p = NR). Muthukrishnan et al.[44] included patients at all stages and reported a chemotherapy rate of 18.2% in the MDT group versus 14.2% in the non-MDT group (p = NR). In addition, the number of patients receiving chemotherapy did not differ between groups in a study conducted by Freeman et al.[16] By contrast, a study conducted by Boxer et al.[15] reported a higher chemotherapy rate in the MDT than the non-MDT group, where MDT group discussion proved an independent predictor of receiving chemotherapy. Nevertheless, subgroup analysis according to LC stage revealed a higher rate of chemotherapy only for stage IV patients. Conversely, Bilfinger et al.[41] reported a higher rate of chemotherapy in the non-MDT group compared with the MDT group.

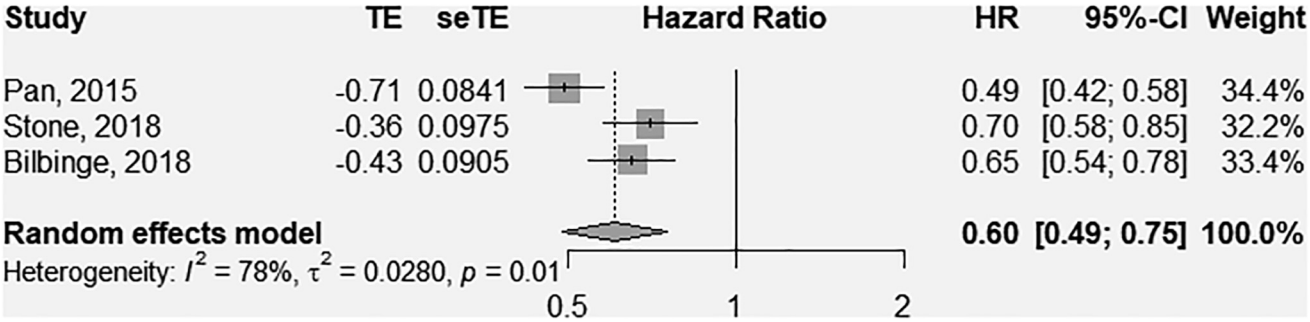

Figure 3. Forest plot of impact of MDT on overall survival. CI, confidence interval; HR, hazard ratio; MDT, multidisciplinary team; seTE, standard error of treatment estimate; TE, estimate of treatment effect.

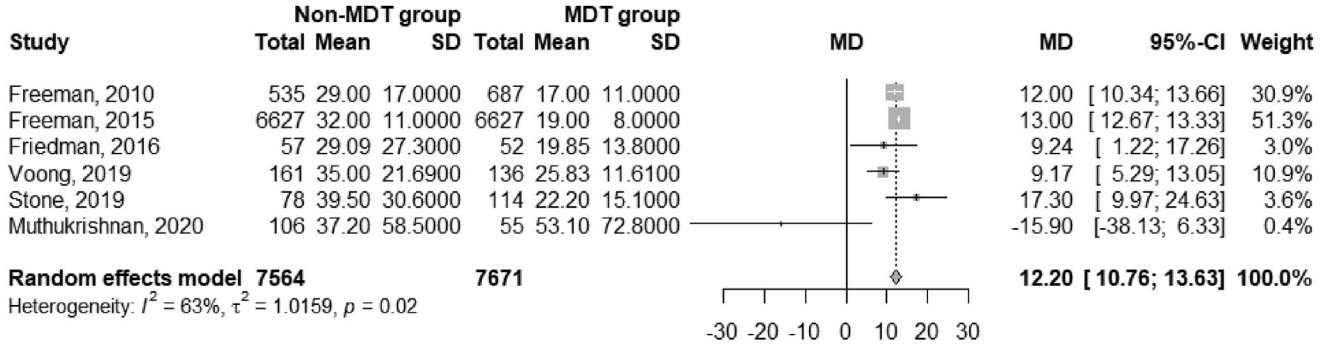

Figure 4. Forest plot of pooled mean difference of time from diagnosis to first treatment in non-MDT group compared with MDT group. CI, confidence interval; MD, mean difference; MDT, multidisciplinary team.

Radiotherapy. Four studies evaluated the radiotherapy outcome. Boxer et al.[15] reported a higher rate of radiotherapy in the MDT group than the non-MDT group, and subgroup analysis according to LC stage revealed a higher rate of radiotherapy in cancer stages I to IV. In addition, the MDT group was independently associated with radiotherapy (OR = 2.64, 95% CI: 1.96–3.56). In contrast, Bilfinger et al.[41] found a higher rate of radiotherapy in the non-MDT relative to the MDT group. Forrest et al.[21] included only patients at stages III and IV, reporting no group differences in radiotherapy rate. Last, Muthukrishnan et al.[44] reported a radiotherapy rate of 20% in the MDT group versus 17.9% in the non-MDT group (p = NR).

Adherence to Guidelines. Two studies evaluated this outcome, with both revealing a higher rate of adherence to guidelines in the MDT than non-MDT groups (97% versus 81%, $p < 0.0001$, and 88% versus 71%, $p < 0.0001$)[16,39] for the two investigations, respectively.

Discussion

A systematic review and meta-analysis was conducted of articles published up to February 2023 investigating whether MDT improved outcomes in LC, predominantly NSCLC. To our knowledge, this is the first systematic review with meta-analysis evaluating this topic. The systematic review was performed according to the Cochrane recommendations and reported according to the PRISMA checklist. Two reviewers evaluated the risk of bias and certainty of evidence in a standardized manner. In addition, the literature search was comprehensive, without language or time of publication restrictions.

A total of 22 studies involving a total of 61,278 patients were included in this systematic review. The studies differed on several aspects, such as number of patients evaluated, stages of NSCLC, composition of MDT, way of reporting outcomes, and follow-up time. These differences among the available studies precluded calculating pooled estimates for most outcomes. Data were pooled for OS, proportion of complete staging NSCLC cases, and time from diagnosis to treatment. Overall, patients with NSCLC managed by MDTs had better OS, higher rate of complete staging, and a shorter time from diagnosis to treatment.

These benefits can be attributed to the greater effectiveness of case management, improved care coordination, and reduced variation in care.[45] Regular meetings involving professionals with expertise in all major treatment modalities can increase the precision

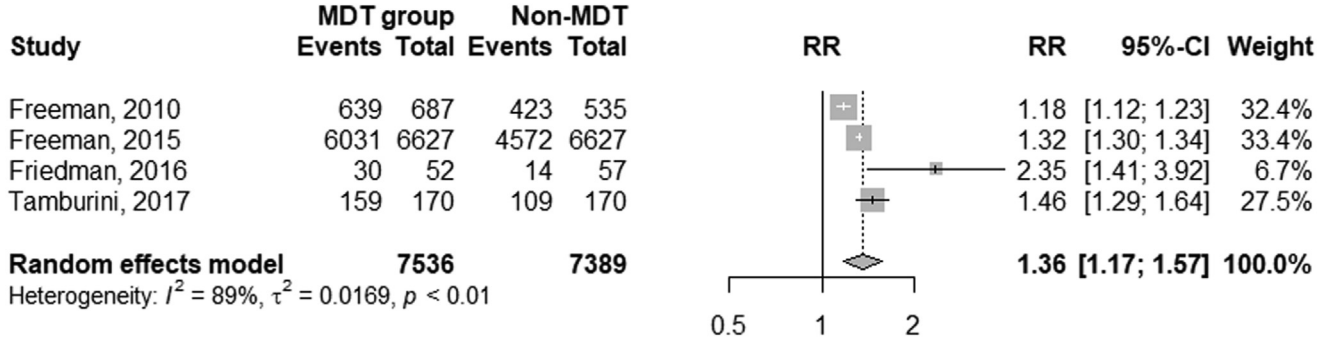

Figure 5. Forest plot of pooled risk ratio of complete staging in MDT group compared with non-MDT group. CI, confidence interval; MDT, multidisciplinary team; RR, risk ratio.

of their decisions and result in better survival.[46] Multiple studies have established a clear association between treatment delays and reduced survival rates among patients diagnosed with having NSCLC.[47–50] In addition to the positive impact of MDTs on survival outcomes and reducing the interval from diagnosis to first treatment, MDT involvement also contributes to a higher proportion of complete staging in patients with NSCLC. Achieving a comprehensive staging of NSCLC often necessitates the utilization of multiple diagnostic tests, including techniques such as endobronchial ultrasound-guided transbronchial needle aspiration, esophageal ultrasound-guided fine-needle aspiration, mediastinoscopy, and integrated positron emission tomography or computed tomography.[51] These tests require the expertise of pathologists, interventional radiologists, pulmonologists, and thoracic surgeons, highlighting the importance of collaboration among various specialists within an MDT.[52] This collaborative approach ensures a thorough and accurate staging process, facilitating the acquisition of sufficient and appropriate tissue samples for subsequent molecular testing.

The improvement in survival outcomes associated with MDT involvement has also been found in systematic reviews involving other types of patients with cancer. For instance, a systematic review encompassing 11 studies of patients with colorectal cancer revealed a important difference in OS between MDT and non-MDT groups (HR = 0.81, 95% CI: 0.69–0.94).[53] Similarly, a systematic review by Shang et al.,[54] including five studies, reported higher survival rates in patients with head and neck cancer who received treatment from an MDT (HR = 0.84, 95% CI: 0.76–0.92). These findings are in line with the results of the present study.

In addition, MDT meetings substantially shorten the interval from diagnosis to first treatment. This can be attributed to the fact that an MDT consisting of several professionals is more effective in defining and guiding the most appropriate treatment according to the pathologic diagnosis and report, resulting in more timely treatment decisions.[55] MDT discussion potentially reduces unnecessary procedures and establishes better patient management.[55] Patient physical[56] and nutritional status[57] are also important factors to consider when making treatment decisions, and these assessments are more feasible within an MDT.

The composition of the MDT was heterogeneous among the studies included in this systematic review. MDT needs to be coordinated, integrated, and qualified to be effective. The quality of MDT must be evaluated frequently.[58] The frequency of meetings, members included in the team, documentation, and recording of discussions and decisions, and communication between health care professionals and patients should be standardized. The quality and impact of MDT decision-making are directly dependent on the organization of the MDT. According to the included studies, most MDTs have a thoracic surgeon, a medical oncologist, and a radiation oncologist. Other important roles are radiologists, pneumologist, and nurse navigators. The nurse navigator role guarantees a more predictable patient journey through the care coordinator during the diagnostic and treatment process, including operational case management, to guarantee the quality of continuity of care.[58,59]

Given that more than 50% of the studies included in this systematic review had a high risk of bias, and the certainty of evidence was classified as very low for all outcomes evaluated, this systematic review has some inherent limitations, as follows: (1) Six eligible studies included a small number of patients with SCLC in addition to patients with NSCLC, which may have introduced a potential bias, as our primary population of interest was specifically patients with NSCLC. (2) The impact of MDT depends on its quality but is also influenced by patient characteristics, such as the stage of NSCLC and age. Nevertheless, most studies performed no subgroup analysis according to these characteristics, precluding investigation into the effect of MDT on the management of specific NSCLC stages. (3) All studies reviewed were observational, and the criteria used to refer patients to each group (MDT or non-MDT) were NR in the studies. Thus, owing to this potential selection bias inherent in the study methodology, MDT and non-MDT potentially had different prognostic characteristics. (4) In some studies, a pre- and a post-test were used to compare the outcomes of patients treated at different times. This type of analysis can also generate a potential bias, for it is unclear whether the differences observed in outcomes were due to MDT meetings or to technological or surgical advances.

Despite limitations in the primary studies, the clinical implementation of MDTs seemed to improve outcomes of a patient with NSCLC, with a favorable risk-benefit ratio. Further research clarifying optimal MDT composition, frequency of meetings, factors influencing decision-making quality, timing of referral to MDTs, metrics to assess program quality, and assessment of the effect of potential confounding factors on the benefits of MDT management is warranted.

In conclusion, this meta-analysis revealed that MDT management is likely associated with better OS and shorter time from diagnosis to first treatment. Despite the very low certainty of the evidence, MDT management positively affects clinical outcomes and should be further evaluated in health care.

CRediT Authorship Contribution Statement

Gilberto de Castro Jr.: Conceptualization, Methodology, Writing—original draft, Review and editing.

Fabiano Hahn Souza: Methodology, Writing—original draft and editing.

Júlia Lima: Methodology, Writing—original draft and editing.

Luis Pedro Bernardi: Methodology, Writing—original draft and editing.

Carlos Henrique Andrade Teixeira: Conceptualization, Writing—original draft and review.

Gustavo Faibischew Prado: Conceptualization, Writing—original draft and review.

Supplementary Data

Note: To access the supplementary material accompanying this article, visit the online version of the *JTO Clinical and Research Reports* at www.jtocrr.org and at https://doi.org/10.1016/j.jtocrr.2023.100580.

References

1. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2021;71:209-249.
2. Islami F, Goding Sauer A, Miller KD, et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States: potentially Preventable Cancers in US. *CA Cancer J Clin*. 2018;68:31-54.
3. Rami-Porta R, Call S, Dooms C, et al. Lung cancer staging: a concise update. *Eur Respir J*. 2018;51:1800190.
4. Jones GS, Baldwin DR. Recent advances in the management of lung cancer. *Clin Med*. 2018;18(suppl 2):s41-s46.
5. National Comprehensive Cancer Network (NCCN). NCCN Guidelines: Non-small cell lung cancer. Version 3.2022. https://www.nccn.org/professionals/physician_gls/pdf/nscl.pdf. Accessed April 26, 2021.
6. Heinke MY, Vinod SK. A review on the impact of lung cancer multidisciplinary care on patient outcomes. *Transl Lung Cancer Res*. 2020;9:1639-1653.
7. Popat S, Navani N, Kerr KM, et al. Navigating diagnostic and treatment decisions in non-small cell lung cancer: expert commentary on the multidisciplinary team approach. *Oncologist*. 2021;26:e306-e315.
8. Seek A, Hogle WP. Modeling a better way: navigating the healthcare system for patients with lung cancer. *Clin J Oncol Nurs*. 2007;11:81-85.
9. Kesson EM, Allardice GM, George WD, Burns HJG, Morrison DS. Effects of multidisciplinary team working on breast cancer survival: retrospective, comparative, interventional cohort study of 13 722 women. *BMJ*. 2012;344:e2718-e2718.
10. Wang X, Zhao J, Shen Z, et al. Multidisciplinary approach in improving survival outcome of early-stage gastric cancer. *J Surg Res*. 2020;255:285-296.
11. Colasante A, Augurio A, Basilico R, et al. A multidisciplinary group for prostate cancer management: a single institution experience. *Oncol Lett*. 2018;15:1823-1828.
12. Brännström F, Bjerregaard JK, Winbladh A, et al. Multidisciplinary team conferences promote treatment according to guidelines in rectal cancer. *Acta Oncol*. 2015;54:447-453.
13. Bumm R, Feith M, Lordick F, Herschbach P, Siewert JR. Impact of multidisciplinary tumor boards on diagnosis and treatment of esophageal cancer. *Eur Surg*. 2007;39:136-140.
14. Bydder S, Nowak A, Marion K, Phillips M, Atun R. The impact of case discussion at a multidisciplinary team meeting on the treatment and survival of patients with inoperable non-small cell lung cancer. *Int Med J*. 2009;39:838-841.
15. Boxer MM, Vinod SK, Shafiq J, Duggan KJ. Do multidisciplinary team meetings make a difference in the management of lung cancer? *Cancer*. 2011;117:5112-5120.
16. Freeman RK, Van Woerkom JM, Vyverberg A, Ascioti AJ. The effect of a multidisciplinary thoracic malignancy conference on the treatment of patients with lung cancer. *Eur J Cardio Thorac Surg*. 2010;38:1-5.
17. Keating NL, Landrum MB, Lamont EB, Bozeman SR, Shulman LN, McNeil BJ. Tumor boards and the quality of cancer care. *JNCI J Natl Cancer Inst*. 2013;105:113-121.
18. Postmus PE, Kerr KM, Oudkerk M, et al. Early and locally advanced non-small-cell lung cancer (NSCLC): ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2017;28(suppl 4):iv1-iv21.
19. Wu YL, Planchard D, Lu S, et al. Pan-Asian adapted Clinical Practice Guidelines for the management of patients with metastatic non-small-cell lung cancer: a CSCO-ESMO initiative endorsed by JSMO, KSMO, MOS, SSO and TOS. *Ann Oncol*. 2019;30:171-210.
20. Prades J, Remue E, van Hoof E, Borras JM. Is it worth reorganising cancer services on the basis of multidisciplinary teams (MDTs)? A systematic review of the objectives and organisation of MDTs and their impact on patient outcomes. *Health Policy*. 2015;119:464-474.
21. Forrest LM, McMillan DC, McArdle CS, Dunlop DJ. An evaluation of the impact of a multidisciplinary team, in a single centre, on treatment and survival in patients with inoperable non-small-cell lung cancer. *Br J Cancer*. 2005;93:977-978.
22. Higgins JPT, Green S, Cochrane Collaboration, eds. Cochrane handbook for systematic reviews of interventions. Hoboken, NJ: Wiley-Blackwell; 2008.
23. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
24. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. *Syst Rev*. 2016;5:210.
25. Wells G, Shea BJ, O'Connell D, Peterson J, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. Available on: https://www.ohri.ca/programs/clinical_epidemiology/oxford.asp. Accessed September 11, 2022.
26. Balshem H, Helfand M, Schünemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol*. 2011;64:401-406.

27. Huang B, Chen Q, Allison D, et al. Molecular tumor board review and improved overall survival in non-small-cell lung cancer. *JCO Precis Oncol*. 2021;5:PO.21.00210.
28. Hung HY, Tseng YH, Chao HS, et al. Multidisciplinary team discussion results in survival benefit for patients with stage III non-small-cell lung cancer. *PLoS One*. 2020;15:e0236503.
29. Stone E, Rankin N, Kerr S, et al. Does presentation at multidisciplinary team meetings improve lung cancer survival? Findings from a consecutive cohort study. *Lung Cancer*. 2018;124:199–204.
30. Stone CJL, Robinson A, Brown E, et al. Improving timeliness of oncology assessment and cancer treatment through implementation of a multidisciplinary lung cancer clinic. *J Oncol Pract*. 2019;15:e169–e177.
31. Osarogiagbon RU, Phelps G, McFarlane J, Bankole O. Causes and consequences of deviation from multidisciplinary care in thoracic oncology. *J Thorac Oncol*. 2011;6:510–516.
32. Tamburini N, Maniscalco P, Mazzarra S, et al. P-219 The Introduction of Multidisciplinary Team Discussion Improves Survival for Lung Cancer Patients Undergoing Surgery. *Interact CardioVasc Thorac Surg*. 2017;25(suppl 1):ivx280.219.
33. Pan CC, Kung PT, Wang YH, Chang YC, Wang ST, Tsai WC. Effects of multidisciplinary team care on the survival of patients with different stages of non-small cell lung cancer: a national cohort study. *PLoS One*. 2015;10:e0126547.
34. Martin-Ucar AE, Waller DA, Atkins JL, Swinson D, O'Byrne KJ, Peake MD. The beneficial effects of specialist thoracic surgery on the resection rate for non-small-cell lung cancer. Lung Cancer Amst. *Neth*. 2004;46:227–232.
35. Friedman EL, Kruklitis RJ, Patson BJ, Sopka DM, Weiss MJ. Effectiveness of a thoracic multidisciplinary clinic in the treatment of stage III non-small-cell lung cancer. *J Multidiscip Healthc*. 2016;9:267–274.
36. Peckham J, Mott-Coles S. The role of the oncology nurse navigator in improving adherence to national guidelines and streamlining Patient Care. *Clin J Oncol Nurs*. 2018;22:656–662.
37. Alsamarai S, Yao X, Cain HC, et al. The effect of a lung cancer care coordination program on timeliness of care. *Clin Lung Cancer*. 2013;14:527–534.
38. Wah W, Stirling RG, Ahern S, Earnest A. Influence of timeliness and receipt of first treatment on geographic variation in non-small cell lung cancer mortality. *Int J Cancer*. 2021;148:1828–1838.
39. Freeman RK, Ascioti AJ, Dake M, Mahidhara RS. The Effects of a Multidisciplinary Care Conference on the Quality and Cost of Care for Lung Cancer Patients. *Ann Thorac Surg*. 2015;100:1834–1838.
40. Voong KR, Liang OS, Dugan P, et al. Thoracic oncology multidisciplinary clinic reduces unnecessary health care expenditure used in the workup of patients with non-small-cell lung cancer. *Clin Lung Cancer*. 2019;20:e430–e441.
41. Bilfinger TV, Albano D, Perwaiz M, Keresztes R, Nemesure B. Survival outcomes among lung cancer patients treated using a multidisciplinary team approach. *Clin Lung Cancer*. 2018;19:346–351.
42. Stevens W, Stevens G, Kolbe J, Cox B. Management of stages I and II non-small-cell lung cancer in a New Zealand study: divergence from international practice and recommendations. *Int Med J*. 2008;38:758–768.
43. Riedel RF, Wang X, McCormack M, et al. Impact of a multidisciplinary thoracic oncology clinic on the timeliness of care. *J Thorac Oncol*. 2006;1:692–696.
44. Thalanayar Muthukrishnan P, Ratnam M, Nguyen MT, et al. Pre-diagnosis multidisciplinary tumor board and time to staging in lung cancer: the case western MetroHealth experience. *Cureus*. 2020;12:e6595.
45. Denton E, Conron M. Improving outcomes in lung cancer: the value of the multidisciplinary health care team. *J Multidiscip Healthc*. 2016;9:137–144.
46. Selby P, Popescu R, Lawler M, Butcher H, Costa A. The value and future developments of multidisciplinary team cancer care. *Am Soc Clin Oncol Educ Book*. 2019;39:332–340.
47. Han KT, Kim W, Song A, Ju YJ, Choi DW, Kim S. Is time-to-treatment associated with higher mortality in Korean elderly lung cancer patients? *Health Policy*. 2021;125:1047–1053.
48. Cushman TR, Jones B, Akhavan D, et al. The effects of time to treatment initiation for patients with non-small-cell lung cancer in the United States. *Clin Lung Cancer*. 2021;22:e84–e97.
49. Cone EB, Marchese M, Paciotti M, et al. Assessment of time-to-treatment initiation and survival in a cohort of patients with common cancers. *JAMA Netw Open*. 2020;3:e2030072.
50. Khorana AA, Tullio K, Elson P, et al. Time to initial cancer treatment in the United States and association with survival over time: an observational study. *PLoS One*. 2019;14:e0213209.
51. Silvestri GA, Gonzalez AV, Jantz MA, et al. Methods for staging non-small cell lung cancer: diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2013;143(suppl):e211S–e250S.
52. Batra U, Munshi A, Kabra V, Momi G. Relevance of multidisciplinary team approach in diagnosis and management of Stage III NSCLC. *Indian J Cancer*. 2022;59(suppl):S46-S55.
53. Peng D, Cheng YX, Cheng Y. Improved overall survival of colorectal cancer under multidisciplinary team: a meta-analysis. *BioMed Res Int*. 2021;2021:5541613.
54. Shang C, Feng L, Gu Y, Hong H, Hong L, Hou J. Impact of multidisciplinary team management on the survival rate of head and neck cancer patients: a cohort study meta-analysis. *Front Oncol*. 2021;11:630906.
55. Daly ME, Riess JW. Multidisciplinary care. In: Reckamp K, ed. *Lung Cancer. Cancer Treatment and Research*. Vol 170. Cham, Switzerland: Springer; 2016:285–300.
56. Billé A, Buxton J, Viviano A, et al. Preoperative physical activity predicts surgical outcomes following lung cancer resection. *Integr Cancer Ther*. 2021;20:153473542097585.
57. Polański J, Chabowski M, Świątoniowska-Lonc N, et al. Relationship between nutritional status and clinical outcome in patients treated for lung cancer. *Nutrients*. 2021;13:3332.
58. Kowalczyk A, Jassem J. Multidisciplinary team care in advanced lung cancer. *Transl Lung Cancer Res*. 2020;9:1690–1698.
59. Taberna M, Gil Moncayo F, Jané-Salas E, et al. The multidisciplinary team (MDT) approach and quality of care. *Front Oncol*. 2020;10:85.