

Do Multidisciplinary Tumor Board Discussions Correlate With Increase in 5-Year Survival? A Meta-Analysis Study

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ABSTRACT

Introduction: Due to the complex nature of cancer cases, it is imperative that the involved healthcare providers coordinate the patients care plan in union to reach the best possible outcome in the smoothest and fastest manner. This is what multidisciplinary tumor board (MTB) meetings strive to achieve. Conducting regular MTB meetings requires significant investment of time and finances. It is thus vital to assess the empirical benefits of such practice. **Methods:** A meta-analysis was conducted to evaluate the literature regarding the impact of MTB meetings on patient 5-year survival. Relevant studies were identified by searching Ovid MEDLINE and Embase databases from January 1995 to July 2019. Studies were included if they assessed 5-year survival in cases discussed in MTB meetings and used a comparison group and/or a pretest and posttest design. **Results:** Five articles met the study's inclusion criteria. Quality of studies was affected by selection bias and the use of historic cohorts. The results showed significantly improved 5-year survival in the MTB group compared with the non-MTB groups (odds ratio for 5-year death rate of 0.59, CI 0.45–0.78, $p < 0.001$). **Conclusion:** This meta-analysis showed that cancer MTB meetings have a significant impact on patients' 5-year survival. This could be because of several reasons, such as less time to treatment initiation, better adherence to guidelines, higher numbers of investigational imaging, lesser surgical complications, and recurrence rates. Future prospective studies are needed to further delineate reasons for improvement of outcome to enhance the benefits of this approach.

Keywords: tumor board, multidisciplinary care, 5-year survival, patient-oriented outcome, multidisciplinary tumor board meetings

INTRODUCTION

The nature of cancer, the second leading cause of death worldwide, is complex. It is time-sensitive and requires multiple diagnostic and therapeutic modalities for its treatment.^[1] Therefore, it requires different specialties for its management especially for late-presenting cases, which is often the case. A single case would require the involvement and teamwork of up to 20 specialties during an average hospital stay.^[2] Thus, it

becomes imperative that the involved healthcare providers coordinate the patients care plan in union, including the current and next steps in management, to reach the best possible outcome in the smoothest and fastest manner. This is what multidisciplinary tumor board (MTB) meetings strive to achieve.

Defined by the National Cancer Institute as a “treatment planning approach in which several doctors who are experts in different specialties (disciplines) review and discuss the medical condition and treatment options

of a patient.¹³ MTB meeting provides a setting for the specialties involved in cancer care to meet and discuss the current status and upcoming plans of the patients they care for. Providers, such as medical oncologists, radiation oncologists, surgical oncologists, pathologists, and radiologists, gather to discuss the aspects of the patient's diagnosis and treatment to construct a plan. MTB meetings are recommended internationally as best standard of care.¹⁴

One disadvantage of MTB meetings is its logistic and financial challenges leading experts to rightfully question its benefit.¹⁵ As mentioned previously, typical MTB meetings involve 10 to 20 healthcare professionals, discussing five to 40 patients in the time span of 1 and 3 hours. This process requires substantial preparation from participants. In addition, in the UK, multidisciplinary conferences are estimated to require 1 million person-hours annually at a cost of 75 million dollars.¹⁶ These potential downfalls have resulted in the publication of multiple studies over the last 20 years that attempt to demonstrate the relationship of a MTB meeting in regard to, a change in diagnosis and stage, a change in management plans,⁷⁻¹¹ a shortened time to intervention,^{12,13} and adherence to current oncologic guidelines.^{12,14,15} However, the data on patient outcome, especially survival, remain scant and inconclusive.

The impact of multidisciplinary care on survival was discussed previously among other outcomes in three systemic reviews, dating 2010, 2014, and 2016.^{7,16,17} Of the three systemic reviews, two concluded weak evidence supporting significant improvement in mortality, while one reported positive outcome in the studies. Yet, there has not been to our knowledge a unified body of research data that has questioned the effect of MTB meetings on an oncology patient's 5-year survival, the outcome of highest importance in oncology, as the main outcome in the form of a meta-analysis. Therefore, our study aim was to answer that question in this article.

METHODS

The identification of relevant articles to include in this study was conducted and reported in concordance with 2009 Preferred Reporting Items for Systematic Reviews and Analysis (PRISMA) guidelines. Articles were identified based on a database search the following keywords: multidisciplinary tumor board meeting* OR multidisciplinary discussion* OR multidisciplinary conference* OR case review meeting* OR multidisciplinary care forum* OR multidisciplinary tumor board* OR case conference* OR case discussion* AND oncology OR cancer. The search was conducted in three main databases, including Cochrane Library (Wiley), PubMed (National Library of Medicine), and Embase (Elsevier). The articles that the initial search yielded were included and excluded based on relevancy of article title. This initial search was completed by one author (Y.S.). The abstract of collected articles were assessed for relevancy individually and

separately by two authors (G.A., Y.S.). Any discrepancies between the two authors were resolved in a discussion until an agreement was reached. If an agreement was not reached between the two authors, a third author (A.J.) was consulted. After the initial screening, each article was further reviewed to ensure that it met the inclusion criteria. This was done by reading of full manuscripts by each of the two authors. If the article did not meet the inclusion criteria, it was excluded after discussion and agreement. Furthermore, every reference listed in each of the articles was reviewed to ensure that no relevant articles were missing from the search. Article quality was assessed using the Newcastle-Ottawa scale.

Studies were included if they met the following criteria: (1) included a comparison group (eg, a non-MTB group or predesign and postdesign); and (2) examined the impact of MTB meetings on patients' 5-year-survival rates. Studies were excluded based on the following criteria: (1) if the full text of the article was unattainable; (2) if the article was not written in English; (3) if the article studied the impact of other multidisciplinary cancer care modalities (such as clinics) rather than the MTB meeting; (4) if the main goal of the article was to assess the feasibility of conducting MTB meetings due to restricting factors; (5) if the study looked at a combined impact of MTB meetings and other interventions, creating confounding bias; and (6) if the article looked at the subjective opinion of members of MTB on its efficacy (eg, survey-based studies).

Data Analysis

The results of all five included studies were pooled and analyzed via Revman Review Manager version 5.2 (RevMan). Results were expressed as odds ratio (OR) for mortality and CI. The χ^2 test was used for heterogeneity assessment. In the absence of clinical heterogeneity ($p \geq 0.05$ and $I^2 \leq 50\%$), the fixed effect model of meta-analysis was applied; in the presence of substantial heterogeneity between studies ($p < 0.05$ and $I^2 > 50\%$), the sensitive analysis was performed to find out the source of heterogeneity and to assess whether the results could be significantly influenced; if the source of heterogeneity remained unclear, the random effect model of meta-analysis was used. A $p < 0.05$ was considered statistically significant.

RESULTS

Our search of the literature yielded an initial total of 429 articles, of which 14 met the set inclusion and exclusion criteria. Of the 14 articles, five detailed an impact of MTB on overall 5-year survival. The studies received a score between 5 and 7 of 7 based on methodologic quality using the Newcastle-Ottawa scale. Quality of studies was affected by selection bias and the use of historic cohorts. Breakdown of the rigorous screening process previously described in the methodology can be found in Figure 1. The publications were all

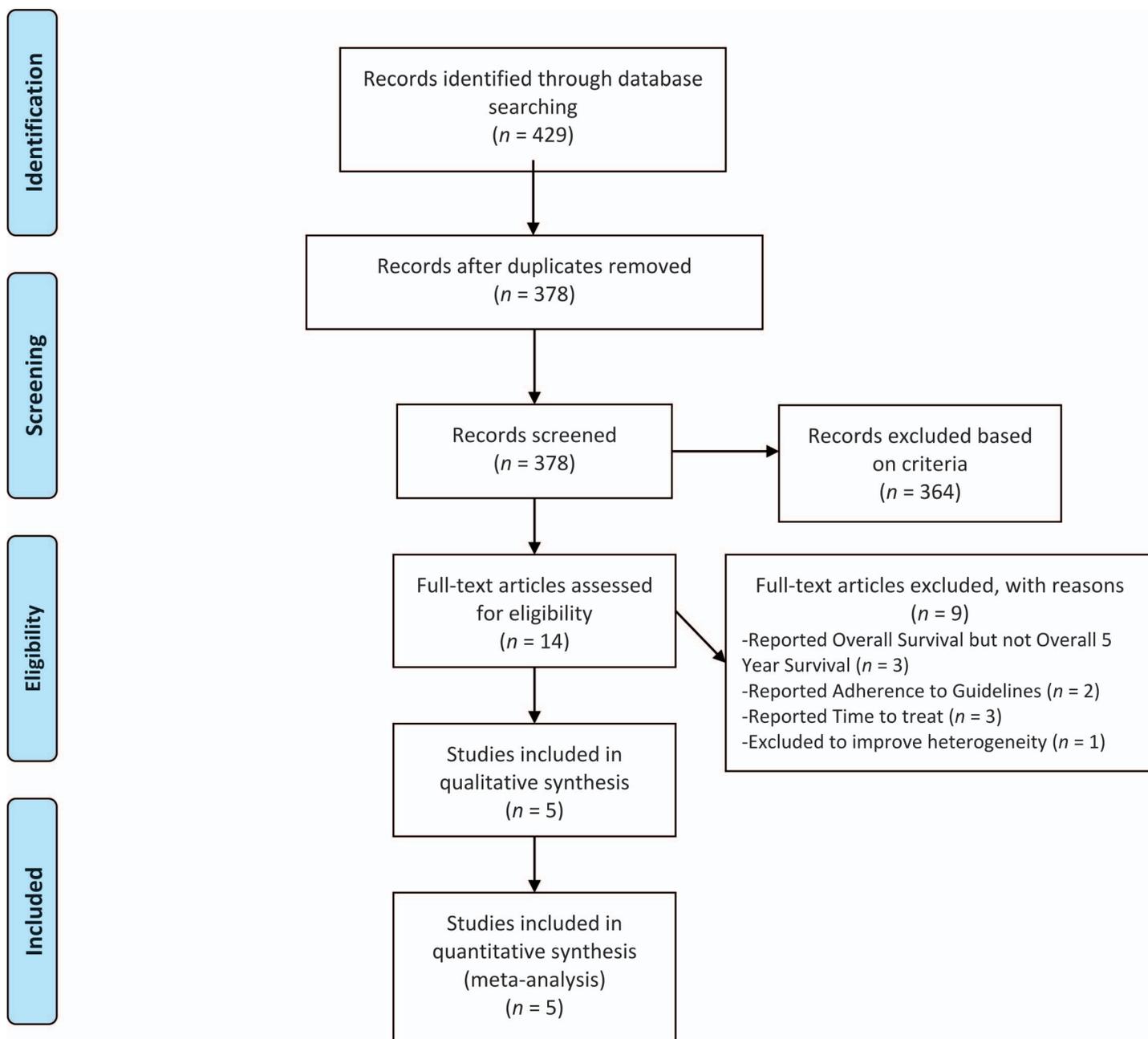


Figure 1.—Selection of studies for the analyses.

published in the past 10 years and encompassed a total of 1518 patients divided into two groups, MTB and non-MTB ($n = 792$ and 726 , respectively). The patient populations described in three of the articles involved patients with colorectal cancer, whereas the rest of the studies described populations consisting of hepatic, head and neck, and other gastrointestinal cancers. The studies encompassed patient populations that were treated based on the practices of more than one country. Further details about the patient populations involved in these studies can be found in Table 1.

Figure 2 displays results from our meta-analysis, which suggests a clear increase in overall 5-year survival in

patients whose cases were discussed in an MTB (45.2%) versus those who were not (55.65%), with an OR of 5-year death rate of 0.59 (CI:0.45–0.78, $p < 0.001$). The same cannot be said regarding some of the individual studies incorporated in our analysis. Palmer et al^[21] (OR: 0.89; CI 0.45–1.76), Lordan et al^[22] (OR: 0.78; CI 0.47–1.29), and Du et al^[23] (OR: 0.68; CI 0.38–1.21) each, respectively, demonstrated that an MTB did not yield a significant effect on overall 5-year survival, but these studies were of a smaller weight in our analysis. Wille-Jorgensen et al^[18] was excluded from the analysis due to its much larger sample size and event value in comparison to the other studies. This study appeared to be an

Table 1.—Characteristics of five included studies

Study Details	Definition of MTB	Population Characteristics	Methodology	Follow-Up	Results
Author: Munro et al. ^[19] Year: 2015 Country: Scotland	Frequency of MTB: Weekly Attendees in MTB: NA Patient selection: Via patient file number	Age mean: 70.6 y Sex: 53.1% male Type: Colorectal Stage: Duke staging (A, B, C, neoadjuvant, metastatic)	Type of study: Retrospective cohort Single/multicenter: Multicenter	Time of follow-up: 74 mo Percentage: 100	Overall, 5-y survival: MTB: 54.4% NMTB: 33.6% ($p < 0.00001$) Cause specific 5-y survival: MTB: 63.1% NMTB: 48.2% ($p < 0.00001$) Overall, 5-y survival: MTB: 61% NMTB: 40% ($p = 0.008$) Disease-specific 5-y survival: MTB: 52% NMTB: 75% ($p = 0.03$)
Author: Liu et al. ^[20] Year: 2019 Country: USA	Frequency of MTB: Weekly Attendees in MTB: Non-fellowship-trained otolaryngologists, medical oncologists, and radiation oncologists, neuroradiology, speech therapy, nutrition, pathology, dental services, and social workers Patient selection: Via institute tumor registry	Age mean: 61.40 y Sex: 72% male Type: Head and neck squamous cell carcinoma Stage: I–IV	Type of study: Retrospective cohort Single/multicenter: Single center	Time of follow-up: 2.8 y Percentage: 100%	Overall, 5-y survival: MTB: 61% NMTB: 40% ($p = 0.008$) Disease-specific 5-y survival: MTB: 52% NMTB: 75% ($p = 0.03$)
Author: Lordan et al. ^[33] Year: 2009 Country: UK	Frequency of MTB: NA Attendees in MTB: MTB team including a liver surgeon Patient selection: Patients referred to the tertiary care center	Age median: Referral from MTB: 66.3 y Referral from other hospital: 64.7 y Sex ratio (male:female): Referral from MTB: 1.8:1 Referral from other hospital: 1.5:1 Type: Colorectal liver metastasis Stage: Metastatic Age median: 55 y Sex: NT: Male, 56.44% Control: Male, 54.32% Type: GI cancer Stage: TNM stage (T3N0–AnyTN2)	Type of study: Retrospective cohort Single/multicenter: Single center	Time: 3.2 y Percentage: NA	Overall, 5-y survival: Patients referred via the MTB: 49.8% Patients referred directly: 43.3% ($p = 0.0001$) Disease-free 5-y survival: Patients referred via the MTB: 27.1% Patients referred directly: 27.9% ($p = 0.205$) Overall, 5-y survival: MTB group: 77.23% Control group: 69.75%, ($p = 0.049$) Disease-free 5 y survival: MTB group: 76.24% Control group: 67.28% ($p = 0.039$)
Author: Du et al. ^[22] Year: 2011 Country: China	Frequency of MTB: NA Attendees in MTB: NA Patient selection: Patients referred or treated at institute	Age median: 55 y Sex: NT: Male, 56.44% Control: Male, 54.32% Type: GI cancer Stage: TNM stage (T3N0–AnyTN2)	Type of study: Retrospective cohort Single/multicenter: Single center	Time of follow-up: 5 y Percentage: 87.8	Overall, 5-y survival: MTB group: 77.23% Control group: 69.75%, ($p = 0.049$) Disease-free 5 y survival: MTB group: 76.24% Control group: 67.28% ($p = 0.039$)

Table 1.—Continued.

Study Details	Definition of MTB	Population Characteristics	Methodology	Follow-Up	Results
Author: Palmer et al. ^[21] Year: 2011 Country: Sweden	Frequency of MTB: NA Attendees in MTB: NA Patient selection: Patients from the Stockholm-Gotland region who were reported to have rectal cancer	Age median: 71 y Sex: Male, 54.46% Type: Locally advanced primary rectal cancer Stage: Image-based staging: TNM (T1–4, N0–2, M0–1) Histopathology staging: TNMR (T0 and T2–4, N0–2 and NX, M0–1, R0–2)	Type of study: Retrospective cohort Single/multicenter: Multicenter	Time of follow-up: 7-y Percentage: 100	Overall, 5-y survival: Group 1: 30% Group 2: 28% Group 3: 12%
Author: Wille-Jørgensen et al. ^[18] Year: 2012 Country: Denmark	Frequency of MTB: Weekly Attendees in MTB: Surgeons, oncologists, radiologists, pathologists, clinical physiologists Patient selection: Patients were selected from the Danish Cancer Registry	Age mean: Pre-MTB: 71 y Post-MTB: 70 y Sex: Female Pre-MTB: 222 Post-MTB: 151 Male: Pre-MTB: 245 Post-MTB: 193 Type: Rectal Stage: I–IV and stage unknown	Type of study: Retrospective cohort Single/multicenter: Multicenter	Time of follow-up: NA Percentage: NA	Overall, 5-y survival: Pre-MTB: 42% Post-MTB: 40% (<i>p</i> = 0.33)

GI, gastrointestinal; MTB, multidisciplinary tumor board; NA, not available; NMTB, non-multidisciplinary tumor board; TNM, tumor, node, metastasis

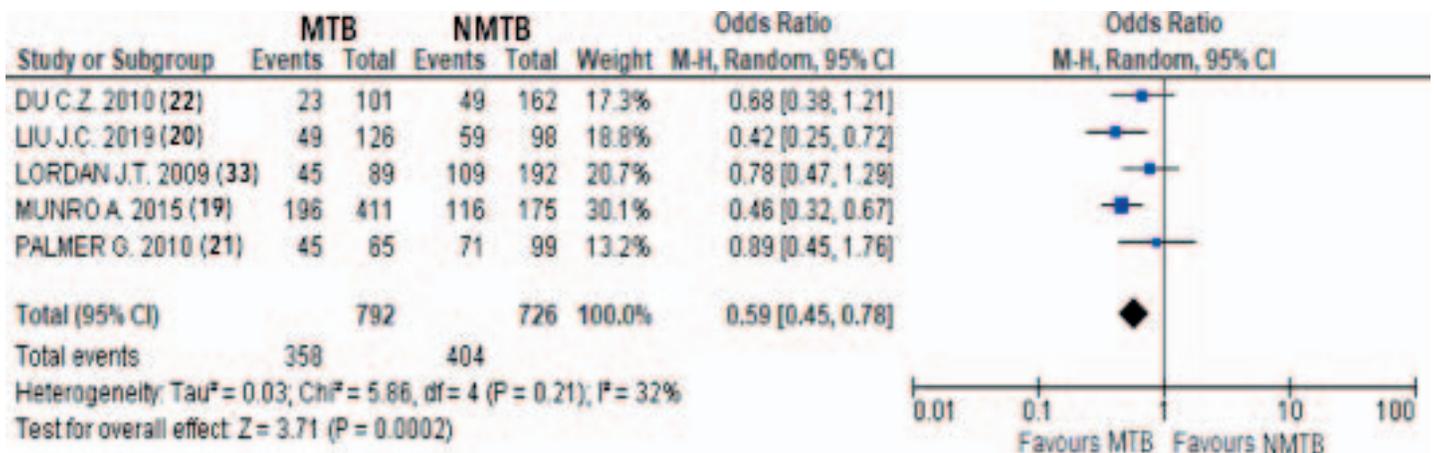


Figure 2.—Individual and pooled odds ratio and 95% CI for 5-year mortality, with forest plot. The squares represent the effect estimate of the individual studies and the horizontal lines indicate the confidence interval; the dimension of the square reflects the weight of each study. The diamond represents the summary point estimate is usually represented with a diamond at the bottom of the graph with the horizontal extremities indicating the confidence interval. MTB, multidisciplinary tumor board; NMTB, non-multidisciplinary tumor board.

obvious outlier compared with the remaining studies and its exclusion led to a substantial reduction in heterogeneity. It is, however, still included in Table 1 as it meets the inclusion criteria.

The heterogeneity index I^2 value indicates that only 32% of the total variation in study estimates was due to heterogeneity (i.e., between-study variability), representing only moderate heterogeneity level.

DISCUSSION

The findings of this meta-analysis from five peer-reviewed papers confirm that discussing oncology patients in MTB meetings leads to a significantly improved 5-year survival in comparison to a control group (OR of 5-year death rate 0.59, CI: 0.45–0.78.) Two studies reported a hazard ratio after adjusting for age, sex, stage, tumor site, grade, socioeconomic deprivation, and comorbidity as 0.72 (95% CI 0.56–0.92; $p = 0.009$)^[19] and 0.94 ($p = .032$).^[20] Although impact on patient management and outcomes have been demonstrated in previously published systemic reviews,^[7,16] no correlation between MTB discussion and 5-year survival has ever been established.

The studies we have included highlight the positive impact of MTB on both disease-oriented and patient-specific outcomes, which could explain the better survival outcome. Palmer et al^[21] found that the incidence of R0 resection differed significantly between the groups (52% MTB vs 43% NMTB; $p < 0.001$). This is in addition to the finding that the local recurrence rate was less in the cohort group (3.96% vs 11.11%, $p < 0.05$). Du et al^[22] reported that the treatment strategy was changed after a MTB discussion in 76.81% of gastric cases and in 58.33% of colorectal cases. For example, cases that were initially labeled as inoperable liver metastasis underwent radical resection after MTB discus-

sion. They also reported that the sphincter preservation and local control of tumors were better in patients allocated to the MTB group than in the control group. In addition, they demonstrated that patients discussed in MTB meetings were more likely to receive neoadjuvant chemotherapy. Finally, they discovered that magnetic resonance imaging was more frequently used in the MTB group than in the control group (60.4% vs 40.7%, $p < 0.05$), while computed tomography was more commonly used in the control group.

Other benefits of the MTB have also been reported in the literature. These benefits reported, could further explain the positive impact of MTB on disease- and patient-specific outcomes. A study on esophageal cancer MTB demonstrated a shorter time interval from diagnosis to the initiation of treatment, with an average of an 11-day difference (27 vs 16; $p < 0.0001$).^[23] This time difference was particularly notable for palliative care referral and receiving palliative chemotherapy (60 vs 44 days; $p = 0.03$).^[24] In addition, MTB teamwork may facilitate better adherence to evidence-based guidelines.^[14] In a study on colorectal cancer MTB, discussed cases underwent complete staging studies and had treatment in keeping with established guidelines, increasing compliance from 83% to 98% ($p < 0.0001$).^[25] Similar results were established from lung and esophageal cancer cases discussed in MTBs.^[23,26] The frequency of preoperative magnetic resonance imaging scans increased in the MTB cohort and perioperative mortality decreased.^[18] An indirect cause of the previously mentioned benefits could be the higher level of expertise of the clinicians and teams attending the MTB meetings, facilitating improved implementation of evidence-based medicine.^[27] Patient experience was better as well; in MTBs with palliative care specialized members, better control of pain was reported, an especially important outcome for patients.^[28] Finally, breast cancer and

hepatocellular carcinoma patients reported increased satisfaction with the care provided when treated in a multidisciplinary setting.^[29,30]

Some of the reasons why our meta-analysis found a significant impact on survival, which previous systemic reviews did not could be possibly due to increase in the amount of published data in recent years on tumors boards, as the concept of multidisciplinary cancer care has been gaining more attention. In addition, opposed to previous systemic reviews, studies that included multidisciplinary clinics were excluded to unify the definition of MTB. Studies that did not include a comparison group were also excluded to assess the effect of MTB meetings carefully.

A limitation of our meta-analysis is the relatively small sample size. There is an urgent need for studies of larger sample size and longer follow-up to clarify the real impact of MTB on survival in cancer patients. It is also important to note observational studies and before–after series are prone to bias as it is challenging to isolate the influence of multidisciplinary care and confounders from concurrent changes in cancer care, such as advances in treatment modalities during the period of the study. However, the logistics of establishing a randomized clinical trial comparing MTB working with non-MTB working would be taxing, and because having an MTB is both common, and in many cases mandated, such a study is highly unlikely to be performed. Further studies should furthermore consider the challenges of MTB implantation, such as the large financial spending MTB meetings entails. The costs could reach a total weekly time expenditure of 16.5 hours and \$2035 weekly, \$190 per case.^[31]

The benefit of MTB meetings for patient survival has been demonstrated in studies on various populations, including breast and lung cancer. However, the studies that met the criteria for the meta-analysis to represent the strongest available evidence were predominantly colon cancer patients. Other challenges include scarcity of data on MTB effect on other types of cancer, especially more rare types of cancers (such as Ewing's sarcoma), which will benefit from the condensed expertise offered at MTB meetings and the lack of a standardized definition of MTB.^[7,32] Finally, impact of MTB meetings on patient satisfaction and quality of life as well as rates of cross-referral between disciplines deserve to be looked into to overall improve the care provided and for a wholesome approach.

The results of this meta-analysis support that the use of MTB meetings improve 5-year survival in cancer patients. Further larger studies that comprehensively evaluate the impact of MTB meetings in more diverse patient populations and further delineate reasons for improvement of outcome and an investigation into the other components of MTB, such as feasibility, practicality, and cost are warranted to enhance the benefits of this approach.

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