



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## Radiation therapy for gynecologic malignancies during the COVID-19 pandemic: International expert consensus recommendations



Christen R. Elledge<sup>a</sup>, Sushil Beriwal<sup>b</sup>, Cyrus Chargari<sup>c</sup>, Supriya Chopra<sup>d</sup>, Beth A. Erickson<sup>e</sup>, David K. Gaffney<sup>f</sup>, Anuja Jhingran<sup>g</sup>, Ann H. Klopp<sup>g</sup>, William Small Jr<sup>h</sup>, Catheryn M. Yashar<sup>i</sup>, Akila N. Viswanathan<sup>a,\*</sup>

<sup>a</sup> Department of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>b</sup> Department of Radiation Oncology, University of Pittsburgh Medical Center, Hillman Cancer Center, Pittsburgh, PA, USA

<sup>c</sup> Department of Radiation Oncology, Gustave Roussy Cancer Campus, Villejuif, France

<sup>d</sup> Department of Radiation Oncology, Advanced Centre for Treatment, Research and Education in Cancer, Tata Memorial Centre, Homi Bhabha National Institute, Kharghar, Navi Mumbai, India

<sup>e</sup> Department of Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, USA

<sup>f</sup> Department of Radiation Oncology, Huntsman Cancer Institute, University of Utah, Salt Lake City, UT, USA

<sup>g</sup> Department of Radiation Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

<sup>h</sup> Department of Radiation Oncology, Loyola University Chicago, Stritch School of Medicine, Maywood, IL, USA

<sup>i</sup> Department of Radiation Oncology, University of California San Diego, San Diego, CA, USA

### HIGHLIGHTS

- An international panel of gynecologic radiation oncologists offer recommendations for RT during the COVID-19 pandemic.
- Recommendations for cervical cancer, uterine cancer, vulvar cancer, vaginal cancer and ovarian cancer have been provided.
- Recommendations for RT timing, fractionation, and dose have been provided for external beam radiation and brachytherapy.
- The panel emphasizes strategies to reduce risk of transmission of the novel SARS-CoV-2 to patients and healthcare workers.
- These recommendations may be used any time an event occurs which limits healthcare resources, including natural disasters.

### ARTICLE INFO

#### Article history:

Received 28 April 2020

Accepted 10 June 2020

Available online 15 June 2020

### ABSTRACT

**Objective.** To develop expert consensus recommendations regarding radiation therapy for gynecologic malignancies during the COVID-19 pandemic.

**Methods.** An international committee of ten experts in gynecologic radiation oncology convened to provide consensus recommendations for patients with gynecologic malignancies referred for radiation therapy. Treatment priority groups were established. A review of the relevant literature was performed and different clinical scenarios were categorized into three priority groups. For each stage and clinical scenario in cervical, endometrial, vulvar, vaginal and ovarian cancer, specific recommendations regarding dose, technique, and timing were provided by the panel.

**Results.** Expert review and discussion generated consensus recommendations to guide radiation oncologists treating gynecologic malignancies during the COVID-19 pandemic. Priority scales for cervical, endometrial, vulvar, vaginal, and ovarian cancers are presented. Both radical and palliative treatments are discussed. Management of COVID-19 positive patients is considered. Hypofractionated radiation therapy should be used when feasible and recommendations regarding radiation dose, timing, and technique have been provided for external beam and brachytherapy treatments. Concurrent chemotherapy may be limited in some countries, and consideration of radiation alone is recommended.

**Conclusions.** The expert consensus recommendations provide guidance for delivering radiation therapy during the COVID-19 pandemic. Specific recommendations have been provided for common clinical scenarios encountered in gynecologic radiation oncology with a focus on strategies to reduce patient and staff exposure to COVID-19.

© 2020 Elsevier Inc. All rights reserved.

\* Corresponding author at: 401 N. Broadway, Suite 1440, Baltimore, MD, 21287, USA.  
E-mail address: [anv@jhu.edu](mailto:anv@jhu.edu) (A.N. Viswanathan).

## 1. Introduction

On March 11, 2020, the World Health Organization (WHO) declared the 2019 coronavirus disease (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a pandemic [1]. Currently, there is neither a vaccine nor confirmed effective medical treatments against SARS-CoV-2 [2]. Public health officials from the U.S. Centers for Disease Control and Prevention (CDC) and WHO have issued recommendations for increased hygiene vigilance, use of masks to reduce spread of respiratory droplets, and social distancing for all persons, as well as screening, testing, and contact tracing to be organized by governments. Around the world, local and federal governments have enacted mandatory quarantines, banned mass gatherings, closed non-essential businesses and schools, and significantly reduced or eliminated travel across regional and international borders in an effort to slow the spread of the virus and avoid overwhelming the capacity of the healthcare system [1,3,4].

Many hospitals have implemented strategies to prevent the spread of the virus among patients and staff including converting in-person appointments to telemedicine visits, reducing or rescheduling routine follow up appointments, limiting hospital visitors, restricting or eliminating medical student and resident interactions with patients, and postponing elective procedures and surgeries [5–7]. However, the treatment of patients with cancer is time-sensitive and delayed treatment has been associated with inferior local control and survival [8–17]. As such, several radiation oncology departments around the world have come up with contingency plans for the treatment of cancer patients during the COVID-19 pandemic. Radiation oncology department-specific [5,18–23], disease site-specific [24–30], and patient population-specific guidelines [31,32] have been published in an effort to reduce patient visits to the clinic, prioritize patient treatments, consider testing for asymptomatic patients and provide guidance on how to best protect patients and staff when treating patients with confirmed or suspected infection with SARS-CoV-2.

For patients with gynecologic malignancies, radiation therapy (RT) is often an integral component of multi-modality management and can be delivered in the definitive, adjuvant, and palliative setting. However, RT requires repeated visits to radiation oncology clinics and may place patients at increased risk of exposure to SARS-CoV-2. Additionally, cancer patients may have an increased risk of contracting the virus or difficulty clearing the virus once infected due to their immunocompromised state [19]. Two independent studies have reported a greater risk of severe events (ICU admission, mechanical ventilation, and death) secondary to COVID-19 in cancer patients compared to patients without cancer in China [33,34]. Radiation oncologists must carefully consider the risks and benefits of RT against the risk of contracting SARS-CoV-2 for each individual patient. Furthermore, the risks to healthcare staff and the use of limited healthcare resources, such as personal protective equipment (PPE) and ventilators, must be considered as well.

An international panel of experts of gynecologic radiation oncology convened to review relevant literature and discuss recommendations regarding the timing and delivery of RT for patients with gynecologic malignancies. This report is meant to provide a framework for clinical decision making. However, when evaluating a patient for consideration for RT during the COVID-19 pandemic, the radiation oncologist should take into consideration the following: the anticipated peak and length of the pandemic in a certain geographic area, the capacity of the healthcare system (including the availability of PPE and highly-trained staff), the age and medical comorbidities of each patient, the magnitude of benefit derived from delivery of RT, and the potential risk of delay, modification, or omission of RT.

The impact of the pandemic on radiology, surgical oncology, and medical oncology may influence RT recommendations. In some locations, cancer screening examinations such as mammography and colonoscopy are not being offered which may result in more advanced disease presentations. In many countries, elective surgical procedures

have been delayed in order to limit patients from entering the health care system, provide adequate intensive care facilities for COVID positive patients, and to preserve crucial supplies of PPE. Though most cancer operations are not considered elective, the lack of available ventilators, recovery spaces, and PPE may result in delays for surgical procedures. Finally, use of chemotherapy may be limited or unavailable in some countries due to manufacturing and supply chain disruptions or deferred to avoid risks of patients becoming immunocompromised.

## 2. Methods

An international panel of ten gynecologic radiation oncologists convened to develop consensus guidelines regarding the timing and delivery of RT for patients with gynecologic malignancies. Based on different clinical scenarios, the panel was asked to place patients in three priority risk groups (A, B, or C) adapted from the Pandemic Planning Clinical Guideline for Patients with Cancer published by Cancer Care Ontario [35]. For the purposes of our panel recommendations, priority A patients are defined as patients who are deemed critical and may require treatment during the pandemic, even if the patient has known or suspected infection with COVID-19. Priority A also includes patients with rapidly progressive tumors that are potentially curable with prompt initiation of treatment. Priority B patients are those who require treatment but whose situation is non-critical. If staff or PPE shortages occur to the extent that clinics are only able to provide care for priority A patients, priority B patients could be delayed up to 8–12 weeks without significant risk of harm. Priority C patients include patients with non-life-threatening conditions whose treatment may be delayed without anticipated change in outcome for an indeterminate period of time. In this group, we have also included patients for whom observation or alternative therapies could be considered instead of RT with minimal or no detriment in outcome. Table 1 summarizes the working definitions of the priority groups.

For patients with metastatic disease, we have compiled recommendations on treatment of symptomatic abdominopelvic disease. However, recommendations for palliative RT to other distant metastatic sites (e.g. brain metastases, spine metastases, etc.) from gynecologic primary sites have not been considered for the purpose of this paper. Recommendations regarding palliative RT during the COVID-19 pandemic have been previously published [31].

Consensus on treatment recommendations was reached through extensive discussion via videoconference call. All authors had access to a shared electronic document and they were able to provide recommendations for treatment management as well as references to published literature to support their recommendations. Recommendations were compiled by author C.E. and forwarded to all members of the expert consensus panel. Any disagreements among members of the panel were discussed by e-mail until a consensus was reached. All authors have reviewed and given support to the final recommendations.

## 3. Results

### 3.1. Cervical cancer

The recommendations from the consensus panel for patients with cervical cancer are provided in Table 2.

**Table 1**  
Working definitions of priority groups used by the consensus panel.

Priority A	Priority B	Priority C
Critical patients due to severe pain or bleeding or patients who require treatment during a pandemic due to potentially curable, rapidly dividing tumors	Patients who can safely be delayed (up to 8–12 weeks if necessary)	Patients with non-life-threatening conditions. Radiation therapy can be reasonably delayed throughout the duration of the pandemic or omitted

**Table 2**  
Consensus panel recommendations for patients with cervical cancer.

Priority A	Technique and Dose	Priority B	Technique and Dose
Locally advanced, inoperable disease (Stage IB3–IVA) or Stage IB1–IIA1 who are medically inoperable or refuse surgical intervention	Definitive CRT WP/EF: EBRT to 45 Gy, SIB boost <sup>a</sup> to gross disease to 55–60 Gy followed by BT  Suggested HDR <sup>b</sup> dose: 7 Gy × 4 f. or 8 Gy × 3 f. [42–44]  If chemotherapy not available: RT alone to 40–50 Gy in 2 Gy/fraction (depending on stage and disease burden) with SIB boost <sup>a</sup> to gross disease followed by BT	Stage IA1, IA2 who are medically inoperable or refuse surgical intervention	Definitive RT alone:  Medically inoperable patients with Stage 1A1 disease may receive BT alone  EBRT + BT is indicated in all patients with stage ≥1A2 [41]  EBRT to 40–50.4 Gy followed by a boost using HDR <sup>b</sup> with IC, IS, or hybrid <sup>c,d</sup> applicator (7 Gy × 4 f. or 8 Gy × 3 fx) [42,44] EBRT 40–50.4 Gy in 1.8–2 Gy fractions [53]
Regardless of tumor stage, any patient with severe bleeding secondary to cervical cancer	Non-metastatic radical treatment: definitive CRT with WP/EF to 45 Gy, SIB nodal boost <sup>a</sup> to 55–60 Gy or RT alone 40–50 Gy followed by a BT boost  Suggested HDR <sup>b</sup> Dose: 7 Gy × 4 fx, or 8 Gy × 3 f. [42–44]  Metastatic or non-metastatic palliative treatment: tumor-directed RT alone as palliation based on extent of disease and performance status  Palliative RT: 10 Gy × 1 f. (can be repeated monthly up to 2 more times) [45–48]  “Quad Shot” of 3.7 Gy BID x 4 f. (can be repeated monthly up to 2 more times) [49,50]  4 Gy × 5 f. [51,52]	Post-operative Stage IA1–IB2 with risk-factors meeting criteria for adjuvant EBRT based on GOG 92 [53]  Post-operative patients with positive pelvic (or PA nodes), surgical margins, or parametria who require CRT based on GOG 109 [54]  Patients with metastatic disease with discomfort controlled with oral pain medications or minimal bleeding who require palliative RT	Can be delayed up to 12 weeks based on consensus panel opinion <sup>e</sup>  No consensus on hypofractionation dose or duration for pelvic RT  CRT to 45–50 Gy [54]  Can be delayed up to 8 weeks [55] if necessary based on consensus panel opinion <sup>e</sup> 10 Gy × 1 f. (can be repeated monthly up to 2 more times) [45–48]  “Quad Shot” of 3.7 Gy BID x 4 f. (can be repeated monthly up to 2 more times) [49,50]  4 Gy × 5 f. [51,52]

BID: twice daily; BT: brachytherapy; CRT: chemoradiotherapy; EBRT: external beam radiation therapy; EF: extended field; Fx: fraction; GOG: Gynecologic Oncology Group; Gy: Gray; IC: intracavitary; IS: interstitial; HDR: high-dose rate; LDR: low-dose rate; PA: paraaortic; PDR: pulsed-dose rate; RT: radiation therapy; SIB: simultaneous integrated boost; WP: whole pelvis.

<sup>a</sup> Boost clinically positive nodes with SIB technique to reduce total number of fractions.

<sup>b</sup> HDR, PDR, or LDR brachytherapy may be used based on resource availability.

<sup>c</sup> Combined intracavitary/interstitial applicators.

<sup>d</sup> To reduce risk of exposure to COVID-19, a single application with the delivery of multiple fx is preferred.

<sup>e</sup> The decision to delay therapy and the interval of delay should be determined based on (1) individual risk of the patient to have an adverse outcome due to COVID-19 based on age and medical comorbidity, (2) individual risk of disease progression given treatment delay, and (3) epidemiologic data based on the projected peak of the pandemic in a specific geographic area.

A summary of recommendations from the consensus panel includes:  
General

- Given the nature of cervical cancer as a rapidly dividing tumor with a high potential for cure, the panel did not feel any clinical scenario was appropriate to be categorized as priority C.

Patients with locally-advanced disease

- For patients with cervical cancer who require treatment breaks, treatment with additional RT dose, while respecting tolerance doses to nearby critical structures, should be considered to account for tumor repopulation. Gay et al. have provided suggestions regarding dose escalation for patients who require treatment breaks [36].

- For patients requiring brachytherapy, inpatient treatment with one insertion rather than outpatient treatment with multiple insertions is preferable to reduce aerosolizing procedures that may occur during anesthesia and to minimize close contact with the patient required for procedures. An attempt should be made to maximize the number of fractions of RT delivered for each applicator insertion.
- The number of delivered RT fractions should be reduced to the fewest number when possible while respecting tolerance doses of nearby OARs. For instance, HDR brachytherapy delivered as 24 Gy in three fractions or 28 Gy in four fractions should be prioritized over longer fractionation schedules. For external beam RT, any boosts should be performed using a simultaneous integrated boost (SIB) technique rather than a sequential cone-down boost to reduce the number of RT fractions [37–39].

- For patients who cannot receive systemic therapy and require external beam RT, the panel recommends a dose of 50 Gy in 25 fractions to the pelvis when possible. In addition, accelerated radiation therapy delivered six days per week may also be used [40].
- All treatment should be completed within 8 weeks when feasible, and delays are not recommended given the potential impact on survival [41].

#### Post-operative patients

- Patients receiving post-operative RT may be delayed up to 8–12 weeks if necessary depending on the clinical scenario.

### 3.2. Endometrial cancer

The recommendations from the consensus panel for patients with endometrial cancer are provided in Table 3.

A summary of recommendations from the consensus panel includes:  
General

- For external beam RT, any boosts should be performed using a simultaneous integrated boost (SIB) technique rather than a sequential cone-down boost to reduce the number of RT fractions [39,56,57].

#### Patients with inoperable disease

- Patients with symptomatic, inoperable disease receiving radiation therapy with or without chemotherapy should be treated expeditiously.
- For patients with endometrioid histology, hormonal therapy may be used to delay RT start.
- SBRT delivered to a dose of 20–30 Gy in 4–5 fractions may be used as a boost in patients who cannot tolerate or refuse brachytherapy [58,59]. However, the consensus panel recommends that brachytherapy boosts remain the standard of care and should always be preferred over SBRT boosts. The potential risks of increased toxicity and inferior local control associated with SBRT boosts should be discussed with the patient prior to treatment [59].

#### Post-operative patients

- Many patients receiving adjuvant radiation therapy may safely be delayed between 6 and 8 weeks after surgery depending on the clinical scenario.
- Brachytherapy fractionation regimens with fewer total fractions should be preferentially used, while respecting tolerance doses to nearby OARs. For instance, patients receiving post-operative vaginal cuff brachytherapy may be treated with a shorter fractionation regimen such as 21 Gy in 3 fractions instead of longer fractionation regimens such as 24 Gy in 6 fractions.
- The panel recommends patients with stage IA grade 3, Stage IB grade 1–2, and patients with low-risk stage II disease [60] may be preferentially treated with adjuvant vaginal cuff brachytherapy instead of external beam radiation therapy to minimize the number of treatment visits required.

### 3.3. Vulvar cancer

The recommendations from the consensus panel for patients with vulvar cancer are provided in Table 4.

A summary of recommendations from the consensus panel includes:  
General

- Patients with intact de novo or recurrent disease receiving definitive radiation therapy with or without chemotherapy should be treated expeditiously.
- For external beam RT, any boosts should be performed using a simultaneous integrated boost (SIB) technique rather than a sequential cone-down boost to reduce the number of RT fractions [39,74].

#### Post-operative patients

- Patients receiving adjuvant radiation therapy may be safely delayed between 6 and 8 weeks after surgery depending on the clinical scenario.
- Post-operative patients found to have positive nodes at the time of surgery should have RT promptly initiated.

### 3.4. Vaginal cancer

The recommendations from the consensus panel for patients with vaginal cancer are provided in Table 5.

A summary of recommendations from the consensus panel includes:  
General

- There were no clinical scenarios reviewed that were categorized as priority C.
- Patients with intact disease receiving definitive radiation therapy with or without chemotherapy should be treated expeditiously.
- For external beam RT, any boosts should be performed using a simultaneous integrated boost (SIB) technique rather than a sequential cone-down boost to reduce the number of RT fractions [39].

#### Post-operative patients

- Post-operative patients with close or positive margins or pathologically involved nodes with no gross residual disease, may be delayed up to 6–8 weeks from the time of surgery depending on the clinical scenario.

### 3.5. Ovarian Cancer

The recommendations from the consensus panel for patients with ovarian cancer are provided in Table 6.

A summary of recommendations from the consensus panel includes:  
General

- There were no clinical scenarios reviewed that were categorized as priority C.
- Patients previously treated with surgery and chemotherapy with an isolated locoregional relapse may be treated with involved-field radiation therapy.

### 3.6. All disease sites

Across disease sites, the panel has recommendations regarding external beam and brachytherapy fractionation, treatment breaks, and systemic therapy.

#### 3.6.1. External beam radiation therapy

When different fractionation regimens are available for external beam radiation therapy, the panel recommends the total number of fractions be minimized while respecting the tolerance doses of organs at risk. For instance, when possible, the use of a simultaneous integrated boost (SIB) should be used instead of a sequential cone-down boost to limit the number of fractions [37,39]. This will help to minimize patient visits to the clinic as well as risks of infection to patients and healthcare personnel. Finally, if a patient contracts the SARS-CoV-2 virus or is a person under investigation (PUI), a treatment break may be required. For patients requiring a treatment break, consider adding additional radiation dose to account for tumor repopulation during the treatment break. The potential benefits of additional radiation dose must be carefully weighed against the potential risks of additional dose to organs at risk. Gay et al. have outlined specific guidelines regarding treatment breaks for patients with cervical cancer [36]. For patients who cannot be safely put on a break throughout the duration of infection with



**Table 3**  
Consensus panel recommendations for patients with endometrial cancer.

Priority A	Technique and Dose	Priority B	Technique and Dose	Priority C	Technique and Dose
Regardless of stage, patients with severe vaginal bleeding	<p>Definitive RT for inoperable cases:</p> <p>EBRT to WP to 45 Gy followed by HDR IC boost: 8.5 Gy × 2 fx, or 6.3–6.5 Gy × 3 f. [42,61] or SBRT boost if BT is not tolerated [58]</p> <p>EBRT to WP to 50.4 Gy followed by HDR IC boost: 6 Gy × 2 f. [42,61] or SBRT boost if BT is not tolerated [58]</p> <p>HDR IC monotherapy (Stage I) [42,61,62]: 8.5 Gy × 4 f. or 8–10 Gy × 3 fx</p> <p>Palliative RT:</p> <p>10 Gy × 1 f. (can be repeated monthly up to 2 more times) [45–48]</p> <p>“Quad Shot” of 3.7 Gy BID x 4 f. (can be repeated monthly up to 2 more times) [49,50]</p>	Post-operative stage IA, grade 3 or stage IB, grade 1–2, and low-risk stage II endometrioid carcinoma [60]	HDR VCBT 7 Gy × 3 f. [63,64] (preferred) <sup>a</sup>	Post-operative stage IA, grade 1–2 endometrioid carcinoma with higher risk features (age > 60, LVSI)	<p>Consider observation (preferred) [65]</p> <p>If patient prefers VCBT, treatment can be deferred up to 12 weeks based on consensus panel opinion</p>
Medically or surgically inoperable patients with <b>non-endometrioid histology</b> who are not candidates for systemic therapy	<p>4 Gy × 5 f. [51,52]</p> <p>Definitive RT:</p> <p>EBRT to WP to 45 Gy followed by HDR IC boost: 8.5 Gy × 2 fx, or 6.3–6.5 Gy × 3 f. [42,61] or SBRT boost if BT not tolerable [58]</p> <p>EBRT to WP to 50.4 Gy followed by HDR IC boost: 6 Gy × 2 f. [42,61] or SBRT boost if BT not tolerable [58]</p> <p>HDR IC monotherapy (Stage I) [42,61,62]: 8.5 Gy × 4 fx, or 8–10 Gy × 3 fx</p>	Post-operative stage IB, grade 3 and Stage II endometrioid carcinoma	<p>EBRT to 45 Gy [66]</p> <p>EBRT should begin within 6–8 weeks of surgery</p>	Medically or surgically inoperable endometrioid carcinoma patients who are candidates for hormone therapy and can begin immediately	
Recurrent vaginal cuff disease	<p>Definitive (chemo) RT with EBRT to 45–50.4 Gy followed by IC/IS<sup>a</sup> HDR Boost: 7–8 Gy × 3 f. or 6 Gy × 4 fx, twice daily [67,68] or SBRT boost if BT not tolerated</p>	<p>Post-operative patients with grade 1-histology with positive nodes (Stage IIIC)</p> <p>Post-operative Stage IA-IV <b>non-endometrioid histology</b> who have completed systemic therapy<sup>b</sup></p>	<p>Consider EBRT<sup>c</sup> to 45–50.4 Gy without chemo [69,70]</p> <p>Stage IA: HDR VCBT<sup>a</sup> 7 Gy × 3 fx</p> <p>Stage IB-IV: EBRT<sup>c</sup> 45–50.4 Gy; consider HDR VCBT boost of 5–6 Gy × 2 f. [42,63] for adverse risk factors</p> <p>Or</p>	Post-operative stage III-IV patients who meet criteria for GOG 258 [71] can be considered for chemotherapy alone (+/– EBRT after chemotherapy)	



**Table 5**  
Consensus panel recommendation for patients with vaginal cancer.

Priority A	Technique and Dose	Priority B	Technique and Dose
Bleeding or severely painful lesions in patients with metastatic disease	10 Gy × 1 f. (can be repeated monthly up to 2 more times) [45–48]  “Quad Shot” of 3.7 Gy BID × 4 f. (can be repeated monthly up to 2 more times) [49,50]  4 Gy × 5 f. [51,52] Definitive RT	Post-operative patients with close/positive margins or pathologically involved nodes with no gross residual disease.	Close/positive margins <sup>a,b</sup> : IC/IS BT +/- EBRT [67,89] or CRT [90]  Pathologically involved nodes: CRT to 45–50.4 Gy with consideration of SIB boost to 55–60 Gy to any areas of gross disease [91]
Medically or surgically inoperable patients with stage I disease	If lesion is ≤0.5 cm depth, use IC BT alone with EQD2 of 60–75 Gy to the tumor with 2 cm margin (7 Gy × 5 fx) using a shielded or multichannel vaginal cylinder [42,67]  If lesion is >0.5 cm in depth, treat WP with EBRT to 45 Gy followed by IS BT boost to EQD2 of 70 Gy (7 Gy × 3 fx) [42,67]		
Intact stage II-IVA disease	Definitive CRT with EBRT to 45–50.4 Gy to the WP (and bilateral inguinal nodes if the tumor is in the lower third of the vagina). Boost any clinically positive nodes with an additional 20–25 Gy <sup>c</sup>  Boost: If lesion is ≤0.5 cm in depth, boost with IC BT 7 Gy × 3 f. [42,67]  If lesion is >0.5 cm in depth, boost with IS BT (7 Gy × 3) [42,67]		

ABS: American Brachytherapy Society; BID: twice per day; BT: brachytherapy; CRT: chemoradiotherapy; EBRT: external beam radiation therapy; EQD2: Equivalent dose in 2 Gray fractions; fx: fraction; Gy: Gray; IC: intracavitary; IS: interstitial; RT: radiation therapy; SIB: simultaneous integrated boost; WP: whole pelvis

<sup>a</sup> The decision to delay therapy and the interval of delay should be determined based on (1) individual risk of the patient to have an adverse outcome due to COVID-19 based on age and medical comorbidity, (2) individual risk of disease progression given treatment delay, and (3) epidemiologic data based on the project peak of the pandemic in a specific geographic area.

<sup>b</sup> EBRT can be delayed up to 6 weeks for patients with positive margins and up to 8 weeks for patients with close margins.

<sup>c</sup> Any EBRT boosts should be delivered with SIB technique, if possible, to reduce the total number of fractions.

SARS-CoV-2, we recommend these patients be treated at the end of the day to minimize risks of infection to other patients.

### 3.6.2. Brachytherapy

When planning brachytherapy, consider the use of locoregional anesthesia or conscious sedation over the use of general anesthesia to minimize aerosolizing procedures such as general endotracheal intubation or use of laryngeal mask airways (LMA). There is an increased risk of aerosol generation associated with these procedures that may lead to airborne transmission of the virus to healthcare personnel [93,94]. Intubation has a high risk of aerosol production during the procedure; but once the tube is in place, the cuff provides a seal within the airway preventing further aerosolization [95]. While empirical data is currently lacking, expert opinion suggests that LMA use may carry greater risk than endotracheal intubation, particularly with the use of higher positive pressures that may result in air leak and continuous aerosolization

throughout the procedure [94]. If general anesthesia is necessary for a case, published protocols and guidelines regarding airway management during the COVID-19 pandemic should be reviewed with anesthesia providers and, if indicated, used to limit risks of viral transmission to healthcare personnel [96–98]. Precautions should be taken to limit the number of individuals in the room to anesthesia personnel only during intubations and extubations and all individuals present must have airborne PPE.

To further mitigate risk, some institutions have initiated universal COVID-19 testing for all patients undergoing procedures, particularly those requiring endotracheal intubation [99]. When available, testing for COVID-19 prior to the procedure will help determine if a patient is COVID-19 positive and will inform providers of appropriate PPE requirements. This information may also be used to decide if a patient should be delayed or treated with an alternative method such as SBRT. At a minimum, for all patients with negative COVID-19 testing or

**Table 6**  
Consensus panel recommendation for patients with ovarian cancer.

Priority A	Technique and Dose	Priority B	Technique and Dose
Bleeding or severely painful disease in patients with metastatic disease who are not candidates for surgical or systemic therapies	Palliative RT:  10 Gy × 1 f. (can be repeated monthly up to 2 more times) [45–48]  “Quad Shot” of 3.7 Gy BID × 4 f. (can be repeated monthly up to 2 more times) [49,50]  4 Gy × 5 f. [51,52]	Isolated locoregional relapse in patients with prior surgery and chemotherapy	Definitive IFRT to 45–68.2 Gy [92]

BID: twice per day; Fx: fraction; Gy: Gray; IFRT: involved-field radiation therapy; RT: radiation therapy.



those presumed to be negative when pre-operative testing is not available, the panel recommends the use of a surgical mask and eye protection. In addition, appropriate PPE should be used even with procedures being performed with conscious sedation as there is a risk of coughing associated with sedative agents [100] and some patients may ultimately require intubation during the course of the procedure if complications arise.

The number of fractions delivered for each applicator insertion should be monitored and brachytherapy fractionation regimens that minimize the total number of fractions delivered should be considered, when normal tissue tolerance permits, to reduce the number of required procedures and treatments during an RT course. For inpatient tandem and ovoid or interstitial procedures, this includes the use of twice daily treatments delivered a minimum of 6 h apart with immobilization and imaging, if available, each day to ensure accurate treatment of the target and avoidance of organs at risk.

### 3.6.3. Chemotherapy

The decision to proceed with concurrent, sensitizing chemotherapy should be made after a careful assessment of patient risk factors, expected magnitude of benefit from systemic therapy, and resource availability. If chemotherapy is omitted in patients with cervical cancer, dose escalation with external beam RT or brachytherapy may be used but tolerance doses to nearby organs at risk should be respected. Alternatively, accelerated RT delivered in six daily fractions per week may be used to compensate for omission of chemotherapy in patients who cannot or refuse to receive chemotherapy [40]. These decisions should be made using a shared decision making approach with patient and caregiver knowledge and involvement.

## 4. Discussion

An international expert consensus panel comprised of ten experts in gynecologic radiation oncology have reviewed the relevant literature and developed clinical practice recommendations to assist radiation oncologists treating gynecologic malignancies during the COVID-19 pandemic. Dissenting opinions were discussed openly and completely. Consensus was reached via the communications methods described above.

Similar to other disease sites, a priority scale was developed to triage patients with gynecologic malignancies [101]. Priority A patients should be treated expeditiously due to the severity of patient symptoms or because these patients have potentially curative, rapidly growing tumors and the opportunity for cure may be lost if treatment is delayed. While resources are not constrained, many priority B patients should be treated expeditiously, but radiation oncologists should consider if a potential delay in therapy may allow patient treatment after the regional peak of COVID-19 cases. If the capacity of the healthcare system is overwhelmed and resources are limited, priority B patients may be safely delayed in order to conserve resources for priority A patients. Priority C patients may delay RT for a longer interval or omit radiation in favor of observation or other therapeutic options. In the event that the pandemic continues for an extended period of time, patients who were initially placed into priority B may ultimately choose to omit RT. These patients should be closely monitored and should receive early salvage therapy at the time of recurrence. This approach is supported from prospective phase II data by Chopra et al. that established 5-year local control, disease free, and overall survival rates of 84%, 73%, and 74.5%, respectively, with the use of RT as early salvage therapy for vaginal recurrences of cervical cancer [102].

These guidelines are meant to help clinicians prioritize treatments but are not meant to serve as a replacement for clinician judgement. For each patient, the radiation oncologist must carefully consider the patient's risk of contracting SARS-CoV-2 (based on age, comorbidities, immunocompetence), the risks of modifying, delaying or omitting radiation therapy, epidemiologic characteristics of the geographic region

(anticipated peak, anticipated duration of peak), and availability of healthcare resources (highly-trained personnel, PPE). For patients with a diagnosis of COVID-19, there must be a careful balancing of the risks of immunosuppression from RT and chemotherapy with the risks of cancer progression that may arise from delay or omission of therapy. Additionally, the risks of exposure to SARS-CoV-2 among other patients and healthcare workers should be considered.

Clinicians may use these guidelines, along with their clinical judgement, when determining if or how RT should be modified during the COVID-19 pandemic. All decisions regarding modification, delay, or omission of RT should be clearly communicated to the patient along with the rationale, risks, benefits, and alternatives. If a decision to delay RT is made, the clinician and patient should have a thorough understanding of a follow up plan to minimize the risk of patients being lost to follow-up. Patients who choose to omit radiation therapy should be provided with a plan for cancer surveillance.

These recommendations are not intended to be static and they will continue to evolve based on local epidemiology of the SARS-CoV-2 virus, resource availability, and the development of effective medical therapies or a vaccine for SARS-CoV-2. However, these recommendations are meant to provide clinicians with a framework for triaging patients with gynecologic malignancies when there is any kind of resource limitation. As such, in the future, these guidelines may also be used for patient triage in the aftermath of other resource-limiting events such as natural disasters.

## Declaration of Competing Interest

Christen Elledge, Supriya Chopra, Beth Erikson, David Gaffney, Anuja Jhingran, Ann Klopp, and Catherine Yashar have nothing to disclose. Akila Viswanathan is the principal investigator of NIH R01 CA237005. Sushil Beriwal is a consultant for Varian and Medical Director of Via Oncology, outside the submitted work. Cyrus Chargari receives grant funding from Roche, personal fees from Merck Sharp & Dohme Corp., Elekta, and GlaxoSmithKline, as well as non-financial support from TherAguiX and GlaxoSmithKline, all outside the submitted work. William Small is the co-chair of the NRG Gyn Committee, has served on an advisory board for Merck, and has received honoraria for invited talks from Carl Zeiss Meditech, outside the submitted work.

## References

- [1] A.R. Escher Jr., An ounce of prevention: coronavirus (COVID-19) and mass gatherings, *Cureus* 12 (2020), e7345.
- [2] F. Rahimi, A. Talebi Bezin Abadi, Practical strategies against the novel coronavirus and COVID-19—the imminent global threat, *Archives of medical research*, 2020.
- [3] M. Chinazzi, J.T. Davis, M. Ajelli, et al., The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak, *Science* 386 (6489) (2020) 395–400.
- [4] M. Ueda, R. Martins, P.C. Hendrie, et al., Managing Cancer care during the COVID-19 pandemic: agility and collaboration toward a common goal, *Journal of the National Comprehensive Cancer Network : JNCCN* (2020) 1–4.
- [5] T.-K.T. Dinh, L.M. Halasz, E. Ford, R. Rengan, Radiation therapy in King County, Washington during the COVID-19 pandemic: balancing patient care, transmission mitigation and resident training, *Advances in Radiation Oncology*. (2020) (In press).
- [6] A. Shankar, D. Saini, S. Roy, et al., Cancer care delivery challenges amidst coronavirus disease - 19 (COVID-19) outbreak: specific precautions for Cancer patients and Cancer care providers to prevent spread, *Asian Pacific Journal of Cancer Prevention : APJCP* 21 (2020) 569–573.
- [7] T.K. Burki, Cancer guidelines during the COVID-19 pandemic, *Lancet Oncol.* 21 (5) (2020) 629–630.
- [8] J.A. González Ferreira, J. Jaén Olasolo, I. Azinovic, B. Jeremic, Effect of radiotherapy delay in overall treatment time on local control and survival in head and neck cancer: review of the literature, *Rep Pract Oncol Radiother* 20 (2015) 328–339.
- [9] V. Soyfer, R. Geva, M. Michelson, M. Inbar, E. Shacham-Shmueli, B.W. Corn, The impact of overall radiotherapy treatment time and delay in initiation of radiotherapy on local control and distant metastases in gastric cancer, *Radiation Oncology (London, England)* 9 (2014) 81–.
- [10] J. Huang, L. Barbera, M. Brouwers, G. Browman, W.J. Mackillop, Does delay in starting treatment affect the outcomes of radiotherapy? A systematic review, *J. Clin. Oncol.* 21 (2003) 555–563.

- [11] S. Song, S. Rudra, M.D. Hasselle, et al., The effect of treatment time in locally advanced cervical cancer in the era of concurrent chemoradiotherapy, *Cancer* 119 (2013) 325–331.
- [12] S.-M. Lin, H.-Y. Ku, T.-C. Chang, T.-W. Liu, J.-H. Hong, The prognostic impact of overall treatment time on disease outcome in uterine cervical cancer patients treated primarily with concomitant chemoradiotherapy: a nationwide Taiwanese cohort study, *Oncotarget* 8 (2017) 85203–85213.
- [13] C.A. Perez, P.W. Grigsby, H. Castro-Vita, M.A. Lockett, Carcinoma of the uterine cervix. I. Impact of prolongation of overall treatment time and timing of brachytherapy on outcome of radiation therapy, *International Journal of Radiation Oncology\*Biophysics\*Physics* 32 (1995) 1275–88.
- [14] J.S. Haviland, S.M. Bentzen, J.M. Bliss, J.R. Yarnold, Prolongation of overall treatment time as a cause of treatment failure in early breast cancer: an analysis of the UK START (standardisation of breast radiotherapy) trials of radiotherapy fractionation, *Radiother. Oncol.* 121 (2016) 420–423.
- [15] E.M. Graboyes, A.R. Kompelli, D.M. Neskey, et al., Association of Treatment Delays with Survival for patients with head and neck Cancer: a systematic review, *JAMA Otolaryngology– Head & Neck Surgery* 145 (2019) 166–177.
- [16] D. Dolly, A. Mihai, B.J. Rimel, et al., A Delay from Diagnosis to Treatment Is Associated with a Decreased Overall Survival for Patients with Endometrial Cancer, *Front. Oncol.* 6 (2016) 31–.
- [17] N. Chen, M. Zhou, X. Dong, et al., Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study, *Lancet (London, England)* 395 (2020) 507–13.
- [18] Y.-L. Chen, F.-M. Hsu, C.J. Tsai, Cheng J. Chia-Hsien, Efforts to reduce the impacts of COVID-19 outbreak on radiation oncology in Taiwan, *Advances in Radiation Oncology*. (2020) (In press).
- [19] W. Chen, X.-Y. Su, V.J. Wang, et al., Novel coronavirus international public health emergency: guidance on radiation oncology facility operation, *Advances in Radiation Oncology*. (2020) (In press).
- [20] M. Krengli, E. Ferrara, F. Mastrolo, M. Brambilla, U. Ricardi, Running a radiation oncology department at the time of coronavirus: an Italian experience, *Advances in Radiation Oncology*. (2020) (In press).
- [21] A. Papachristoflou, T. Finazzi, G. Kohler, C. Dott, F. Zimmermann, Contingency plans in a radiation oncology department amid the 2019-nCoV outbreak in Switzerland, *Advances in Radiation Oncology*. (2020) (In press).
- [22] A. Rivera, N. Ohri, E. Thomas, R. Miller, M.A. Knoll, The impact of COVID-19 on radiation oncology clinics and Cancer patients in the U.S, *Advances in Radiation Oncology*. (2020) (In press).
- [23] S. Wu, D. Zheng, Y. Liu, D. Hu, W. Wei, G. Han, Radiotherapy care during a major outbreak of COVID-19 in Wuhan, *Advances in Radiation Oncology*. (2020) (In press).
- [24] A. Al-Rashdan, M. Roumeliotis, S. Quirk, et al., Adapting radiotherapy treatments for breast Cancer patients during the COVID-19 pandemic: hypo-fractionation and accelerated partial breast irradiation to address World Health Organization recommendations, *Advances in Radiation Oncology*. (2020) (In press).
- [25] G. Banna, A. Curioni-Fontecedro, A. Friedlaender, A. Addeo, How we treat patients with lung cancer during the SARS-CoV-2 pandemic: primum non nocere, *ESMO Open* 5 (2020).
- [26] L.Z. Braunstein, E.F. Gillespie, L. Hong, et al., Breast radiotherapy under COVID-19 pandemic resource constraints – approaches to defer or shorten treatment from a Comprehensive Cancer Center in the United States, *Advances in Radiation Oncology*. (2020) (In press).
- [27] F. De Felice, A. Polimeni, V. Valentini, The impact of coronavirus (COVID-19) on head and neck cancer patients' care, *Radiother. Oncol.* 147 (2020) 84–85.
- [28] M. Guckenberger, C. Belka, A. Bezjak, et al., Practice recommendations for lung cancer radiotherapy during the COVID-19 pandemic: an ESTRO-ASTRO consensus statement, *Radiother. Oncol.* 146 (2020) 223–229.
- [29] F. De Felice, N. Petrucciani, Treatment approach in locally advanced rectal cancer during Coronavirus (COVID-19) pandemic: long course or short course? *Colorectal Disease : The Official Journal of the Association of Coloproctology of Great Britain and Ireland* (2020) (In press).
- [30] N.G. Zaorsky, J.B. Yu, S.M. McBride, et al., Prostate Cancer radiotherapy recommendations in response to COVID-19, *Advances in Radiation Oncology*. (2020) (In press).
- [31] D. Yerramilli, A.J. Xu, E.F. Gillespie, et al., Palliative radiotherapy for oncologic emergencies in the setting of COVID-19: approaches to balancing risks and benefits, *Advances in Radiation Oncology*. (2020) (In press).
- [32] C. Yang, C. Li, S. Wang, Clinical strategies for treating pediatric cancer during the outbreak of 2019 novel coronavirus infection, *Pediatr. Blood Cancer* 67 (2020), e28248. .
- [33] W. Liang, W. Guan, R. Chen, et al., Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China, *Lancet Oncol.* 21 (2020) 335–337.
- [34] L. Zhang, F. Zhu, L. Xie, et al., Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China, *Annals of Oncology : Official Journal of the European Society for Medical Oncology* (2020) (In press).
- [35] Pandemic Planning Clinical Guideline for Patients with Cancer, , Accessed April 9, 2020, at [https://www.accc-cancer.org/docs/documents/cancer-program-fundamentals/oh-cco-pandemic-planning-clinical-guideline\\_final\\_2020-03-10.pdf?sfvrsn=d2f04347\\_2\\_2020](https://www.accc-cancer.org/docs/documents/cancer-program-fundamentals/oh-cco-pandemic-planning-clinical-guideline_final_2020-03-10.pdf?sfvrsn=d2f04347_2_2020).
- [36] H.A. Gay, R. Santiago, B. Gil, et al., Lessons learned from hurricane Maria in Puerto Rico: practical measures to mitigate the impact of a catastrophic natural disaster on radiation oncology patients, *Practical Radiation Oncology* 9 (2019) 305–321.
- [37] I.-M. Jürgenliemk-Schulz, S. Beriwal, A.A.C. de Leeuw, et al., Management of Nodal Disease in advanced cervical Cancer, *Semin. Radiat. Oncol.* 29 (2019) 158–165.
- [38] C.H. Feng, Y. Hasan, M. Kopec, H.A. Al-Hallaq, Simultaneously integrated boost (SIB) spares OAR and reduces treatment time in locally advanced cervical cancer, *Journal of Applied Clinical Medical Physics* 17 (2016) 76–89.
- [39] J. Boyle, O. Craciunescu, B. Steffey, J. Cai, J. Chino, Methods, safety, and early clinical outcomes of dose escalation using simultaneous integrated and sequential boosts in patients with locally advanced gynecologic malignancies, *Gynecol. Oncol.* 135 (2014) 239–243.
- [40] M. Sharma, S. Revannasiddaiah, M. Gupta, R.K. Seam, M.K. Gupta, M. Rastogi, Can pure accelerated radiotherapy given as six fractions weekly be an option in locally advanced carcinoma cervix: results of a prospective randomized phase III trial, *J. Cancer Res. Ther.* 12 (2016) 103–108.
- [41] Cervical Cancer (Version 1.2020), National Comprehensive Cancer Network, Accessed April 26, 2020, at [https://www.nccn.org/professionals/physician\\_gls/pdf/cervical.pdf](https://www.nccn.org/professionals/physician_gls/pdf/cervical.pdf) 2020.
- [42] K. Albuquerque, B.A. Hryckushko, M.M. Harkenrider, et al., Compendium of fractionation choices for gynecologic HDR brachytherapy—an American brachytherapy society task group report, *Brachytherapy* 18 (2019) 429–436.
- [43] J. Hendry, G.W. Jones, U.M. Mahantshetty, et al., Radiobiological Analysis of Outcomes Using External Beam Radiotherapy Plus High Dose-Rate Brachytherapy (4x7 Gy or 2x9 Gy) for Cervical Cancer in a Multi-Institution Trial, *Int. J. Radiat. Oncol. Biol. Phys.* 99 (2017) 1313–4.
- [44] A.N. Viswanathan, S. Beriwal, J.F. De Los Santos, et al., American brachytherapy society consensus guidelines for locally advanced carcinoma of the cervix. Part II: high-dose-rate brachytherapy, *Brachytherapy* 11 (2012) 47–52.
- [45] M. Onsrud, B. Hagen, T. Stricker, 10-Gy single-fraction pelvic irradiation for palliation and life prolongation in patients with cancer of the cervix and corpus uteri, *Gynecol. Oncol.* 82 (2001) 167–171.
- [46] R.J. Boulware, J.B. Caderao, L. Delclos, J. Taylor Wharton, L.J. Peters, Whole pelvis megavoltage irradiation with single doses of 1000 rad to palliate advanced gynecologic cancers, *International Journal of Radiation Oncology\*Biophysics\*Physics* 5 (1979) 333–8.
- [47] D.I. Hodson, G. Krepert, Once-monthly radiotherapy for the palliation of pelvic gynecological malignancy, *Gynecol. Oncol.* 16 (1983) 112–116.
- [48] J.S. Halle, J.G. Rosenman, M.A. Varia, W.C. Fowler, L.A. Walton, J.L. Currie, 1000 CGY single dose palliation for advanced carcinoma of the cervix or endometrium, *International Journal of Radiation Oncology\*Biophysics\*Physics* 12 (1986) 1947–50.
- [49] W. Spanos Jr., C. Guse, C. Perez, P. Grigsby, R.L. Doggett, C. Poulter, Phase II study of multiple daily fractionations in the palliation of advanced pelvic malignancies: preliminary report of RTOG 8502, *Int. J. Radiat. Oncol. Biol. Phys.* 17 (1989) 659–661.
- [50] W.J. Spanos Jr., C.A. Perez, S. Marcus, et al., Effect of rest interval on tumor and normal tissue response—a report of phase III study of accelerated split course palliative radiation for advanced pelvic malignancies (RTOG-8502), *Int. J. Radiat. Oncol. Biol. Phys.* 25 (1993) 399–403.
- [51] D.H. Kim, J.H. Lee, Y.K. Ki, et al., Short-course palliative radiotherapy for uterine cervical cancer, *Radiat Oncol J* 31 (2013) 216–221.
- [52] L.G. Sapienza, M.S. Ning, A. Jhingran, et al., Short-course palliative radiation therapy leads to excellent bleeding control: a single Centre retrospective study, *Clinical and Translational Radiation Oncology* 14 (2019) 40–46.
- [53] A. Sedlis, B.N. Bundy, M.Z. Rotman, S.S. Lentz, L.I. Muderspach, R.J. Zaino, A randomized trial of pelvic radiation therapy versus no further therapy in selected patients with stage IB carcinoma of the cervix after radical hysterectomy and pelvic lymphadenectomy: a gynecologic oncology group study, *Gynecol. Oncol.* 73 (1999) 177–183.
- [54] W.A. Peters, P.Y. Liu, R.J. Barrett, et al., Concurrent chemotherapy and pelvic radiation therapy compared with pelvic radiation therapy alone as adjuvant therapy after radical surgery in high-risk early-stage Cancer of the cervix, *J. Clin. Oncol.* 18 (2000) 1606–1613.
- [55] A.I. Tergas, A.I. Neugut, L. Chen, W.M. Burke, D.L. Hershman, J.D. Wright, Radiation duration in women with cervical Cancer treated with primary Chemoradiation: a population-based analysis, *Cancer Investig.* 34 (2016) 137–147.
- [56] G. Macchia, S. Cilla, F. Deodato, et al., Simultaneous integrated boost volumetric modulated arc therapy in the postoperative treatment of high-risk to intermediate-risk endometrial Cancer: results of ADA II phase 1-2 trial, *Int. J. Radiat. Oncol. Biol. Phys.* 96 (2016) 606–613.
- [57] G. Macchia, S. Cilla, A.G. Morganti, et al., Adjuvant volumetric-modulated arc therapy with simultaneous integrated boost in endometrial cancer. Planning and toxicity comparison, *Acta Oncologica (Stockholm, Sweden)* 53 (2014) 251–8.
- [58] E. Kemmerer, E. Hernandez, J.S. Ferriss, et al., Use of image-guided stereotactic body radiation therapy in lieu of intracavitary brachytherapy for the treatment of inoperable endometrial neoplasia, *Int. J. Radiat. Oncol. Biol. Phys.* 85 (2013) 129–135.
- [59] K. Albuquerque, V. Tumati, J. Lea, et al., A phase II trial of stereotactic ablative radiation therapy as a boost for locally advanced cervical Cancer, *Int. J. Radiat. Oncol. Biol. Phys.* 106 (2020) 464–471.
- [60] M.M. Harkenrider, B. Martin, K. Nieto, et al., Multi-institutional analysis of vaginal brachytherapy alone for women with stage II endometrial carcinoma, *Int. J. Radiat. Oncol. Biol. Phys.* 101 (2018) 1069–1077.
- [61] J.K. Schwarz, S. Beriwal, J. Esthappan, et al., Consensus statement for brachytherapy for the treatment of medically inoperable endometrial cancer, *Brachytherapy* 14 (2015) 587–599.
- [62] T.M. Niazli, L. Souhami, L. Portelance, B. Bahoric, L. Gilbert, G. Stanimir, Long-term results of high-dose-rate brachytherapy in the primary treatment of medically inoperable stage I–II endometrial carcinoma, *International Journal of Radiation Oncology\*Biophysics\*Physics* 63 (2005) 1108–13.

- [63] W. Small Jr., S. Beriwal, D.J. Demanes, et al., American brachytherapy society consensus guidelines for adjuvant vaginal cuff brachytherapy after hysterectomy, *Brachytherapy* 11 (2012) 58–67.
- [64] R.A. Nout, V.T. Smit, H. Putter, et al., Vaginal brachytherapy versus pelvic external beam radiotherapy for patients with endometrial cancer of high-intermediate risk (PORTEC-2): an open-label, non-inferiority, randomised trial, *Lancet* (London, England) 375 (2010) 816–23.
- [65] B. Sorbe, B. Nordstrom, J. Maenpaa, et al., Intravaginal brachytherapy in FIGO stage I low-risk endometrial cancer: a controlled randomized study, *International Journal of Gynecological Cancer : Official Journal of the International Gynecological Cancer Society* 19 (2009) 873–878.
- [66] A. Klopp, B.D. Smith, K. Alektiar, et al., The role of postoperative radiation therapy for endometrial cancer: executive summary of an American Society for Radiation Oncology evidence-based guideline, *Practical Radiation Oncology* 4 (2014) 137–144.
- [67] S. Beriwal, D.J. Demanes, B. Erickson, et al., American brachytherapy society consensus guidelines for interstitial brachytherapy for vaginal cancer, *Brachytherapy* 11 (2012) 68–75.
- [68] D. D'Souza, E. Wiebe, N. Patil, et al., CT-based interstitial brachytherapy in advanced gynecologic malignancies: outcomes from a single institution experience, *Brachytherapy* 13 (2014) 225–232.
- [69] A.H. Klopp, A. Jhingran, L. Ramondetta, K. Lu, D.M. Gershenson, P.J. Eifel, Node-positive adenocarcinoma of the endometrium: outcome and patterns of recurrence with and without external beam irradiation, *Gynecol. Oncol.* 115 (2009) 6–11.
- [70] A. Mariani, M.J. Webb, G.L. Keeney, M.G. Haddock, G. Aletti, K.C. Podratz, Stage IIIC endometrioid corpus cancer includes distinct subgroups, *Gynecol. Oncol.* 87 (2002) 112–117.
- [71] D. Matei, V. Filiaci, M.E. Randall, et al., Adjuvant chemotherapy plus radiation for locally advanced endometrial Cancer, *N. Engl. J. Med.* 380 (2019) 2317–2326.
- [72] H.M. Keys, J.A. Roberts, V.L. Brunetto, et al., A phase III trial of surgery with or without adjunctive external pelvic radiation therapy in intermediate risk endometrial adenocarcinoma: a gynecologic oncology group study, *Gynecol. Oncol.* 92 (2004) 744–751.
- [73] R. Cattaneo 2nd, R.K. Hanna, G. Jacobsen, M.A. Elshaiikh, Interval between hysterectomy and start of radiation treatment is predictive of recurrence in patients with endometrial carcinoma, *Int. J. Radiat. Oncol. Biol. Phys.* 88 (2014) 866–871.
- [74] M.C.W.M. Bloemers, L. Portelance, R. Ruo, W. Parker, L. Souhami, A dosimetric evaluation of dose escalation for the radical treatment of locally advanced vulvar cancer by intensity-modulated radiation therapy, *Med. Dosim.* 37 (2012) 310–313.
- [75] C.M. Faul, D. Mirmow, Q. Huang, K. Gerszten, R. Day, M.W. Jones, Adjuvant radiation for vulvar carcinoma: improved local control, *Int. J. Radiat. Oncol. Biol. Phys.* 38 (1997) 381–389.
- [76] D.K. Gaffney, B. King, A.N. Viswanathan, et al., Consensus recommendations for radiation therapy contouring and treatment of vulvar carcinoma, *Int. J. Radiat. Oncol. Biol. Phys.* 95 (2016) 1191–1200.
- [77] A.N. Viswanathan, A.P. Pinto, D. Schultz, R. Berkowitz, C.P. Crum, Relationship of margin status and radiation dose to recurrence in post-operative vulvar carcinoma, *Gynecol. Oncol.* 130 (2013) 545–549.
- [78] B.V. Chapman, B.S. Gill, A.N. Viswanathan, G.K. Balasubramani, P. Sukumvanich, S. Beriwal, Adjuvant radiation therapy for margin-positive vulvar squamous cell carcinoma: defining the ideal dose-response using the National Cancer Data Base, *Int. J. Radiat. Oncol. Biol. Phys.* 97 (2017) 107–117.
- [79] N.C. te Grootenhuis, A.W. Pouwer, G.H. de Bock, et al., Margin status revisited in vulvar squamous cell carcinoma, *Gynecol. Oncol.* 154 (2019) 266–275.
- [80] J.M. Heaps, Y.S. Fu, F.J. Montz, N.F. Hacker, J.S. Berek, Surgical-pathologic variables predictive of local recurrence in squamous cell carcinoma of the vulva, *Gynecol. Oncol.* 38 (1990) 309–314.
- [81] H.D. Homesley, B.N. Bundy, A. Sedlis, L. Adcock, Radiation therapy versus pelvic node resection for carcinoma of the vulva with positive groin nodes, *Obstet. Gynecol.* 68 (1986) 733–740.
- [82] A. Parthasarathy, M.K. Cheung, K. Osann, et al., The benefit of adjuvant radiation therapy in single-node-positive squamous cell vulvar carcinoma, *Gynecol. Oncol.* 103 (2006) 1095–1099.
- [83] D.H. Moore, S. Ali, W.-J. Koh, et al., A phase II trial of radiation therapy and weekly cisplatin chemotherapy for the treatment of locally-advanced squamous cell carcinoma of the vulva: a gynecologic oncology group study, *Gynecol. Oncol.* 124 (2012) 529–533.
- [84] C. Faul, D. Miramow, K. Gerszten, C. Haung, R. Edwards, Isolated local recurrence in carcinoma of the vulva: Prognosis and implications for treatment, *Eur. J. Cancer* 33 (1997) S205-S.
- [85] N.T. Raffetto, Vincenzo, Mario Santarelli, et al., Radiotherapy alone and chemoradiation in recurrent squamous cell carcinoma of the vulva, *Anticancer Res.* 23 (2003) 3105–3108.
- [86] P. Blake, Radiotherapy and chemoradiotherapy for carcinoma of the vulva, *Best Practice & Research Clinical Obstetrics & Gynaecology* 17 (2003) 649–661.
- [87] J.N. Frey, M. Hampl, M.D. Mueller, A.R. Gunther, Should groin recurrence still be considered as a palliative situation in vulvar Cancer patients?: a brief report, *International Journal of Gynecological Cancer : Official Journal of the International Gynecological Cancer Society* 26 (2016) 575–579.
- [88] G. Cormio, V. Loizzi, C. Carriero, A. Cazzolla, G. Putignano, L. Selvaggi, Groin recurrence in carcinoma of the vulva: management and outcome, *European Journal of Cancer Care* 19 (2010) 302–307.
- [89] M.M. Manuel, L.P. Cho, P.J. Catalano, et al., Outcomes with image-based interstitial brachytherapy for vaginal cancer, *Radiotherapy and Oncology : Journal of the European Society for Therapeutic Radiology and Oncology* 120 (2016) 486–492.
- [90] D.T. Miyamoto, A.N. Viswanathan, Concurrent chemoradiation for vaginal cancer, *PLoS One* 8 (2013) e65048-e.
- [91] A. Kang JaV, Perez and Brady's Principles and Practice of Radiation Oncology, 6th ed. Wolters Kluwer/Lippincott Williams & Wilkins, Philadelphia, PA, 2013.
- [92] A.P. Brown, A. Jhingran, A.H. Klopp, K.M. Schmeler, P.T. Ramirez, P.J. Eifel, Involved-field radiation therapy for locoregionally recurrent ovarian cancer, *Gynecol. Oncol.* 130 (2013) 300–305.
- [93] R.S. Wax, M.D. Christian, Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients, *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie* 67 (2020) 568–576.
- [94] COVID-19 and Anesthesia FAQ, Anesthesia Patient Safety Foundation, Accessed April 26, 2020, at <https://www.apsf.org/covid-19-and-anesthesia-faq/> 2020.
- [95] V.A. Hamilton, M.J. Grap, The role of the endotracheal tube cuff in microaspiration, *Heart Lung* 41 (2012) 167–172.
- [96] D.J. Brewster, N.C. Chrimes, T.B. Do, et al., Consensus statement: safe airway society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group, *Med. J. Aust.* 212 (10) (2020) 472–481 2020–03.
- [97] T.M. Cook, K. El-Boghdady, B. McGuire, A.F. McNarry, A. Patel, A. Higgs, Consensus guidelines for managing the airway in patients with COVID-19: guidelines from the difficult airway society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists, *Anaesthesia* 75 (6) (2020) 785–799.
- [98] D.F. D'Silva, T.J. McCulloch, J.S. Lim, S.S. Smith, D. Carayannis, Extubation of patients with COVID-19, *Br. J. Anaesth.* (2020) (In press).
- [99] UCLA, Health Initiates COVID-19 Testing for all Incoming Surgical, Procedure Patients and ER Admissions. UCLA Newsroom, Accessed April 19, 2020, at <https://newsroom.ucla.edu/releases/covid-19-testing-surgeries-procedures-emergency-2020>.
- [100] T.B. Brown, L.M. Lovato, D. Parker, Procedural sedation in the acute care setting, *Am. Fam. Physician* 71 (2005) 85–90.
- [101] J.L. Wright, S.R. Alcorn, T. McNutt, et al., An integrated program in a pandemic: Johns Hopkins radiation oncology department, *Advances in Radiation Oncology* (2020) (In press).
- [102] S. Chopra, R. Engineer, S. Shah, et al., MRI- and PET-Guided Interstitial Brachytherapy for Postsurgical Vaginal Recurrences of Cervical Cancer: Results of Phase II Study, *International Journal of Radiation Oncology\*Biophysics* 106 (2020) 310–9.