A Review of Clinical Practice Guidelines and Treatment Recommendations for Cancer Care in the COVID-19 Pandemic

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Abstract: The COVID-19 pandemic has inevitably caused those involved in cancer care to change clinical practice in order to minimize the risk of infection while maintaining cancer treatment as a priority. General advice during the pandemic suggests that most patients continue with ongoing therapies or planned surgeries, while follow-up visits may instead be delayed until the resolution of the outbreak. We conducted a literature search using PubMed to identify articles published in English language that reported on care recommendations for cancer patients during the COVID-19 pandemic from its inception up to 1st June 2020, using the terms “(cancer or tumor) AND (COVID 19)”. Articles were selected for relevance and split into five categories: (1) personal recommendations of single or multiple authors, (2) recommendations of single authoritative centers, (3) recommendations of panels of experts or of multiple regional comprehensive centers, (4) recommendations of multicenter cooperative groups, (5) official guidelines or recommendations of health authorities. Of the 97 included studies, 10 were personal recommendations of single or multiple independent authors, 16 were practice recommendations of single authoritative cancer centers, 35 were recommendations provided...
by panel of experts or of multiple regional comprehensive centers, 19 were cooperative group position papers, and finally, 17 were official guidelines statements. The COVID-19 pandemic is a global emergency, and has rapidly modified our clinical practice. Delaying unnecessary treatment, minimizing toxicity, and identifying care priorities for surgery, radiotherapy, and systemic therapies must be viewed as basic priorities in the COVID-19 era.

**Keywords:** cancer; patients; treatment; COVID-19; pandemic

1. **Introduction**

Since the first report and identification of the responsible agent, the disease associated with the novel beta-coronavirus SARS-CoV2 (COVID-19) has spread globally, with an estimated 3.5 million cases and more than 20,000 deaths by end of April 2020. The explosion has been overwhelming, disrupting almost every healthcare system of involved countries and finding unprepared even those funded by robust economic resources. Healthcare professionals have suddenly seen the dawn of a completely new disease. COVID-19 has promptly been understood to be a “systemic disease” rather than a mere interstitial pneumonia.

Managing such a new clinical condition involves the challenge of dealing with both a lack of evidence and a lack of experience. However, unlike the previous HIV pandemic in the 80s, for the first time in the modern age we have had to face the problems of high volumes and an unprecedented rapidity of spread. Professionals from all specialties have suddenly found themselves being forced to become respiratory physicians, infectious disease specialists, and anesthetists; in this framework, the lack of knowledge in biology, epidemiology, pathophysiology, immune response, and treatment has highlighted the unmet need for uniformity and systematic review of current evidence.

Many national and international oncologic scientific societies have developed indications and guidelines for oncologists to follow in daily clinical practice. The aim of this review is to collect and discuss the current available guidelines and clinical practice recommendations for oncologists so far, as these professionals are faced with the challenge of continuing to deliver optimal care to cancer patients during the COVID-19 pandemic.

2. **Results**

2.1. **Personal Recommendations or Single Authoritative Center Statements**

Several local, national, and international recommendations for the management of cancer patients have emerged during the COVID-19 pandemic [1–16]. For example, there have been suggestions that surveillance should be delivered remotely for patients who have completed cancer treatment. In other cases, treatment might be deferred or completely avoided if the impact on quality of life is thought to be marginal. Only when treatment has a potentially curative role should it not be delayed. Examples are chemotherapy responsive tumors such as testicular, ovarian, and small cell lung cancers [4]. Moreover, a switch from intravenous to oral correspondent formulations (e.g., etoposide and vinorelbine) may be a valid indication [5]. Less intensive strategies are important especially in the cases of older and vulnerable patients. For example, in metastatic breast cancer patients, maintenance endocrine therapies after completing chemotherapy might represent a sound option in the elderly population. In general, older patients with cancer should not be systematically excluded from cancer treatments during COVID-19. However, it is worth noticing that, in case of COVID-19 infection and related complications during anticancer treatments, elderly patients are less likely to experience benefit from intensive unit admission and need for invasive mechanical ventilation highlighting the need for detailed upfront discussions about ceiling of care among oncologists, patients, and their families in this scenarios.
Not only medical treatment but also surgical indications for cancer patients have been influenced by the COVID-19 pandemic. The Massachusetts General Hospital has proposed a multidisciplinary approach for triage of resectable patients. Using a virtual conference modality, the team identified five different profiles of patients suitable for oncologic surgery in a 7–10 day time frame. In particular, patients in the window of resectability after preoperative chemotherapy and cancer types with aggressive behaviors (e.g., triple negative breast cancer) are prioritized. In addition, diagnostic surgeries, second parts of staged procedures (after completion of the first part), and interventions due to onset of acute symptoms (e.g., gastrointestinal bleeding) are considered urgent and non-delayable [6].

In colorectal cancer surgery, a minimally invasive approach was suggested, with the prioritization of cancer-related emergencies (to be treated within 2 weeks). Conversely, a deferral period of up to 2 months was proposed in the case of surgeries for curable tumors. In early-stage disease, surgery could be deferred even later than 2 months from diagnosis [7]. Similarly, surgery for early-stage lung cancer was promoted both in stages I and IIa disease, the former with a low risk of progression and of COVID-19 infection, the latter with a high risk of progression and a low risk of infection. However, for stage IIb disease (low risk of progression but high risk of COVID-19 infection), conservative management with a follow-up up to 3 months before potential surgery is advisable. Finally, stage III disease, with a high risk of progression and of COVID-19 infection, requires specific medical treatments [8]. Among non-surgical therapies in lung cancer, adjuvant chemotherapy after surgery may be delayed up to 4 months after surgery without affecting patient survival. Chemotherapy with adjuvant and maintenance intent may be postponed or switched to oral formulation, while oral targeted drugs for patients with sensitive gene mutations should be administered without combination chemotherapy in order to avoid adverse events. As far as immunotherapy is concerned, treatment with checkpoint inhibitors has low immunosuppressive potential and avoiding it during a coronavirus infection may unfairly deprive these patients of an active class of drugs. However, special consideration should be given to patients suffering from immune-related adverse events because of their prolonged exposition to immunosuppressive agents, such as steroids [9]. On the whole, immunotherapy may be suspended or postponed in the case of stable disease and, generally, there is no need to administer it regularly during the epidemic period [10]. In non-small cell lung cancer, neoadjuvant chemotherapy for locally advanced resectable disease and sequential or concurrent chemoradiotherapy for stage III disease should be started when possible. In the advanced stages, first-line treatment and palliative or ablative radiotherapy outside the lung should not be delayed, either. Similarly, in small-cell lung cancer, both concurrent chemoradiotherapy and first-line therapy are both indicated with palliative or curative purposes [11].

In addition to medical and surgical treatment, radiation treatment should also be omitted or shortened in times of COVID-19 infection. Breast cancer experts from the Memorial Sloan Kettering Cancer Center in New York suggested the omission of radiotherapy in the case of ductal carcinoma in situ, in patients aged 70 and older, and in the case of invasive estrogen-receptor positive disease smaller than 3 cm in size without nodal involvement and with negative resection margins. However, in the cases of ductal carcinoma in situ with lesions bigger than 2.5 cm, inadequate resection margins, or high-grade disease and in invasive estrogen-receptor positive tumors in younger patients, experts recommended a delay in treatment of 8–12 weeks after surgery. In general, hypofractionated or accelerated breast radiotherapy regimens are preferred in order to reduce treatment duration. High priority indications for breast radiotherapy are the diagnosis of inflammatory breast cancer and residual node positivity after neoadjuvant treatment, the presence of node-positive (N2) disease, recurrent disease, a diagnosis of triple negative node-positive disease, and extensive lymphovascular invasion [12].

In a pandemic phase with reduced availability of intensive/subintensive care beds, treatment strategies may prioritize medical treatment aimed at downstaging the disease until the peak of the pandemic has disappeared and the number of intensive care unit beds has increased. This approach is recommended in the treatment of ovarian cancer, where first-step surgery is preferred, especially in the
case of otherwise healthy patients. In these unprecedented times, indications may be inverted and neoadjuvant chemotherapy could become the standard of care [13].

Management of cancers of the head and neck during a COVID-19 infection is an important matter to discuss because of the multidisciplinary features of management of these cancers. Moreover, patients with tracheostomy or total laryngectomy have a high risk of virus aerosolization and require special attention in terms of strategies to minimize the risks of infection [14]. Treatment of low-risk tumors like differentiated thyroid cancer should be delayed, with minimally invasive and transoral surgical approaches preferred over open and major surgery [15]. In the case of concomitant chemoradiotherapy indication for locally advanced disease, medical treatment should be omitted for patients who have comorbidities or who are older than 70. Similarly, sequential treatment with cisplatin-based induction chemotherapy should not be administered for these patients. Exclusive and definitive radiotherapy should be limited to simultaneous integrated boost techniques in the standard or accelerated schedule, in order to reduce treatment duration to 1 week, shorter than the sequential technique. In the case of salivary gland tumors, it is indicated to delay post-operative radiotherapy up to 12 weeks after surgery [15].

2.2. Recommendations of Panels of Experts or Regional Cooperative Centers

Different groups of experts tried to provide recommendations at a regional or more general level. For example, by describing the approach used to manage patients with cancer during a large-scale, respiratory syndrome-coronavirus hospital outbreak in Saudi Arabia in 2015, the authors offered a plan to help manage oncology services to prevent harm to patients or staff [16]. The plan focused on managing oncology services, infected patients, preventing any new infections in patients or staff, ensuring the continuity of cancer care, and incorporating measures to sustain these interventions far into the postoutbreak period.

Similarly, authors from Iran provided recommendations in order to limit the exposure of cancer patients to medical environments and to modify the treatment modalities in a manner that reduces the probability of myelosuppression. Such recommendations include delaying elective diagnostic and therapeutic services, shortening the treatment course, or prolonging the interval between treatment courses [17]. Specific precautions to prevent virus spread among cancer patients and cancer care providers were also suggested by Indian authors who additionally provided a table of myths and misinformation about COVID-19. This Table 1, based on advice published by the WHO, proved useful in mitigating panic in cancer patients [18].
Table 1. Characteristics of included studies.

| Author/Year | Journal | Country | Type of Study | Disease | Synthesis of Main Recommendations |
|-------------|---------|---------|---------------|---------|-----------------------------------|
| Ansarin/2020 | Acta Otorhinolaryngol Ital | Italy | Personal view or multi-authors review | H&N | Recommendations about surgery and compromise between the necessary cancer treatments and the risk of infection |
| Banna/2020 | ESMO Open | Italy and Switzerland | Personal view or multi-authors review | Lung | A decisional tool to support oncologists and physicians in treatment for patients with lung cancer: primum non nocere |
| Cafarotti/2020 | J Thorac Oncol | Switzerland | Personal view or multi-authors review | Lung | An algorithm of care to balance the risk of dying from cancer or from potentially fatal infection |
| Di Saverio/2020 | Colorectal Dis | Italy | Personal view or multi-authors review | Colorectal | Management of patients needing surgery to mitigate some risks and reduce exposure to other patients |
| Falandry/2020 | J Geriatr Oncol | France | Personal view or multi-authors review | Various | Challenges with the management of older patients with cancer |
| Kattan/2020 | Immunotherapy | France and Lebanon | Personal view or multi-authors review | Various | A careful selection of the most efficacious anti-tumor weaponry with the lower risk of weaning the patients’ immune system |
| Mandato/2020 | Obstet Gynecol | Italy | Personal view or multi-authors review | Ovarian | Finding new effective strategies in cancer care is mandatory (allocate resources and real-life treatment) |
| Schrag/2020 | JAMA | US | Personal view or multi-authors review | Various | Planning for resuming cancer treatment and screening to mitigate harms; changes will transform cancer treatment |
| Scotté/2020 | Eur J Cancer | France | Personal view or multi-authors review | Various | Use of telemedicine for monitoring and optimizing referral of Covid-19-positive patients with cancer (CAPRI programme) |
| Zhao/2020 | Thorac Cancer | China | Personal view or multi-authors review | Lung | Recommendations and suggestions of individualized treatment strategies and management of common adverse events for patients with lung cancer |
| Braunstein/2020 | Adv Radiat Oncol | US | Single authoritative center view | Breast | The parsimonious application of breast radiotherapy without compromising long term oncologic outcomes |
| Davis/2020 | Immunotherapy | Australia | Single authoritative center view | Immunotherapy | Suggestions about immunotherapy use during pandemic |
| De Felice/2020 | Radiother Oncol | Italy | Single authoritative center view | H&N | To offer adequate individualized treatment recommendations based on both the epidemic situation and the patient’s own condition |
| Gentileschi/2020 | Eur J Surg Oncol | Italy | Single authoritative center view | Skin | Skin cancer management |
Table 1. Cont.

| Author/Year | Journal | Country | Type of Study | Disease | Synthesis of Main Recommendations |
|-------------|---------|---------|---------------|---------|----------------------------------|
| Kligerman/2020 | Head Neck | US and Hong Kong | Single authoritative center view | H&N | To help minimize the risk of aerosolization and SARS-CoV-2 exposures in head and neck cancer patients with tracheostomy and TL |
| Qadan/2020 | Ann Surg | US | Single authoritative center view | Various | A multidisciplinary team approach for triage of elective cancer surgery |
| Salari/2020 | Oral Oncol | Iran | Single authoritative center view | H&N | The role of virtual multidisciplinary team meetings |
| Tagliaferri/2020 | J Eur Acad Dermatol Venereol | Italy | Single authoritative center view | Skin | Management of skin cancers during COVID-19 era |
| Tasoulis/2020 | Eur J Surg Oncol | UK | Single authoritative center view | Breast | Position of The Royal Marsden regarding breast cancer surgery |
| Wang/2020 | JAMA Oncol | China | Single authoritative center view | Various | More attention should be paid to patients with cancer as a special population |
| Thompson/2020 | Ann Surg | USA | Single authoritative center view | Breast | Revised indication of neoadjuvant endocrine therapy for the treatment of early stage estrogen receptor positive breast cancer |
| Li/2020 | Leukemia | China | Single authoritative center view | Chronic myeloid leukemia | Questionnaires of subjects with chronic myeloid leukemia during COVID-19 pandemic |
| Sharma/2020 | Liver Int | UK | Single authoritative center view | Hepatocellular Cancer (HCC) | Recommendations for the treatment of HCC during COVID-19 pandemic |
| Yerramilli/2020 | Adv Radiat Oncol | USA | Single authoritative center view | Various | Use of hypofractionated radiation therapy for patients requiring palliation for oncologic emergencies |
| Valenza/2020 | Tumori | Italy | Single authoritative center view | Various | Screening of patients accessing to a Comprehensive Cancer Center with real-time PCR of nose-throat swabs |
| Viale/2020 | Oncologist | Italy | Single authoritative center view | Breast | Personalized strategies for optimal breast cancer management |
| Cakmak/2020 | Eur J Breast Health | Turkey | Panel of experts or regional recommendations | Breast | Recommendations about timing of surgery of breast cancer according to biology and risk |
| Carneiro/2020 | Int Braz J Urol | Brazil | Panel of experts or regional recommendations | Urologic | Suggestions and recommendations for the management of urological conditions in times of COVID-19 crisis in Brazil and other low- and middle-income countries |
| Cinar/2020 | J Natl Compr Canc Netw | US | Panel of experts or regional recommendations | Various | Strategies to mitigate transmission of COVID-19 in an effort to reduce morbidity and mortality associated with the disease for patients with cancer and for the healthcare workers |
| Author/Year          | Journal                   | Country     | Type of Study                                      | Disease | Synthesis of Main Recommendations                                                                                                                                 |
|---------------------|---------------------------|-------------|----------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Curigliano/2020     | Breast                    | International | Panel of experts or regional recommendations       | Breast  | Advise on how to triage, prioritize, and organize diagnostic procedures, surgical, radiation, and medical treatments in breast cancer                                                                 |
| Dietz/2020          | Breast Cancer Res Treat   | US          | Panel of experts or regional recommendations       | Breast  | Recommendations for prioritization, treatment and triage of breast cancer patients during the COVID-19 pandemic                                                                                     |
| Ficarra/2020        | Minerva Urol Nefrol       | Italy        | Panel of experts or regional recommendations       | Urologic| Strategies for the reorganization of urological routine practice and a set of recommendations to facilitate the process of rescheduling surgical activity                                            |
| Finley/2020         | Can J Surg                | Canada       | Panel of experts or regional recommendations       | Various | Recommendations about cancer surgery by Canadian surgeons                                                                                                                                       |
| Head and Neck Surgery Treatment Guidelines Consortium/2020 | Head Neck               | US          | Panel of experts or regional recommendations       | H&N     | It is important to have a robust mechanism to prioritize patients to ensure the provision of timely care while preventing further harm by guiding staff to provide care in safety                             |
| Jazieh/2020         | JCO Glob Oncol            | Saudi Arabia | Panel of experts or regional recommendations       | Various | Recommendation about CLL treatment by a CLL panel of experts                                                                                                                                 |
| Koffman/2020        | Am J Hematol              | US          | Panel of experts or regional recommendations       | CLL     | Procedures essential to maintain safety of otolaryngologists and maxillofacial surgeons exposed to the greatest risk of infection                                                                     |
| Kowalski/2020       | Head Neck                 | International | Panel of experts or regional recommendations       | H&N     | To adopt preventive measures and recommendations for patients, professionals, and clinical operations to minimize the risk of infection while safely treating cancer patients                              |
| Krengli/2020        | Adv Radiat Oncol          | Italy        | Panel of experts or regional recommendations       | Various | Risks must be balanced carefully, public health strategies implemented thoroughly, and resources utilized wisely                                                                               |
| Kutikov/2020        | Ann Intern Med            | US          | Panel of experts or regional recommendations       | Various | Recommendations to assist in prioritizing systemic therapies for patients with genitourinary cancers                                                                                               |
| Lalani/2020         | Can Urol Assoc J          | Canada       | Panel of experts or regional recommendations       | Genitourinary | Practical suggestions on how to implement cancer care during the COVID-19 outbreak                                                                                                             |
| Lambertini/2020     | ESMO Open                 | Italy        | Panel of experts or regional recommendations       | Various | An approach for the management of surgical patients in the context of the COVID-19 pandemic                                                                                                      |
| Liu/2020            | Indian J Surg             | International | Panel of experts or regional recommendations       | Various |                                                                                                                                                                                                 |

Table 1. Cont.
| Author/Year | Journal | Country | Type of Study | Disease | Synthesis of Main Recommendations |
|------------|---------|---------|--------------|---------|----------------------------------|
| Lou/2020   | JCO Oncol Pract | US     | Panel of experts or regional recommendations | Gastrointestinal | GI cancer treatment with the aim of minimizing patient risk during pandemic |
| Marijnen/2020 | Radiother Oncol | International | Panel of experts or regional recommendations | Rectal | Radiotherapy treatment options for rectal cancer during the COVID-19 pandemic |
| Meattini/2020 | ESMO Open | Italy | Panel of experts or regional recommendations | Various | Recommendations in order to keep cancer care as safe as possible for both patients and healthcare providers |
| Mohile/2020 | Neuro Oncol | International | Panel of experts or regional recommendations | Glioma | To highlight opportunities to maximize the benefit and minimize the risk of glioma management during this pandemic and potentially, in the future |
| Monk/2020 | Gynecol Oncol | US | Panel of experts or regional recommendations | Ovarian | Recommendation about alternative routes of therapy for ovarian cancer |
| Motlagh/2020 | Arch Iran Med | Iran | Panel of experts or regional recommendations | Various | Two limit the exposure of cancer patients to medical environments, and modify the treatment modalities to reduce the probability of myelosuppression (delaying diagnostic and therapeutic services, shortening the treatment course, or prolonging the interval between treatment courses) |
| O’ Cathail/2020 | Clin Oncol | UK | Panel of experts or regional recommendations | Anorectal | Management of anorectal cancers provided by experts of UK |
| Patnaik/2020 | Am J Hematology | International | Panel of experts or regional recommendations | Myelodisplastic/myeloproliferative syndrome | Recommendation about treatment by a panel of experts |
| Pino/2020 | JCO Glob Oncol | Colombia | Panel of experts or regional recommendations | Various | Prioritization of adequate pathways for patients in low- and middle-income settings is critical |
| Pothuri/2020 | Gynecol Oncol | US | Panel of experts or regional recommendations | Gynecologic | An expert panel convened to develop initial consensus guidelines regarding anti-neoplastic therapy during the COVID-19 pandemic with respect to gynecologic cancer care and clinical trials |
| Ramirez/2020 | Int J Gynecol Cancer | International | Panel of experts or regional recommendations | Gynecologic | To share options in both the management and surveillance of patients diagnosed with gynecologic cancers during this time of global crisis |
| Sarkissian/2020 | J Am Acad Dermatol | US | Panel of experts or regional recommendations | Dermatologic | Recommendations regarding dermatological surgery during COVID-19 pandemic |
| Shankar/2020 | Asian Pac J Cancer Prev | International | Panel of experts or regional recommendations | Various | Specific precautions for cancer patients and cancer care providers to prevent spread |
| Soran/2020 | Eur J Breast Health | US | Panel of experts or regional recommendations | Breast | A consensus and a statement that may guide breast care professionals (Magee-Breast Cancer Program) |
| Author/Year | Journal | Country | Type of Study | Disease | Synthesis of Main Recommendations |
|------------|---------|---------|---------------|---------|-----------------------------------|
| Teoh/2020 | World J Urol | EU | Panel of experts or regional recommendations | Bladder | Intravesical therapies recommendations |
| Ueda/2020 | J Natl Compr Canc Netw | US | Panel of experts or regional recommendations | Various | The importance of organizational structure, preparation, agility, and a shared vision to provide cancer treatment to patients in the face of uncertainty and rapid change |
| Wang/2020 | Crit Care | China | Panel of experts or regional recommendations | Various | Medical management strategies |
| Werner/2020 | Otolaryngol Head Neck Surg | US | Panel of experts or regional recommendations | H&N | Care of cancer patients with head and neck cancers by US experts |
| Wu/2020 | Otolaryngol Head Neck Surg | International | Panel of experts or regional recommendations | H&N | Point of view about head and neck cancer treatment during pandemic by Toronto and Wuhan hospitals |
| Akladios/2020 | J Gynecol Obstet Hum Reprod | France | Multicenter cooperative groups | Gynecologic | Recommendations about curative treatment of cervical, ovarian and endometrial cancers according to stage and risk groups |
| Al-Shamsi/2020 | Oncologist | International | Multicenter cooperative groups | Various | Consideration of risk and benefit for active intervention in the cancer population during an infectious disease pandemic must be individualized |
| Ardura/2020 | Biol Blood Marrow Transplant | US | Multicenter cooperative groups | Hematologic cancers (stem cell transplantation) | Recommendations about hematopoietic stem cell transplantation during COVID-19 |
| Glehen/2020 | J Visc Surg | France | Multicenter cooperative groups | Peritoneal | RENAPE and BIG-RENAPE guidelines for peritoneal cancers |
| Penel/2020 | Ann Oncol | France | Multicenter cooperative groups | Sarcoma | General recommendations for the management of sarcoma patients |
| Thureau/2020 | J Bone Oncol | International | Multicenter cooperative groups | Bone metastasis | The COVID-19 crisis requires a reorganization of the health system, particularly in radiotherapy. A single 8Gy fraction is recommended for most clinical situations |
| Thoracic Surgery Outcomes Research Network/2020 | Ann Thorac Surg | US | Multicenter cooperative groups | Thoracic | A document to offer guidance and to facilitate decisions when caring for patients with thoracic malignancies during the COVID-19 pandemic |
| Whisenant/2020 | Cancer Cell | International | Multicenter cooperative groups | Thoracic Cancers | Evaluation of the impact of COVID-19 infection in patients with non-small cell lung cancer, small cell lung cancer, mesothelioma, thymic epithelial tumors, and thoracic carcinoid/neuroendocrine tumors. Thoracic Cancers International COVID-19 collaboration |
## Table 1. Cont.

| Author/Year   | Journal           | Country       | Type of Study                      | Disease       | Synthesis of Main Recommendations                                                                                                                                 |
|---------------|-------------------|---------------|-----------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dingemans/2020| J Thorac Oncol    | International| Multicenter cooperative groups    | Lung          | Multidisciplinary recommendations for the treatment of lung cancer during COVID-19 pandemic                                                                         |
| Di Fiore/2020 | Dig Liver Dis     | France        | Multicenter cooperative groups    | Gastrointestinal tumors | Alternatives in the management of digestive cancers during COVID-19 pandemic. Clinical point of view of the French Intergroup                                           |
| Hungria/2020  | Hematol Transfus Cell Ther | Brazil              | Multicenter cooperative groups    | MM            | Recommendations for the treatment of MM during COVID-19 pandemic. Recommendations from the ABHH Monoclonal Gammopathies Committee                   |
| Geskin/2020   | J Am Acad Dermatol| USA           | Multicenter cooperative group     | Skin          | Recommendations for the treatment of skin cancer patients during COVID-19 pandemic                                                                             |
| Spolverato/2020| Surgery           | Italy         | Multicenter cooperative group     | Surgical cancer patients | Management of surgical patients with cancer                                                                                                                          |
| De Azambuja/2020| ESMO Open        | EU            | Multicenter cooperative group     | Breast        | Recommendations for the treatment of breast cancer patients during COVID-19 pandemic                                                                           |
| Catanese/2020 | ESMO Open         | EU            | Multicenter cooperative group     | Pancreas      | Recommendations for the treatment of pancreatic cancer patients during COVID-19 pandemic                                                                       |
| Jozaghi/2020  | Head Neck         | USA           | Multicenter cooperative group     | Endocrine     | Recommendations for the treatment of endocrine surgical cancer patients during COVID-19 pandemic                                                                |
| Jereczek-Fossa/2020| Clin Oncol     | Italy         | Multicenter cooperative group     | Various       | Online questionnaires on how Lombardy radiotherapy departments have coped with COVID-19 pandemic                                                                    |
| Van De Haar/2020| Nat Med           | EU            | Multicenter cooperative group     | Various       | A report on how seven comprehensive cancer centers in EU have organized their healthcare systems during COVID-19 pandemic                                      |
| Al-Rashdan/2020| Adv Radiat Oncol | Canada        | Multicenter cooperative group     | Breast        | Use of hypo-fractionation and accelerated partial breast irradiation for breast cancer during COVID-19 pandemic                                                   |
| Bartlett/2020 | Ann Surg Oncol    | US            | Official guidelines or health authorities’ recommendations | Various   | Considerations in management of cancer surgery cases during the COVID-19 pandemic                                                                               |
| Bitar/2020    | Future Oncol      | Lebanon       | Official guidelines or health authorities’ recommendations | Various   | Recommendations for daily practice for the care of cancer patients relate to prevention of contamination, prioritization of patients, avoiding overcrowded clinics, ensuring the separation of oncology departments from other units, and management of palliative care patients |
| Author/Year      | Journal              | Country      | Type of Study                                                                 | Disease  | Synthesis of Main Recommendations                                                                                                                                                          |
|-----------------|----------------------|--------------|-------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coles/2020      | Clin Oncol          | International| Official guidelines or health authorities’ recommendations                     | Breast   | Recommendations where RT is minimized and targeted to those with the highest risk of relevant breast recurrence, to protect our patients and health care professionals from potential exposure to COVID-19 as well as reducing the workload for health care providers and/or infrastructure. |
| Kimmig/2020     | J Gynecol Oncol     | International| Official guidelines or health authorities’ recommendations                     | Gynecologic | Robot assisted surgery (RAS) may help to reduce hospital stay for patients that urgently need complex-oncological-surgery, thus making room for COVID-19 patients.                                    |
| Ribal/2020      | Eur Urol             | EU           | Official guidelines or health authorities’ recommendations                     | Urologic | Position of EAU and reporting of guidelines recommendations during pandemic.                                                                                                             |
| Thomson/2020    | Int J Radiat Oncol Biol Phys | International | Official guidelines or health authorities’ recommendations                     | H&N      | This statement attempts to address the immediate impacts of the COVID-19 pandemic on HNC clinical practice. Practice recommendations for risk-adapted head and neck cancer radiotherapy.                     |
| Troost/2020     | Radiother Oncol     | US + EU      | Official guidelines or health authorities’ recommendations                     | Lung     | ASTRO and ESTRO recommendations                                                                                                                                                           |
| Von Lillenfeld-Toal/2020 | Leukemia         | EU           | Official guidelines or health authorities’ recommendations                     | Various  | EHA Infectious Disease Scientific Working Group recommendations of cancer treatment.                                                                                                          |
| Yahalom/2020    | Blood                | International| Official guidelines or health authorities’ recommendations                     | Hematologic | Recommendations for alternative radiation treatment schemes: maintaining clinical efficacy and safety by increasing the dose per fraction while reducing the number of daily treatments.                  |
| You/2020        | Lancet Oncol        | France       | Official guidelines or health authorities’ recommendations                     | Various  | In a situation where available care facilities are scarce, prioritization should involve the patients managed with curative-intent therapeutic strategies, and those with a life expectancy of 5 years or more, acknowledging that final decisions lie with the referring clinicians. |
| Zaorsky/2020    | Adv Radiat Oncol    | US and UK    | Official guidelines or health authorities’ recommendations                     | Prostate | A RADS framework (Remote visits, and Avoidance, Deferment, and Shortening of radiotherapy) was created and applied to determine the appropriate management for men with prostate cancer during the global COVID-19 pandemic. |
| Author/Year | Journal          | Country          | Type of Study                                                                 | Disease                                                                 | Synthesis of Main Recommendations                                                                                                                                 |
|------------|------------------|------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chan/2020  | Support Care Cancer | USA/Canada/Australia | Official guidelines or health authorities’ recommendations                      | Various                                                                 | Three priority areas of survivorship care identified: triage of immediate needs of cancer survivors, tele-survivorship care, alternative models of care. A qualitative survey of Multinational Association of Supportive Care in Cancer (MASCC) Survivorship Study Group |
| Bergsland/2020 | Pancreas | USA | Official guidelines or health authorities’ recommendations                           | Neuroendocrine tumors (NETs)/carcinomas (NECs)                           | Recommendations for the treatment of NETs/NECs during COVID-19 pandemic: Official guidelines of the North American Neuroendocrine Tumor Society                                                                 |
| Terpos/2020 | Leukemia | EU | Official guidelines or health authorities’ recommendations                           | Multiple Myeloma (MM)                                                   | Recommendations for the treatment of MM during COVID-19 pandemic: European Myeloma Network (EMN) Consensus Paper                                                                 |
| Nguyen/2020  | Cancers           | International    | Official guidelines or health authorities’ recommendations                      | Various                                                                 | Practice proposal for the management of older cancer patients during COVID-19 pandemic. Proposal of the International Geriatric Radiotherapy Group                                                                 |
| Desideri/2020 | J Geriatr Oncol | International    | Official guidelines or health authorities’ recommendations                      | Various                                                                 | Recommendations for the treatment of older cancer patients during COVID-19 pandemic. Global perspective of the Young International Society of Geriatric Oncology (SIOG)                                                                 |
| Vecchione/2020 | ESMO Open | EU | Official guidelines or health authorities’ recommendations | Colorectal | ESMO recommendations: redefinition of diagnostic and therapeutic algorithms in colorectal cancer                                                                 |

H&N, head and neck; US, United States.
Among the areas of China hardest hit by COVID-19 was Heilongjiang province. A series of protocols were established when the first confirmed case emerged, and authors summarized their experience in medical management strategies including protection of medical staff, reallocation of medical resources, plans for hierarchical treatment, and utilization of a network platform [19].

In an attempt to help cancer centers in low-resource settings, authors from Colombia created some adjusted recommendations such as (1) assuring social containment; (2) moving tumor boards and scientific meetings to virtual modalities; (3) changing of immunotherapy to 4 or 6 week schedules for selected patients, switching to oral therapies for advanced cases with intravenous treatments, and temporarily discontinuing noncritical therapies, such as bisphosphonates or denosumab; (4) using strict selection criteria for in-hospital chemotherapy. According to these authors, only potentially curative chemotherapy with severe toxicity profile should be delivered to inpatients for acute leukemias, high-grade lymphomas or soft tissue sarcomas [20].

Simple and straightforward guidance on decisions about immediate cancer treatment involving different treatment modalities (i.e., surgery, chemotherapy, and radiotherapy) during the COVID-19 crisis was also generated by Kutikov and colleagues from the Fox Chase Cancer Center [21]. Based on the risk for significant morbidity from COVID-19 (comorbidities need to be considered) and on the risk of cancer progression in case of treatment delay, patients were prioritized in disease groups to streamline clinical decisions and avoid deferral of treatment in specific high-risk groups.

Another panel of experts from the US reviewed strategies for mitigating the transmission of COVID-19 in an effort to reduce morbidity and mortality of cancer patients and healthcare workers [22]. Outside China, Italy had one of the largest COVID-19 outbreaks. Lambertini and colleagues offered practical and interesting suggestions on how to implement cancer care during the COVID-19 outbreak [23]. Their approach was summarized by the acronym YOP, which outlines priorities to protect: (1) Yourself (physicians) and their families, both at work and in their personal life, by following all official instructions, respecting lifestyle restrictions, and focusing on proper use and adequate stocks of personal protective equipment (PPE); (2) Oncological care of patients, by deferring what can be delayed but trying, as much as possible, to minimize the impact of the pandemic on the usual standard of care; (3) Patients themselves from being infected, by making any possible effort to minimize the risks and giving continuous direction and appropriate official information.

A number of experts tried to provide specific recommendations based on tumor subgroups. For example, leaders from the Magee Breast Cancer Program (from Surgery, Medical Oncology, Radiation Oncology, Plastic Surgery, Pathology, and Genetics) came to a consensus and prepared a statement that may guide breast care professionals in diagnosis, treatment, and follow-up during the COVID-19 pandemic [24]. Similarly, a panel of breast surgeons from Turkey highlighted the national and international approach to the crisis, and wrote a document to be used in routine clinical practice which may provide beneficial recommendations for breast surgery in the state of emergency [25]. Breast Journal panelists proposed how to triage, prioritize, and organize breast cancer cases during a COVID-19 outbreak [26]. Marijn et al. provided recommendations for rectal cancer treatment using ESMO guidelines as a platform [27]. They encourage modulating treatments (from TME surgery alone to short course radiotherapy (RT) + neoadjuvant chemotherapy (CT) or CTRT for more advanced cases) and depict scenarios of various risk groups.

A further panel of experts provided suggestions and recommendations for the management of urological conditions during COVID-19 crisis in Brazil and other low- and middle-income countries. Specifically, the panel reached a consensus to prepare a practical guide for urologists based on the recommendations from the main Urologic Associations, as well from as data from the literature supporting the suggested management [28]. Additional recommendations on how to reorganize routine urological practice and prioritize systemic therapies for genitourinary malignancies came from Italy and USA, respectively [29,30]. Interestingly, the Editorial Team of the International Journal of Gynecological Cancer took the initiative to use established guidelines to prepare a practical tool in order to be able to propose strategies to optimize care of gynecological oncology patients [30].
Recommendations on dermatologic surgery during the COVID-19 pandemic were also published by experts from the UK who clearly stated that elective surgery such as the excision of benign lesions and cosmetic procedures should be postponed [31]. Conversely, patients with locally aggressive tumors (e.g., melanoma, dermatofibroma sarcoma protuberans, Merkel cell carcinoma, microcystic adnexal carcinoma) should proceed as soon as possible [31].

Finally, Italian radiation therapists provided recommendations on how to safely run a radiation oncology department and listed practical recommendations for radiation therapy during the COVID-19 outbreak, based on specific cancer care contexts [32,33]. Furthermore, a RADS framework (Remote visits, Avoidance, Deferment, and Shortening of radiotherapy) was created by an international panel of experts and applied to determine the appropriate management for prostate cancer during the global COVID-19 pandemic. Consensus was reached that all aspects of patient visits, treatment, and overall resource utilization can be reduced for all identified stages of prostate cancer treated with radiotherapy [34].

2.3. Recommendations of Multicenter Cooperative Groups

Al-Shamsi et al., on behalf of the International Collaborative Group, outlined various aspects of cancer care for patients being treated during the pandemic in a paper published in The Oncologist [35]. They discussed economic issues, allocation of resources, treatment of outpatients and hospitalized cancer patients, risk of infecting patients, and surgical considerations. In this exhaustive review, the authors addressed some of the current challenges associated with the managing of cancer patients during the COVID-19 pandemic and provided topical recommendations. In particular, lung cancer, hematopoietic stem cell transplantation, psychological aspects, and clinical research were discussed.

Thureau et al., on behalf of the GEMO group (a European study group for bone metastases), discussed the topic of palliative RT for symptomatic bone metastases [36]. They indicated a single 8 Gy fraction as the recommended schedule for the palliation of bone pain. For spinal cord compression, surgical treatment should be prioritized whenever possible for all patients with a life expectancy of more than a few months. In cases where surgery is not indicated, exclusive RT may be indicated with a similar fractionation used for treating bone pain. Penel et al., on behalf of the French Sarcoma Group, briefly identified the major topics of sarcoma treatment [37]. In suspected COVID-19 cases, primary treatment should be postponed for at least 15 days after the symptoms start. Otherwise, all other treatment settings in COVID-19 negative patients should reflect the current practice.

The Consensus Statement from Thoracic Surgery Outcomes Research Network determined the ideal priorities for thoracic surgery in cancer patients [38]. They outlined situations that need immediate surgery (for staging, for symptomatic or node positive cancers, or after neoadjuvant therapy), delayed surgery (up to 3 months, for isolated lung nodules, thymomas or indolent histologies, for example), or alternative treatment modalities (as stereotactic body RT). When almost all hospital centers are dedicated to COVID-19, all cases except for those with perforated cancer of esophagus, septic patients, or patients with surgical complications may be reasonably delayed until after the pandemic has resolved.

Finally, the gynecological FRANCOGYN group discussed the topic of gynecological cancers during the pandemic [39]. They prefer neoadjuvant chemotherapy in stage III ovarian cancer with cytoreduction (without HIPEC) performed after six cycles. Cervical cancer can be managed with definitive CTRT to avoid surgical burden and low-risk endometrial cancers can be resected even after a 1–2 month waiting period.

2.4. Official Guidelines or Recommendations of Health Authorities

Several papers providing regional or international guidelines were published in these weeks [40–50]. Three were national guidelines (n = 2 French and n = 1 Lebanese) and eight came from international societies. Four were RT guidelines (for lymphomas, head and neck, lung, and breast cancers), four were specific surgical guidelines (n = 1 gynecological, n = 1 urological, n = 2 head and
neck malignancies), one discussed infection prevention, and one was the guidelines of the Society of Surgical Oncology (SSO). Finally, a European hematologist discussed prevention and treatment of cancer patients at risk of with COVID-19 infection.

The ILROG consensus was published by the International Society for Radiotherapy treatment in Lymphomas. They advised three possible strategies for RT delivery during the pandemic: omitting, delaying, and shortening the RT course. In particular, they consider omitting RT in the case of a palliative setting, localized low-grade lymphomas if completely excised, localized nodular lymphocyte-predominant Hodgkin lymphoma if wholly excised, and for consolidation RT for diffuse large B cell lymphomas/aggressive non Hodgkin lymphomas in patients who have completed the full CT course and achieved a complete remission.

Bartlett et al., on behalf of the SSO, briefly outlined the surgical indications for significant cancer types according to stage. Except for lung and gynecological cancers that were not part of these guidelines, they described surgical indications of the main cancer subtypes (breast, thyroid, abdominal, melanoma, and sarcoma). They endorse neoadjuvant therapies in many cases (breast, gastroesophageal, pancreatic, peritoneal, and high-grade sarcomas) with the deferral of resection procedures in many low-risk settings. Coles et al. reported on international guidelines for breast cancer RT. They reported five statements/recommendations regarding low-risk breast cancer, fractionation, elderly with ER+ breast cancer, boost necessity, and nodal RT.

A group of French authors published local recommendations for the protection of cancer patients from COVID-19 infection. They suggest minimizing hospital visits, using telemedicine and phone calls to replace safety visits, replacing intravenous drugs with oral drugs, and adjusting the dosage of CT and RT to reduce the frequency of hospital admissions. They list three treatment settings with reduced priority: (1) the curative setting, (2) the palliative (first line) setting for younger and fit patients or patients with at least 5 years of life expectancy, and (3) the palliative therapy setting in other cases.

ASTRO, ESTRO, and select Asia-Pacific countries provided head and neck RT guidelines through a modified rapid Delphi process. They reported agreement in many domains such as priority areas, treatment dose adjustment, RT delay, indications for surgery, and management of outpatients. Finally, Fakhry et al., on behalf of French societies for head and neck cancers, discussed surgical priorities in these patients. Group A refers to life-threatening emergencies (shortness of breath, hemorrhage) where immediate treatment is required, Group B refers to cancers for whom postponing the treatment beyond 1 month could have a negative prognostic impact for the patient and where management should not be delayed, and Group C refers to cancers for which treatment can be postponed for at least 6–8 weeks without any significant prognostic impact.

3. Materials and Methods

We conducted a literature search using PubMed to identify articles published in English language that reported on cancer patient care recommendations during the COVID-19 pandemic from inception up to 1st June 2020, using the terms “(cancer or tumor) AND (COVID-19)” (Table 1) [1–97].

Of the 97 included studies, 10 were personal recommendations of single or multiple independent authors, 16 were practice recommendations of single authoritative cancer centers, 35 were recommendations provided by panels of experts or by multiple regional cooperative centers, 19 were cooperative group position papers, and finally, 17 were official guidelines statements. The flow diagram of the included studies is reported in Figure 1.
4. Conclusions

We systematically searched and collected all recommendations produced for cancer care during the COVID-19 pandemic era at various levels (personal view, single institution position, panel of experts, cooperative groups, and specific guidelines). Several aspects of treatment were discussed by the authors (surgery, CT, RT, supportive therapies) and these recommendations may judiciously guide care of patients in oncology setting during this worldwide emergency situation. The COVID-19 pandemic is a global emergency, and this has rapidly modified our clinical practice. Delaying of unnecessary treatment, minimizing the burden of toxicity, and identifying care priorities for surgery, radiotherapy, and systemic therapies settings must be viewed as basic priorities in the COVID-19 era and may shape cancer care services in the future.

Clinicians are aware about the various recommendations that are being provided for care of cancer from a local to an international point of view. International guidelines are probably less suitable for universal (worldwide) use. In fact, there are enormous differences between various countries and continents due to economic resources available, to the different evolution of the pandemic, to the presence or not of local (hub) high volume centers for the treatment of oncological pathologies, etc. In conclusion, we believe that oncologists, surgeons, and radiation oncologists should refer to the indications of their proper, national, scientific societies. The rapid evolution of epidemiology of pandemic, however, makes a continuous update of clinical practice guidelines, a necessity.

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