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"Ruolo dei Tumor Board virtuali nella gestione dei pazienti oncologici in Sicilia"

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Abstract

Introduction: Virtual Multidisciplinary Tumor Boards (VMTBs) facilitate multidisciplinary cancer care and could be essential to reinforce oncological networks especially in a vast geographical area like Sicily. Moreover, the Covid-19 pandemic has altered the way of approaching the patient and virtual meetings helped to avoid interpersonal contact and, on the other side, to optimize the clinical information flows within the regional healthcare network. This pilot observational study assessed the feasibility and acceptance of using telemedicine to implement a cloud-based virtual tumor board program within Sicily.

Patients and Methods: The VMTB program was implemented through a cloud-based platform (Navify, Roche; Basel, Switzerland). Feasibility, acceptability, and suitability were assessed via validated survey (1–5-point Likert scale), administered to 72 VMTB participants. The *Secondary Endpoints* included the preliminary data on VMTB meetings utilization and the effectiveness in providing access to quality and equitable cancer care including timely and appropriate multidisciplinary evaluation.

Results: Overall, 365 patients were referred to the virtual conferences over an 18-month observation period. Nearly the 48% of cases came from general hospitals and tertiary centers, the 35% were referred from the comprehensive cancer centers and the 17% were referred form the teaching hospitals. Three cancer groups were formed: Prostate Cancer Group (PCG), Gynecological Cancer Group (GCG) and Lung Cancer Group (LCG). The majority of participants (96%) assumed, through the survey, that the VMTB could eliminate the geographical barriers and could improve the equity of care. Most of the prostate cancer patients had a stage III (45%) and IV (34%) of disease, while most Gynecological cancer patients and lung cancer patients had a stage III and IV of disease. The more discussed topics in the PCG, the GCG and the LCG were radiology findings followed by the medical treatment in the PCG and GCG, and the surgical treatment in the LCG. In the PCG, GCG and LCG respectively the 71%, 68% and 64% of the clinical cases discussed had no change in the diagnostic-therapeutic work-up after the virtual conferences. All

the final recommendations electronically voted at the end of each meeting were controlled for adherence to the guidelines; the appropriateness of the VMTB assessment was of 98%. The majority of VMTB meetings (80%) were presented in a timely fashion; mean time from the consult request to the clinical case discussion was 7.3 business days.

Conclusion: VMTB's development is feasible and highly accepted by its participants. However, virtual conferences cannot necessarily replace traditional meetings because the VTBMs have still to overcome many barriers. Future studies should focus on widespread implementation and validating the effectiveness of this model.

Summary

The COVID-19 pandemic has changed the way of approaching the cancer patients, therefore telemedicine has begun necessary to facilitate the clinical information flows and the cancer patient care.

A multimodality treatment of a cancer patient mean that multiple healthcare professionals are involved in the decision-making process; tumor boards are multidisciplinary team meetings in which different specialists work together sharing clinical decisions in cancer care. Implementation of Multidisciplinary Tumor Boards (MTBs) depends on many factors like the presence various specialists on-site. During the pandemic, telemedicine has helped to avoid interpersonal contact and to assure to cancer patients a rapid and equitable cancer treatment.

The aim of this observational study was to develop the web-based Virtual Tumor Board Meetings within the Sicilian regional healthcare network. Primary goals of this project were the evaluation of the feasibility and the acceptance among the participants. Secondary endpoints concerned the preliminary data on Virtual Tumor Board utilization and its effectiveness in providing access to quality and equitable cancer care including timely and appropriate multidisciplinary evaluation.

Over an 18-month period, 365 clinical cases were discussed, 72 professional healthcare and 32 Healthcare institutions were involved in the program. A case manager/coordinator was responsible for planning the virtual meetings that were held once/twice a week according to the specialists' need. The case manager also managed a specifically designed cloud-based platform that was able to geolocate clinical trials and to check the recommendation adherence to specific guidelines.

Feasibility, acceptability and suitability were evaluated through a validated survey (1-5 point Likert Scale). The majority of participants (96%) highly accepted the program, assuming that it was helpful to eliminate geographical barriers optimizing the clinical information flows and improving patients' equity of care within Sicily.

At the end of each meeting, the electronically voted recommendations by the participants were checked for appropriateness with the specific pathology guidelines: the 98% of the proposals had an appropriate multidisciplinary assessment. The timely evaluation was defined as clinical case presentation within 14 days of consult request. The majority of clinical cases (80%) were presented in a timely fashion: mean time from consult request to case discussion was 7.3 business days.

From July 2020 to March 2022 three multidisciplinary groups were formed: *Prostate Cancer Group(PCG), Gynecological Cancer Group(GCG), and Lung Cancer Group(LCG).* Radiology findings were the most frequent primary reasons for clinical case presentations among the three

working groups. After the virtual conferences in the *Prostate Cancer Group, Gynecological Cancer Group, and Lung Cancer Group* respectively the 71%, the 68% and the 64% of the clinical cases discussed had no change in the diagnostic-therapeutic work-up initially proposed by the physician in charge.

The results of this project reported the Virtual Multidisciplinary Tumor Board (VMTB) effectiveness in providing access to quality and equitable cancer care including timely and appropriate multidisciplinary evaluation. Additionally, VMTBs also had some educational aspects since upskilling nonspecialist oncologists and trainees had a chance to take part to the meetings and/or presenting the clinical cases.

In conclusion, VMTB's development is feasible and highly accepted by its participants. However, virtual conferences cannot necessarily replace traditional meetings because the VTBMs have still to overcome many barriers. Future studies should focus on widespread implementation and validating the effectiveness of this model.

“The great victory, which appears so simple today, was the result of a series of small victories that went unnoticed.”

(“The Warrior of Light” P. Coelho)

Dedicated to all the Warriors of Light I’ve met in my route.

CHAPTER 1

Background, Rationale and Objectives

Multidisciplinary Tumor Boards (MTB) play a pivotal role in the patient-centered clinical management, to date, they are increasingly used to achieve high-quality treatment recommendations across health-care regions.

The need of a Virtual Tumor Board (vTB) is born to overcome geographical barriers and to implement a network among health professionals and institutions to optimize patient management in a patient centered approach. This need is stronger than ever during the COVID-19 pandemic.

A *Multidisciplinary Team* (MDT) is a team composed of professionals from different clinical specialties who work together to make decisions about the recommended clinical pathway of an individual patient. The UK has been the first State to introduce MDT in the 1990s and the publication of the Calman-Hile plan in 1995 gave more strength to this kind of organization. This plan was focused on UK's cancer services to ensure patients with cancer a high and uniform standard of care, no matter where they might live (1).

An MTB includes many specialists cooperating in the same setting, such as gynecological surgeons/Thoracic surgeons/urologists, oncologists, radiation therapists, molecular biologists, pathologists, radiologists. Sometimes there is the need of an extended board that could include nuclear medicine specialists, nutritionists, research nurses.

It has been described that MTB impact on cancer care is positive: an umbrella review by ML Specchia et al. has reported that the multidisciplinary approach is the best way to deliver the complex cancer care needed by patients. The main findings on their research were that MTB led to changes in diagnosis (a more accurate assessment and staging), treatment (usually more appropriate, more enrollment in clinical trials) (2).

1.1 Board Virtualization and Telemedicine

The COVID-19 pandemic has changed the way of approaching the cancer patient and face to face meetings have become more difficult to plan. Telemedicine has helped clinicians to communicate and has avoided any delay in modifying care coordination in this time of crisis. Virtual Tumor Boards (vTB) has improved the collaboration between providers across geographic locations and institutions giving proper allocation of health care resources and reducing time wasted for travel and related expenses. Face to Face meetings remain an important way of communication between clinicians even if the arrival of the virtualization has overcome many issues (figure 1) (3). The University of Pittsburgh has experienced that meeting virtualization allowed an efficient communication between all the participants independently of the current pandemic state and if the organization was well structured, these virtual meetings created a unique network between high-volume academic institutions, general hospitals and multiple satellites and community hospitals (4). In the USA the DUKE Cancer Center Network developed a secure web-based platform aimed to connect a rural community and small hospitals with a university-based cancer center, this has allowed a faster patient evaluation from the clinicians (5).

1.2 Impact on Clinical Outcomes

The Virtualization of the meetings may also improve the clinical outcomes: many evidences suggest this above mentioned aspect. Specchia et al. reported on their umbrella review that tumor boards impact on all types of cancer (2). Australian researchers recently published a review reporting current evidence for Lung Cancer-MDT data collection and analysis of the impact on clinical outcome. The authors identified: 13 studies on Lung Cancer MDT, more specifically 3 studies also comprised other kind tumors. The authors found that eleven studies measured the effect of MDT discussion on clinical outcomes and eight of them were positive. The DATA sources included MDT records, medical and hospital records, and institutional registries (6). In 2001 a single institution study in the USA reported changes in the pretreatment evaluation, diagnosis, and treatment plans in 20-50% of cases (breast cancers for the most) (7). In 2007, the French Groupe d' Oncologie Thoracique Azure ´en carried out a 1-year prospective study on 334 patients discussed during its

multidisciplinary weekly meetings showing a 4.4% therapeutic discordance between the planned and the administered treatment (8). In this series of patients, median delay of treatment was 20 days, and the overall 1-year survival rate was lower for patients with MTD discordance with no statistical significance. A study carried out in Australia on 988 LC patients registered in the cancer registry before 2011 showed how MTD discussion produced a significantly better receipt of radiotherapy among non-small-cell lung cancer (NSCLC) patients with any stage (66 vs. 33%, p\0.001) and had significantly better receipt of chemotherapy among patients with stage IV NSCLC (46 vs. 29%, p\0.001) and palliative care (66 vs. 53%, p\0.001) as compared to patients without MDT discussion (9). A logistic regression analysis identified MDT discussion as an independent predictor of receiving radiotherapy, chemotherapy, and referral to palliative care but did not influence survival. In 2012, a retrospective and comparative scientific report showed that in the UK, the introduction of multidisciplinary care was associated with improved overall survival and reduced variation in survival data in various hospitals with MTB compared to the hospitals without such implementation (10). In 2015, investigators at the MD Anderson Cancer Center and the Dana-Farber Cancer Institute published a survey on 1198 physicians to explore lung cancer-MTB participation associations with patient survival and rate of clinical trial enrollment guideline-recommended care, and patient-reported quality (11). This paper showed that physician engagement in MTB was associated with higher patient clinical trial participation and higher curative-intent surgery rates for stage I-II NSCLC but not with overall survival. In the same year, a national cohort study in Taiwan showed that the adjusted hazard ratio of death of stage III and IV NSCLC patients discussed at MDT was significantly lower at multivariate Cox proportional hazards model than that of patients without MDT discussion (HR = 0.87, 95% confidence interval = 0.84–0.90) (12). Data were also analyzed for the propensity score as a control variable to reduce selection bias between patients with and without MDT care involvement. In 2018, an Australian cohort study included 1197 cases discussed prospectively at MTB and analyzed for adjusted survival and referral to palliative care (13). Survival of patients discussed at MTD was higher for all stages, but IIIB as compared to patients not discussed, but referral to palliative care was not different. Overall adjusted survival analysis for the entire cohort showed improved survival at 5 years for patients discussed at MDT (HR 0.7, range, 0.58–0.85, p\0.001). However, the MTD group had a lower stage IV percentage (39.3 vs. 56.1%) and a higher proportion of early-stage disease (stage I, 23.1 vs. 9.7%, and stage II, 10.2 vs. 4.8%, stage IIIA, 14.6 vs. 6.3%). In 2018, a

retrospective propensity score analysis was performed on 246 consecutive Italian patients who underwent surgery for NSCLC before or after implementing an MTB (14). Patients discussed at the MTB showed more complete staging, better TNM classification, and a longer 1-year survival rate when compared to those who were not discussed at the MTB. In 2020, a German matched-pair analysis showed a positive impact of a higher number of multidisciplinary tumor boards on the clinical outcome (15). Patients discussed at 3 MDT meetings had a significantly better overall survival than patients never discussed. In the same year, researchers in Taiwan carried out a retrospective study on 500 patients with stage III NSCLC to evaluate MTB's impact on survival. The median survival of patients discussed at MDT was statically longer than that of control patients (41.2 vs. 25.7 months; $p = 0.018$) (16).

1.3 Barriers and Facilitators

Funding and health care sources are needed for the implementation of MTBs, these limitations may negatively influence the use of MDTs, and these factors may differ among different countries. Researchers at New South Wales, Australia, recently reported an exhaustive review on evidence-practice gaps in Lung Cancer-MDT implementation. Several pitfalls have been identified and grouped according to the following issues: patient, team, health service, and health system. Research and evaluation gaps comprised the lack of control condition, variation in definitions, and outcome measures. These gaps also included barriers to start pragmatic trials as a consequence of sample size and heterogeneity of MDTs. Patient-related gaps included insufficient patient-centered discussion, and a lack of patient evaluation of MDT meetings. Among MTB team-related pitfalls were difficulties in reaching consensus, variation in patient selection for team review, educational value, and communication within meetings. Health service and system gaps included quality outcomes and lack of cost data. Health professionals react positively to MDT participation and report various advantages from such strategy, but they also define areas for improvement, e.g., access to complete information and clearly identified roles for the different health professionals (17). Klarenbeek SE et al explored the barriers and the facilitators for implementing Computerized Clinical Decision Support systems (CCDSs) in managing lung cancer cases among 26 various health care professionals involved in MTBs. Easy access to well-structured patient data, reduction of time

needed to prepare cases, and MTD duration were primary facilitators for the use of CCDSs. The main barriers for adoption were incomplete or non-trustworthy output generated by the system and low capacity of MDT to adapt to local and contextual needs. Successful implementation depended on the reliability and adaptability of the CCDSs and key users' involvement in the implementation process (18). A Swedish qualitative work was aimed to analyze the views on enabling and impeding factors for multidisciplinary care of health professionals participating in a nationwide Virtual MTB on rare cancers. Investigators examined the free-text opinions to identify three thematic categories: decision-making, organization, and responsibilities (19). Data feedback of recommendations is another important issue. Stone et al. reported a mixed-method study on the clinical impact of modeled data feedback at a lung cancer MDT based on pre- and post-surveys and semi-structured interviews at three Australian cancer centers. Results demonstrated agreement if they reached 4 values on a five-point Likert scale. Most participants found modeled data easy to interpret, relevant to clinical practice and the MDT, and welcomed future regular data presentations (20).

1.4 Liability

Health professionals participating in vMTB may undergo medico-legal obligations, including patient consent, privacy, professional liability, reporting dissenting views, and duty of care. Compliance with laws and regulations for data transfer and need for confidentiality agreements are mandatory. Most vMTBs employ a video platform that provides a secure website coupled with a secure teleconference platform to ensure patient confidentiality. Although evidence to formulate legal recommendations is scarce, authors identify the formative evidence that may guide the management of these issues in future MDTs (21).

1.5 Technology in the MDT

The achievement of an accurate diagnosis and timely delivery of care demands high-quality MDT collaboration and coordination among participants. Computed clinical decision support systems (CDSSs) are significant technological progress and an integral component of today's health information technologies (22). They assist health professionals with interpretation, diagnosis, staging, and treatment. A CDSS can be embedded throughout the patient safety continuum providing reminders,

recommendations, and alerts to health care providers. Although CDSSs may reduce medical errors and improve patient outcomes, they have fallen short of their full potential. User acceptance has been identified as one of the potential reasons for this shortfall. Investigators at the University of North Carolina at Chapel Hill, USA, reported a critical analysis of health professional barriers to the adoption of computed clinical decision support systems (23). Health professional non-acceptation of CDSS was the main barrier to technology implementation, with a possible negative effect on patients' health and well-being. The incorporation of CDSSs based on user needs/expectations in the assistance-engage model may improve the tool's use. Using CCDSs, MTBs may increase the efficiency of workflows supporting participants in elaborating a shared conceptual workflow of a patient case. CCDSs may help the MTB to evaluate the completeness of collected diagnostic data, stratification for the right personalized therapy according to the clinical and radiological stage and other treatment-influencing factors and adapt care management strategies when needed. CDSSs have not been currently included in the MTB decision-making workflow, which hampers their clinical practice impact.

1.6 Virtual Tumor Boards: a network experience in Sicily

The Covid-19 pandemic has altered the way of approaching the patient also for some limitations with clinical resources. Therefore, a multidisciplinary care consultation has become more difficult. In this situation, a patient with cancer would receive a multidisciplinary consultation within several weeks. As above stated, a Virtual Multidisciplinary Tumor Board (VMTB) allowed the connection between large referral cancer centers and peripherical tertiary or community hospitals, and it could be essential to sustain oncological networks especially in a vast geographical area like Sicily.

The *purpose* of this work is to report the results of a prospective observational study "ONCONSENSUS" regarding the cloud-based implementation of Virtual Multidisciplinary Tumor Boards in Sicily from July 2020 to March 2022.

The *primary endpoints* of this study were the feasibility, acceptability and suitability of VMTB program implementation within a regional healthcare network and its acceptance from the participants.

The *Secondary Endpoints* included the preliminary data on VMTB meetings utilization and the effectiveness in providing access to quality and equitable cancer care including timely and appropriate multidisciplinary evaluation.

CHAPTER 2

Patients and Methods

Study Design.

This was a prospective observational study evaluating the implementation of a virtual tumor board program within a regional healthcare system and it was approved by the Ethics Committee of the University of Palermo [International Registered Report Identifier (IRRID): DERR1-10.2196/26220] in July 2020. This research was part of a larger 5-year observational study "Virtual clinical and precision medicine Tumor-boards cloud-based platform mediated implementation of multidisciplinary reviews among oncology centers in the covid-19 ERA" (25), based on Bowen's Framework (26) and focused on the implementation of multi-institutional VMTBs in Sicily.

The present study was aimed on implementing virtual meetings in the COVID-19 pandemic era and it included data concerning organization skills and pitfalls, barriers, efficiency, number, and types of the clinical cases discussed during the VMTB.

VMTB implementation framework

Oncology healthcare professionals from various subspecialties came from Oncology departments located in different hospitals: academic hospitals, tertiary centers, community hospitals.

The VMTB used an innovative, virtual and cloud-based platform to share anonymized medical data that were discussed via a video-conferencing system, having a Health Insurance Portability and Accountability Act-compliant online environment (Navify, Roche; Basel, Switzerland). This cloud-based platform allowed the geo-location of clinical trials and it also allowed to match

recommendations with updated guidelines: Associazione Italiana Oncologia Medica (AIOM), European Society for Medical Oncology (ESMO), National Comprehensive for Cancer Network (NCCN).

Project Structure

The observational study took place over an 18-month period. The *Core Group* was represented by the physicians who attended the virtual meetings and that belong to all the subspecialties: medical oncologists, radiation oncologists, urologists, gynecologists, molecular biologists, radiologists, nuclear medicine specialists, radiation oncologists, palliative care physicians. Residents and PhD students were also allowed to take part to the virtual meetings.

The cloud-based platform was managed by a trained *Case Manager*, who was also responsible for prospectively collecting the clinical cases referred from the physicians and for planning the virtual meetings.

Informed consent was administered to the patient before the clinical discussion, then the *case manager* anonymized the patient's records. The meeting's workflow (figure 2) included the submission of the clinical case referred by the physician in charge, the case manager / coordinator of the meeting was responsible for listing all the cases putting them in a password-protected "virtual room".

Virtual meetings were held at 6:30 pm once a week, in different days, according to the subspecialties. The frequency of the meeting also depended on the physicians' need. From July 2020 to March 2022 three multidisciplinary groups were formed: *Gynecological Cancer Group, Prostate Cancer Group and Lung Cancer Group.*

The clinical cases were presented with relevant pathological and radiological findings in order to obtain a valid final recommendation. At the end of each clinical case discussion, the web platform allowed an anonymous electronic vote on the core group's proposals; if the recommendation reached >75% of the votes, each patient's file was uploaded with the working group's final decision. The shared recommendations were stored and rediscussed if the working group needed a patient's follow-up.

The *core group* also constituted a Steering Committee, with the aim of promoting scientific research.

Patient's enrollment.

Patients with gynecological, prostate or lung cancer, > 18 years old, informed consent signed, were enrolled. Exclusions criteria were life expectancy fewer than 6 months, Easter Cooperative Oncology Group Performance Status (ECOG PS) >3 and absence of a signed informed consent.

The case presenters (physicians) were suggested to initially refer complex clinical cases that needed to be discuss in a multidisciplinary team, so the VMTB could be more functional.

Endpoints

The *primary endpoints* were the feasibility, acceptability and suitability of VMTB program implementation within a regional healthcare network. VMTB participants' acceptance was measured using validated surveys designed to examine satisfaction and confidence with each meeting, using a 5-point Likert scale in which higher scores represent more positive responses.

The *Secondary endpoints* included:

- preliminary data on the VMTB meetings program utilization

-the appropriate multidisciplinary evaluation, defined as match between all recommended and present cancer specialties for each corresponding cancer type according to guidelines: AIOM, ESMO and NCCN.

- the timely evaluation, defined as occurring within 2 weeks of initial consultation request.

CHAPTER 3

Results

The VMTB program took place in Sicily, the largest geographical region of Italy, with an area of 9,926 square miles (25,708 sq km) and 5 million inhabitants.
Three academic institutions, two public and three private comprehensive cancer centers plus many tertiary centers were involved in this clinical observational study (Figure 3).

Demand

The Investigators assessed the demand by recording the number of referrals to the program and the acceptance of those referrals to it.
In the study interval were held:

- 36 meetings of the *Prostate Cancer Group* (PCG), 126 patients were evaluated;
- 55 meetings of the *Gynecological Cancer Group* (GCG), 152 patients were evaluated;
- 33 meetings of the *Lung Cancer Group* (LCG), 87 patients were evaluated.

The median age for prostate cancer patients was 69 years (range=41-86 years), while the median age for gynecological cancer patients was 63 years (range=40-86) and the median age for lung cancer patients was 68 years (range=55-85 years).

Implementation of the VMTB

A crucial phase of this study was the creation of the Core Team (healthcare professionals) the intergroup communication and the interpersonal relations.
Before the establishment of the three Cancer Groups, preliminary virtual meetings were held to assess the will of an active participation to this program. The 80% of the physicians involved, accepted to take part to the project.
Overall, the VMTB program involved 32 Healthcare Institutions (HCIs) and 72

healthcare professionals (Figure 4). The HCIs that took part comprised three teaching hospitals, five cancer centers, eleven general hospitals and twelve tertiary centers. Nearly the 48% of cases came from general hospitals and tertiary centers, the 35% were referred from the comprehensive cancer centers and the 17% were referred from the teaching hospitals (Figure 5).

Feasibility, acceptability and suitability

Three months after the beginning of the program, a survey on the feasibility, acceptability and suitability was administered to all the core group (72 participants).

A 5-point Likert scale assessed the acceptance and the feasibility of the project. The survey was divided into five main sections*: the first one* included general information of the participants like their experience in multidisciplinary teams and the frequency of face-to-face tumor boards in their working place.

The last four sections pertained the feasibility, acceptability and suitability regarding: the optimizations of clinical information flows, the improvement of the equity of care, the enhancement of the collaboration among health care professional, the method standardization and the accuracy on data security, traceability, storage, and reuse. The electronic vote was considered as "approved" if it achieved at least the 75% of the participants' consensus. As shown in Table 1, the survey demonstrated that the majority of participants agreed to the items. Interestingly, the 96% of the participants reported that key advantages of the program were the elimination of the geographical barriers, assuming that the project was also cost- and time-saving.

Overview and performance of VMTB

The main baseline demographic and pathological characteristics of prostate, gynecological and lung cancer patients discussed, are depicted in Tables 2a, 2b and 2c. The majority of the prostate cancer patients had a stage III (45%) and IV (34%) of disease, while most Gynecological cancer patients and lung cancer patients had a stage III and IV of disease.

The primary reason for clinical case presentation is reported in table 3.

Figures 6a, 6b and 6c summarized the most significant clinical decisions taken during the virtual meeting of the three Multidisciplinary Groups.

In the PCG the 71% of the clinical cases discussed had no change in the diagnostic-therapeutic work-up, while the 29% had a change after the meetings, whereas in the GCG the 68% of the patients discussed during the meetings had no modifications in the initial diagnostic-therapeutic work up proposed by the physician in charge, the remaining 32% had a different final recommendation. In the LCG most of the patients, 64%, did not change the initial clinical decisions while for the 36% of them the diagnostic-therapeutic work up changed.

The most debate points in the PCG, the GCG and the LCG were radiology findings followed by the medical treatment in the PCG and GCG, and the surgical treatment in the LCG.

The cloud-based platform used for the virtual meetings was useful both to check that all the final recommendations were adherent to the guidelines (appropriateness) and to geo-locate clinical trials within the national territory. The appropriateness of the multidisciplinary assessment was high, since the 98% of the proposals approved matched the specific pathology guidelines (Table 4), while eleven patients were enrolled in some clinical trials.

The timely evaluation was defined as occurring within 2 weeks of initial consultation request. As summarized in Table 4, the majority of VMTB meetings (80%) were presented in a timely fashion; mean time from the consult request to the clinical case discussion was 7.3 business days.

CHAPTER 4

Discussion

The primary goal of this study was to evaluate whether the implementation of a virtual Multidisciplinary Tumor Board was feasible, suitable, and acceptable within the regional healthcare network. The vast majority of those surveyed reported that VMTBs could provide the same standard of care as face-to-face MDTs, particularly, this project could solve the crucial problem of the geographical barriers, assuring an improvement of the equity of care to Sicilian patients. Additionally, the effectiveness data we described, revealed timely and appropriate multidisciplinary assessment with the program.

The role of a Multidisciplinary team discussion in improving outcomes has already been reported in literature (27-30). It has been demonstrated that a Multidisciplinary treatment planning was associated with favorable effects on several indicators of cancer care quality, like the improvement of the diagnostic and therapeutic guidelines adherence, staging completeness and timeliness (27).

Telemedicine has been rapidly accepted during COVID-19 pandemic, becoming an integral part of health care delivery (28,29). Its use has been reported for respiratory diseases, diabetes, cardiovascular diseases (28-31), also, the switch from a real patient to a virtual one allowed to minimize the risk of exposure in immunocompromised cancer patients. Virtual Tumor Boards implementation is a very functional avenue in such situations for reaching many expert consultations within a national and regional healthcare system.

Our study focused on evaluating specific measures of feasibility, acceptance, and suitability; these aspects were critical for future dissemination and sustainability of the program. These measurements were subjectively determined by a validated survey and a 5-point Likert scale assessment. The vast majority of participants (95%) were highly satisfied of the project, reporting that this pilot study could

reduce geographical barriers in Sicily, allowing the optimization of clinical information flows and improving the equity of care for patients geographically far from highly specialized cancer centers. These results are similar to those reported by prior studies evaluating confidence and satisfaction of the participants. Specifically, Marshall et al. (32) described their experience of developing a regional virtual tumor board between the Houston Veterans Affairs Medical Center (VAMC) and the New Orleans VAMC. 14 virtual meetings were held over a 4-month period, a survey on satisfaction and confidence was administered to all the participants; the virtual tumor boards were highly accepted with positive scores for satisfaction and confidence and there were no meaningful differences compared with the regular (face-to-face) tumor boards. A pilot Study by Gagliardi et al (33) reported that the 75% of participants were satisfied with the virtual meetings and with its discussion and format.

Additionally, the results of our work shed light on the impact of virtual-case presentation during conferences. Even if the use of the VMTB was not practice-changing for all, the clinical case discussions nurtured collaboration among geographically dispersed colleagues, reinforcing the Sicilian Oncological Network. Our project had also some educational aspects since upskilling nonspecialist oncologists and trainees had a chance to take part to the meetings and/or presenting the clinical cases. Our experience supported the proposal that VMTBs could deliver continued medical education by promoting collegial interactions.

Our work also reported the effectiveness in providing access to quality and equitable cancer care including timely and appropriate multidisciplinary evaluation. The virtual Tumor Board cases successfully obtained multidisciplinary evaluation, even those that needed the presence of subspecialties normally absents during face-to-face meetings. The 98% of the final recommendations were appropriate since they matched the pathology guidelines. We also reported a timely evaluation of the clinical cases (80%) since the mean time from consult request to case presentation was of 7.3 days.

In conclusion, our pilot observational prospective study on cloud-based Virtual Tumor Board implementation “ONCONSENSUS” confirmed the feasibility and the acceptance among participants and the utility of VMTBs in our healthcare model to provide access to multidisciplinary expertise in cancer centers.

Additionally, we presented preliminary data on clinical effectiveness and utilization that may favor the VTBM use. This program is helpful to build regional networks and to reinforce the Sicilian Oncological Network, anyway further research is required to confirm our findings on larger scale.

VMTBs offer undeniable advantages and solve many issues in terms of costs and time compared to traditional, face-to-face meetings. During the COVID-19 pandemic this avenue was functional to reduce interpersonal contact and the spread of the virus. However, virtual conferences cannot necessarily replace traditional meetings because the VMTBs have still to overcome many barriers.

Overall, this work presents encouraging results, and this model can be replicated in situations where multidisciplinary decision making is crucial.

CHAPTER 5

Tables and Figures

Criterion	Face-to-face MDT	Virtual Tumor Boards
Team	The members have already working relationships	Members sometimes do not know each other, trust and confidence may be difficult to establish, though members can take part to the meeting more easily if they are busy.
Attendance	The Leader can assess whether the relevant members are attending the meeting	Participation may be improved Reduction of time wasted to reach the coordinating center
Leader	The leader is known personally	Leader may change according to the specific task
Team Working	Tensions between the participants may be easily solved	The discussions may be less intense than in a face-to-face interaction
Scheduling	Meetings are usually scheduled at given day and time	Timing can be flexible, according to the need of the members
Personal growth and training	Good chances to improve intepersonal skills	Team members can interact with experts working far from their work places.

Figure 1. Comparison between traditional face-to-face multidisciplinary tumor boards and virtual tumor boards (3).

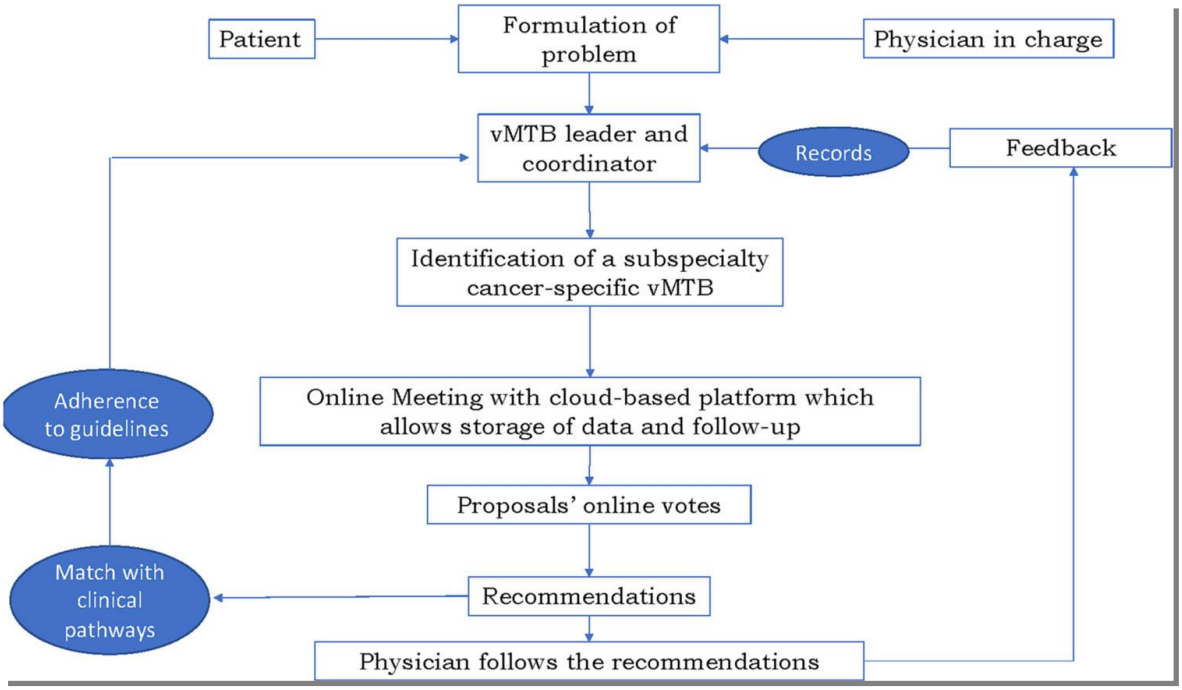

Figure 2. Workflow of our virtual multidisciplinary tumor board (3).

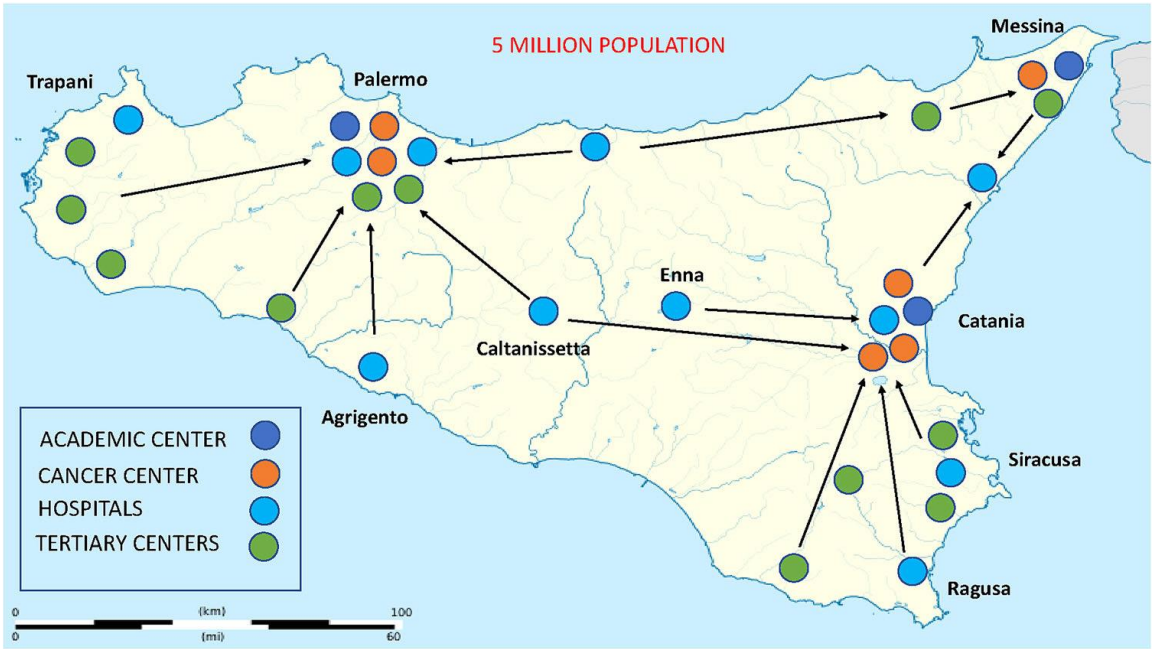

Figure 3. Map indicating cancer centers, academic hospitals, and tertiary centers participating in the network of the virtual multidisciplinary tumor board. Arrows indicate usual patient referral dynamics and bullets represent all centers with an oncology unit according to patients' volume and type of institution (3).

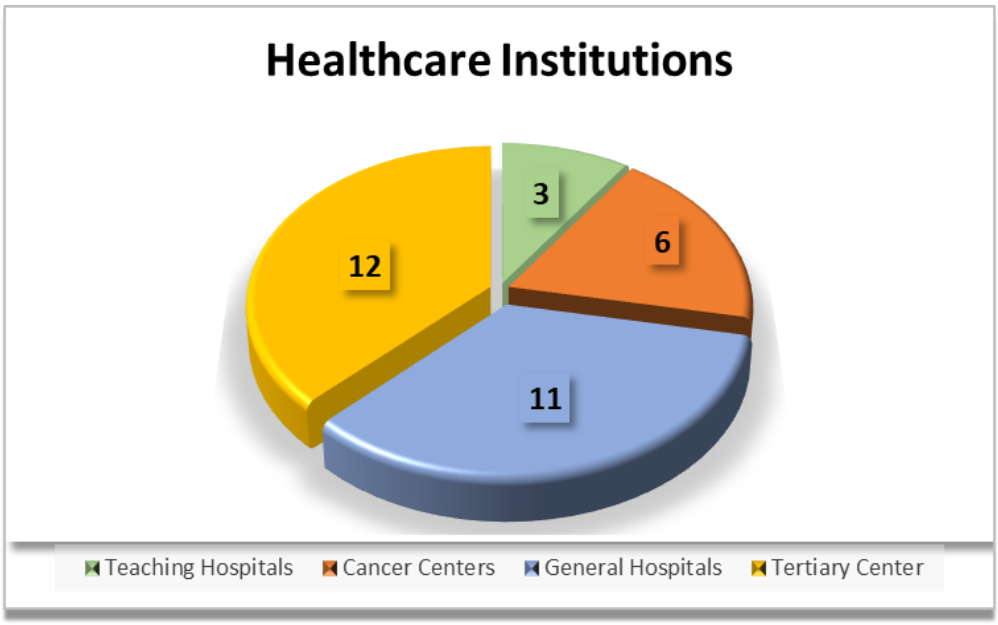

Figure 4. Healthcare Institutions' classification

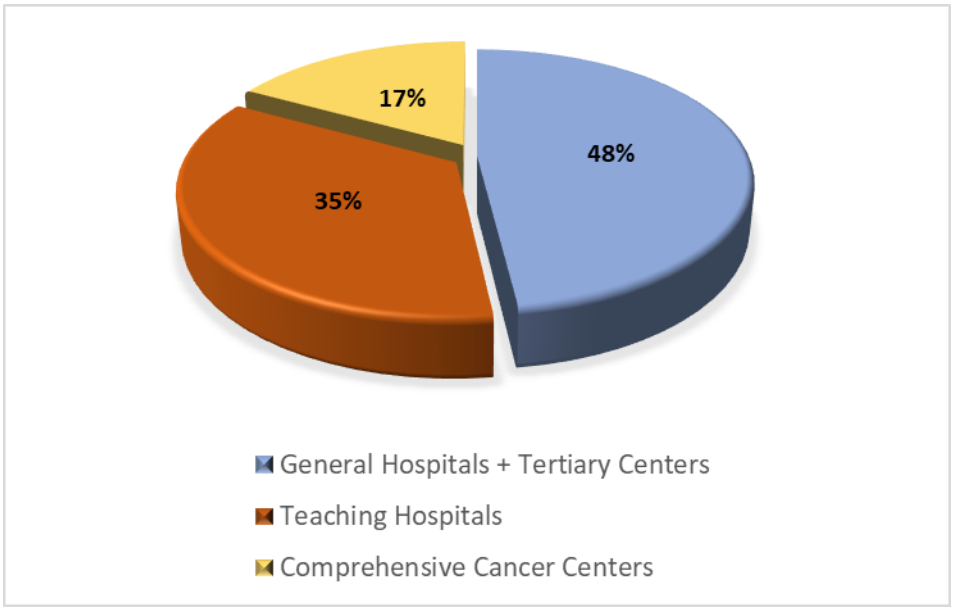

Figure 5. Percentage of the patients coming from the different HCIs

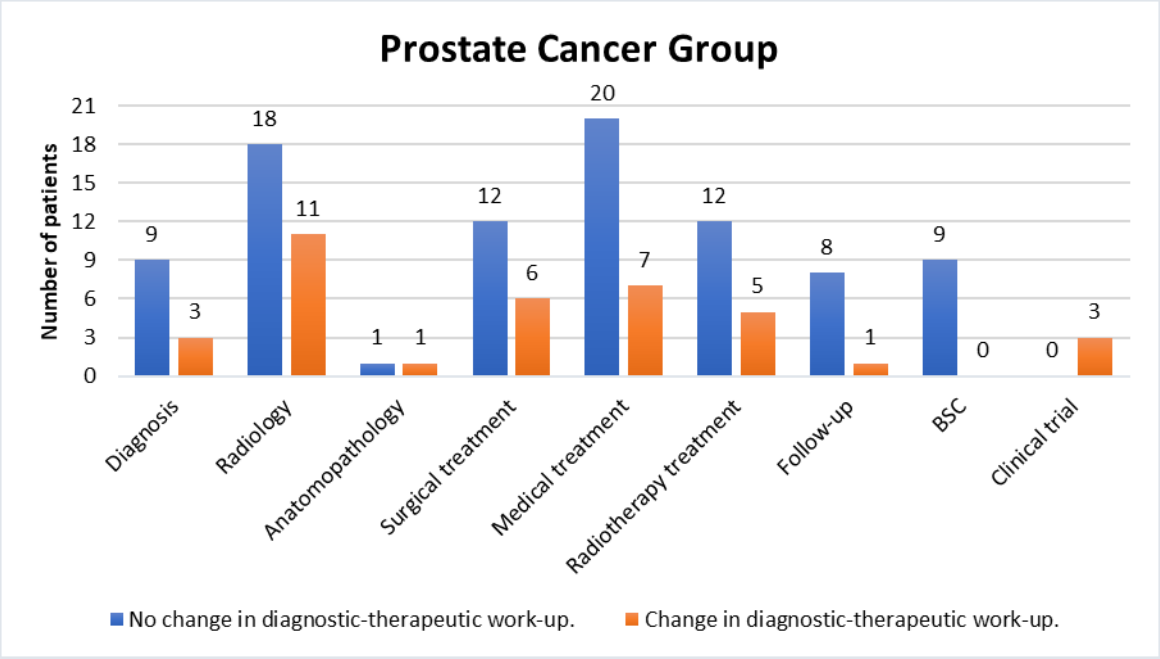

Figure 6a. Main decisions taken during the VMTBs of the PCG

BSC=Best Supportive Care

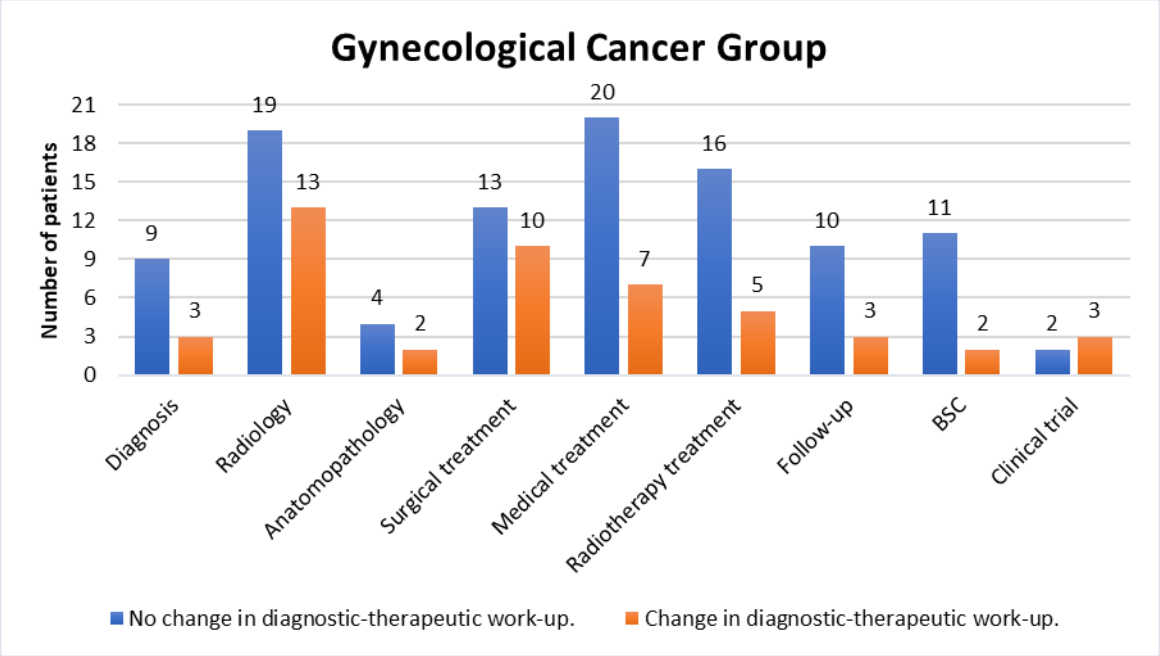

Figure 6b. Main decisions taken during the VMTBs of the GCG

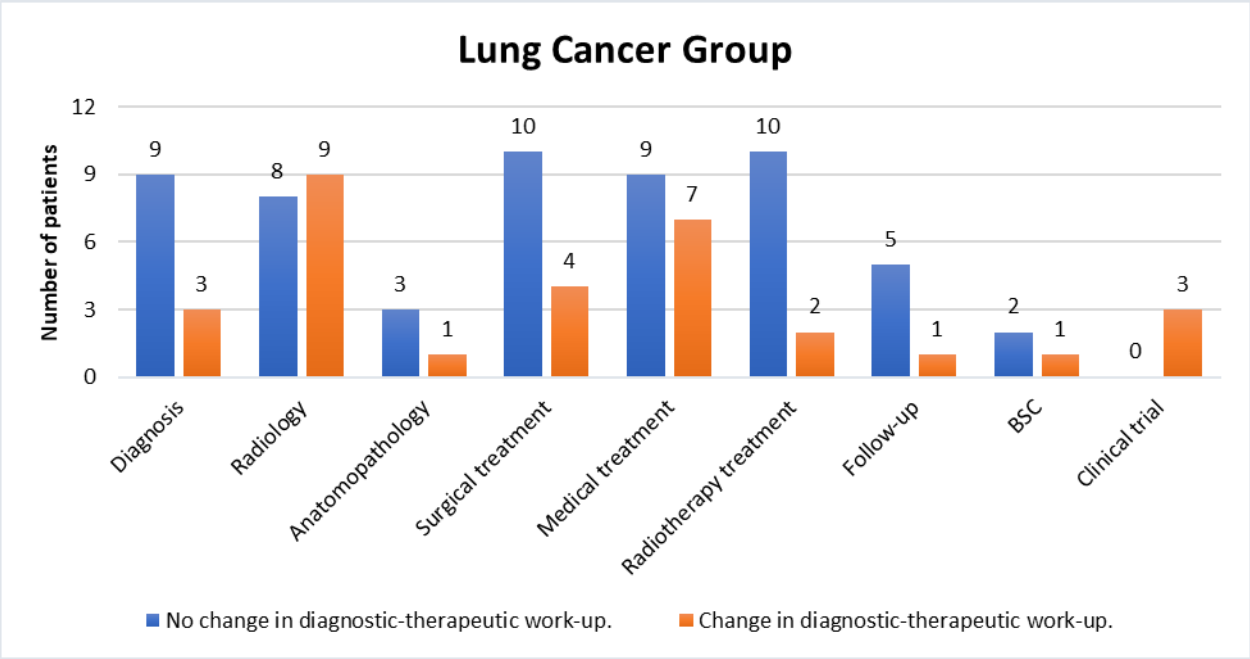

Figure 6c. Main decisions taken during the VMTBs of the LCG

Survey items	Agree	Disagree
Optimization of clinical information flows	91%	9%
Improved equity of care	96%	4%
Enhanced collaboration among health care professionals and method standardization	88%	12%
Accuracy on data security, traceability, storage, and reuse	87%	13%

Table 1. Survey results

Prostate Cancer (N=126)	
Mean age	69 Y (52-91)
Histopathology	
Adenocarcinoma	100%
Stage at multidisciplinary evaluation	
I	3 (2,4%)
II	24 (19%)
III	57 (45,2%)
IV	42 (33,3%)

Table 2a. Main baseline demographic and pathological characteristics of prostate cancer patients

Gynecological Cancer (N=152)	
Mean age	63 Y (40-86)
Histopathology	
Ovarian Serous Adenocarcinoma	62 (40,8%)
Endometrial Adenocarcinoma	58 (38,2%)
Cervical Squamous Cell Carcinoma	23 (15,1%)
Others	9 (5,9%)
Stage at multidisciplinary evaluation	
I	12 (7,9%)
II	25 (16,4%)
III	55 (36,2%)
IV	60 (39,5%)

Table 2b. Main baseline demographic and pathological characteristics of gynecological cancer patients

Lung Cancer (N=87)	
Mean age	68 Y (55-85)
Histopathology	
Non Small Cell Lung Cancer (NSCLC)	81 (93,1%)
Others	6 (6,9%)
Stage at multidisciplinary evaluation	
I	5 (5,7%)
II	15 (17,2%)
III	36 (41,4%)
IV	31 (35,6%)

Table 2c. Main baseline demographic and pathological characteristics of lung cancer patients

Primary reason for case presentation				
Clinical cases discussed	**Prostate Cancer**	**Gynecological Cancer**	**Lung Cancer**	**Total**
Diagnosis	12	12	12	**36 (10%)**
Radiology	29	32	17	**78 (21%)**
Anatomopathology	2	6	4	**12 (3%)**
Surgical treatment	18	23	14	**55 (15%)**
Medical treatment	27	27	16	**70 (19%)**
Radiotherapy treatment	17	21	12	**50 (14%)**
Follow-up	9	13	6	**28 (8%)**
BSC	9	13	3	**25 (7%)**
Clinical trial	3	5	3	**11 (3%)**
Total	**126**	**152**	**87**	**365**

Table 3. Primary reason for clinical case presentation at VMTB

Measure	VMTBs (N=124)
Mean duration of case presentation (minutes)	10,3
Mean time from consult request to case presentation (days)	7,3
Cases accomplishing appropriate multidisciplinary assessment	N=122 (98%)
Clinical cases with timely evaluation*	N=99 (80%)

* Timely evaluation was defined as clinical case presentation within 14 days of consult request

Table 4. Effectiveness of the virtual tumor board

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