Managing haematology and oncology patients during the COVID-19 pandemic: interim consensus guidance

Robert Weinkove*[,1,2], Zoe K McQuilten*[,3,4], Jonathan Adler[5], Meera R Agar[6], Emily Blyth[7,8], Allen C Cheng[3], Rachel Conyers[9,10], Gabrielle M Haeusler[11,12], Claire Hardie[13], Christopher Jackson[14,15], Steven W Lane[16], Tom Middlemiss[17], Peter Mollee[18,19], Stephen P Mulligan[20], David Ritchie[21], Myra Ruka[22,23], Benjamin Solomon[24], Jeffrey Szer[11,21], Karin A Thursky[11,24], Erica M Wood[3,4], Leon J Worth[11,24], Michelle K Yong[11,24], Monica A Slavin[11,24], Benjamin W Teh[11,24]

Following a cluster of viral pneumonia cases in late 2019, a novel coronavirus was isolated and reported in Wuhan, China in January 2020.[1] This virus, now termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causes a respiratory disease called coronavirus disease (COVID)-19 in infected individuals. COVID-19 spread rapidly worldwide, meeting conventional definitions of a pandemic. Although 81% of patients with COVID-19 have a mild illness, 14% have severe illness requiring hospitalisation and supplemental oxygen, and the remaining 5% become critically ill with respiratory failure, septic shock and/or multi-organ dysfunction.[1] Recent estimates of COVID-19 case fatality rates are around 2%, rising to 15% in patients aged 80 years or over.[1]

By early March 2020, the first instances of community spread of COVID-19 were documented in Australia, and the first COVID-19 cases were diagnosed in New Zealand. Given the spread of COVID-19 in other countries, including the dramatic rise in case numbers in Europe and the United States in March 2020, a further rise in cases across Australasia over the following months appears likely. At present, no vaccine or specific antiviral therapy is available. The only measures available to prevent or delay community spread of COVID-19 are containment and rigorous case finding. Once COVID-19 becomes widespread within a community, quarantine and social distancing measures may slow its further spread, and have been adopted in many jurisdictions.

Patients with cancers are frequently immunosuppressed by their disease and treatment, and are at increased risk of severe complications of respiratory viruses.[2] Moreover, many haematology and oncology patients will have additional risk factors for severe COVID-19, such as advanced age and comorbidities.[3]

Early review of a Chinese national data repository suggested a disproportionately higher prevalence of cancer (mainly lung cancer) in patients with confirmed COVID-19 compared with the general population;[4] however, no data are available on the incidence of COVID-19 in cancer patients compared with the general population.[5] Early COVID-19 outcome data suggested a case fatality rate of 5.6% among patients with cancer,[1] and one study suggested patients with cancer had a 3.5 times higher risk of severe COVID-19.[4] However, reported case numbers remain low, and the relative contribution of other risk factors, including age, to this risk is not clear.[6] Haematopoietic stem cell transplant (HSCT) recipients could be at particularly high risk: before the emergence of SARS-CoV-2, progression of the less pathogenic

Abstract

Introduction: A pandemic coronavirus, SARS-CoV-2, causes COVID-19, a potentially life-threatening respiratory disease. Patients with cancer may have compromised immunity due to their malignancy and/or treatment, and may be at elevated risk of severe COVID-19. Community transmission of COVID-19 could overwhelm health care services, compromising delivery of cancer care. This interim consensus guidance provides advice for clinicians managing patients with cancer during the pandemic.

Main recommendations: During the COVID-19 pandemic:

- In patients with cancer with fever and/or respiratory symptoms, consider causes in addition to COVID-19, including other infections and therapy-related pneumonitis.
- For suspected or confirmed COVID-19, discuss temporary cessation of cancer therapy with a relevant specialist.
- Provide information on COVID-19 for patients and carers.
- Adopt measures within cancer centres to reduce risk of nosocomial SARS-CoV-2 acquisition; support population-wide social distancing; reduce demand on acute services; ensure adequate staffing; and provide culturally safe care. Measures should be equitable, transparent and proportionate to the COVID-19 threat.
- Consider the risks and benefits of modifying cancer therapies due to COVID-19. Communicate treatment modifications, and review once health service capacity allows.
- Consider potential impacts of COVID-19 on the blood supply and availability of stem cell donors.
- Discuss and document goals of care, and involve palliative care services in contingency planning.

Changes in management as a result of this statement: This interim consensus guidance provides a framework for clinicians managing patients with cancer during the COVID-19 pandemic. In view of the rapidly changing situation, clinicians must also monitor national, state, local and institutional policies, which will take precedence.

Endorsed by: Australasian Leukaemia and Lymphoma Group; Australasian Lung Cancer Trials Group; Australian and New Zealand Children's Haematology/Oncology Group; Australia and New Zealand Society of Palliative Medicine; Australasian Society for Infectious Diseases; Bone Marrow Transplantation Society of Australia and New Zealand; Cancer Council Australia; Cancer Nurses Society of Australia; Cancer Society of New Zealand; Clinical Oncology Society of Australia; Haematology Society of Australia and New Zealand; National Centre for Infections in Cancer; New Zealand Cancer Control Agency; New Zealand Society for Oncology; and Palliative Care Australia.

*Joint first authors

[1] Wellington Blood and Cancer Centre, Capital and Coast District Health Board, Wellington, NZ. [2] Malaghan Institute of Medical Research, Wellington, NZ. [3] Monash University, Melbourne, VIC. [4] Monash Health, Melbourne, VIC. [5] Wellington Regional Hospital, Capital and Coast District Health Board, Wellington, NZ. [6] Improving Palliative, Aged and Chronic Care through Clinical Research and Translation, University of Technology, Sydney, NSW. [7] Westmead Hospital, Sydney, NSW. [8] Westmead Institute for Medical Research, Sydney, NSW. [9] Children's Cancer Centre, Royal Children's Hospital, Melbourne, VIC. [10] Murdoch Children's Research Institute, Melbourne, VIC. [11] Peter MacCallum Cancer Centre, Melbourne, VIC. [12] Royal Children's Hospital, Melbourne, VIC. [13] MidCentral District Health Board, Palmerston North, NZ. [14] Cancer Society of New Zealand, Wellington, NZ. [15] University of Otago, Dunedin, NZ. [16] Royal Brisbane and Women's Hospital, Brisbane, QLD. [17] Te Omanga Hospice, Lower Hutt, NZ. [18] Princess Alexandra Hospital, Brisbane, QLD. [19] University of Queensland, Brisbane, QLD. [20] Royal North Shore Hospital, Sydney, NSW. [21] Royal Melbourne Hospital, Melbourne, VIC. [22] Waikato District Health Board, Hamilton, NZ. [23] University of Auckland, Auckland, NZ. [24] University of Melbourne, Melbourne, VIC. ✉ zoe.mcquilten@monash.edu • doi: 10.5694/mja2.50607 • The unedited version of this article was published as a preprint on mja.com.au on 20 March 2020.

seasonal coronavirus infections from the upper to lower respiratory tract occurred in up to 30% of HSCT recipients.[7]

Patients with cancer could be at elevated risk of severe COVID-19, while delivery of cancer therapies could be disrupted by quarantines, social distancing measures, and interruption of routine health care delivery by the pandemic. Pending more definitive evidence, this article presents interim guidance, based on expert opinion, to aid decision making for clinicians treating patients with cancers. The suggestions provided here may be relevant to both adult and paediatric patients. As recommendations may change in light of new evidence or experience, we encourage clinicians to refer to the official information sources regularly, and the website of the National Centre for Infections in Cancer (https://cancerandinfections.org/) for updates to this guidance.

Clinical presentation and diagnosis

The most frequent symptoms of COVID-19 are fever (90–98%), cough (59–76%) and lethargy (38–70%).[3,8–10] Abnormalities on computed tomography scans of the chest have been reported in 80–100% of admitted patients, with bilateral ground glass opacities the most common finding.[3,8,10–12] Median time to development of dyspnoea is 5–8 days[3,9] with median hospital admission stay of 7–10 days.[3] In adults, intensive care admission has been reported in 26% of admissions at a median time of 12 days after illness onset, coinciding with onset of acute respiratory distress syndrome.[10] Atypical clinical presentations of other infections are common among cancer patients receiving highly immunosuppressive therapies,[13] although whether this applies to COVID-19 is not yet known.

The clinical impact of COVID-19 in children with cancer or haematological malignancy is currently unknown. Although the mechanism is not clear, children appear to be less frequently affected by SARS-CoV-2, representing only 2% of COVID-19 presentations in a large Wuhan series.[1,14] When symptomatic illness occurs in children, it is usually mild, with fever and cough most frequently reported. Diffuse pulmonary infiltrates in an asymptomatic child were recently described.[15] However, while asymptomatic or mild illness following SARS-CoV-2 infection is the norm in otherwise well children, the risk of severe illness may be higher in the immunocompromised. This is highlighted by a report of severe COVID-19 in a child receiving chemotherapy for acute lymphoblastic leukaemia.[16]

Diagnosis can be made by specific reverse transcription polymerase chain reaction assay of nasopharyngeal or oropharyngeal swabs and lower respiratory tract samples[3] with median viral shedding of 20 days (interquartile range, 17–24 days).[10] Following infection, SARS-CoV-2 viral shedding might be more prolonged in patients with cancer: viral shedding of seasonal coronaviruses lasts up to 4 weeks in patients with cancer,[7] and shedding of other respiratory viruses is prolonged in immunosuppressed patients.[17] The SARS-CoV-2 virus can also be detected in stool samples. Although the impact of this on virus transmission remains uncertain, this should be considered in patients with therapy-associated diarrhoea or with stomas.[18] Clinicians must note that the coronavirus testing incorporated in routine respiratory virus polymerase chain reaction panels may not detect SARS-CoV-2, and should verify suitability of the assays in local use for COVID-19 testing.

Risk factors for severe COVID-19

Established risk factors for severe COVID-19 in adults include advanced age and medical comorbidities.[3] In-hospital death has been independently associated with higher age, higher Sequential Organ Failure Assessment score and elevated D-dimer levels.[10] Importantly, some laboratory findings associated with adverse COVID-19 outcomes, such as lymphopenia, neutrophilia, elevated D-dimer levels and elevated lactate dehydrogenase levels, are frequent in patients with cancer. However, the applicability of these biomarkers of COVID-19 severity to patients with cancer has not been established, and they should be interpreted with caution.

In an early report of patients with COVID-19 in China, receipt of chemotherapy or cancer surgery was a risk factor for severe complications.[20] Patients with cancer were also reported to be at higher risk of severe complications including intensive care unit admission, invasive ventilation or death,[20] and deteriorated more rapidly (median, 13 days *v* 43 days). Receipt of cancer therapy or surgery within the preceding month was associated with an increased risk of severe events after adjusting for other factors (odds ratio, 5.34; $P < 0.01$).[20] However, the number of COVID-19 cases with cancer in this series was small and the contribution of confounding factors, including smoking, was not clear.[5]

Risk factors for severe COVID-19 in children are currently unknown, although a study of seasonal coronaviruses in children found that co-infection, younger age and immunocompromise were associated with an increased risk of severe lower respiratory tract infection.[21]

Specific risk factors for severe respiratory viral infection in patients with solid tumours are poorly described in the literature. Although many treatments for solid tumours do not cause prolonged severe lymphopenia or neutropenia, severe infection risk may be elevated due to disruption of mucosal barriers by chemotherapy-induced mucositis, or altered anatomy and reduced physiological reserve caused by the malignancy itself or as a consequence of surgery or radiotherapy.[22] This may be of particular relevance to patients with lung cancer, who made up the majority of cancer patients affected by COVID-19 in an early report.[20]

Among adult haematology and HSCT patients with seasonal coronavirus (not SARS-CoV-2) infections, the following risk factors for lower respiratory tract disease were identified:[2,7,23] age 50 years and above; receipt of corticosteroids; graft versus host disease; lymphopenia; neutropenia; and hypogammaglobulinaemia (IgG < 4 g/L).

Until specific risk factors for severe COVID-19 manifestations among patients with cancer have been identified, clinicians will need to use their clinical judgement, referencing established risk factors for severe manifestations of other respiratory viruses, to evaluate an individual patient's risk of severe COVID-19.

Method

The consensus development process began with definition of the objectives, a review of evidence, and identification of key considerations for clinicians, by members of the Australasian Leukaemia and Lymphoma Group and the National Centre for Infections in Cancer. The objective was to provide interim guidance for clinicians managing patients with cancer during the COVID-19 outbreak.

As clinical urgency and travel restrictions precluded face to face meetings, discussions were held by telephone conference

and email. Draft guidance was circulated by email to clinicians with expertise in medical and radiation oncology, HSCT, palliative care and Indigenous health; comments and edits were integrated into the guidance by a core writing group. As well as circulating versions to all co-authors for comment, sequential versions were uploaded to the National Centre for Infections in Cancer website in view of the clinical urgency. Later versions were circulated to leads of cancer and infectious disease organisations across Australia and New Zealand for review and to consider endorsement; additional suggestions from these groups were incorporated into the text by the core writing group, and the document was recirculated for approval. The draft guidance was reviewed by the consumer representative group of the Australasian Leukaemia and Lymphoma Group, and their suggestions were incorporated. As the clinical urgency and paucity of clinical evidence precluded satisfaction of all advancing guideline development, reporting and evaluation in health care (AGREE) instrument items,[24] this document is presented as interim, rather than definitive, consensus guidance.

Recommendations

Management of COVID-19

At this time, indications for testing for SARS-CoV-2 in cancer patients remain the same as the general population, although some specialist societies have recommended screening of patients for SARS-CoV-2 before high risk procedures, such as stem cell transplantation.[25] As indications for SARS-CoV-2 testing are rapidly evolving, clinicians should defer to the latest jurisdictional or institutional guidelines.

Interim guidance for the treatment of COVID-19 is available elsewhere.[19] Antiviral therapies such as lopinavir–ritonavir and remdesivir are undergoing evaluation, and the role of anticytokine therapies such as tocilizumab for severe infections is under exploration. Pending further information, we suggest that management of COVID-19 should be similar for patients with and without cancer. Immunocompromised patients with suspected or confirmed COVID-19 should be discussed with an infectious disease or clinical microbiology specialist. However, clinicians should be aware of the following considerations for patients with cancer who develop symptoms of COVID-19:

- Among immunocompromised patients, the differential diagnosis of fever and respiratory symptoms is broad, and clinicians should be alert to the possibility of alternative or secondary infections, including bacterial, fungal or other viral infections. Early recognition and treatment of bacterial sepsis remains vital, particularly in severely neutropenic patients.
- Pneumonitis may occur following certain cytotoxic chemotherapies, immune checkpoint blockade or radiotherapy, and shares clinical and radiological features with COVID-19. Corticosteroids should be considered if therapy-related pneumonitis is suspected, acknowledging that a detrimental impact of corticosteroids on the risk of severe COVID-19 has not been excluded.
- Temporary discontinuation of cancer therapies will be warranted for some patients with cancer who develop symptoms of COVID-19, to minimise treatment-related immunosuppression or to reduce the risk of drug interactions. This should be undertaken in discussion with an oncologist or haematologist familiar with management of the malignancy, who can advise on the benefits and risks of pausing therapy.

For each of the reasons above, community assessment and management procedures developed for healthy people with COVID-19 may be less well suited for some patients with cancer.

Cancer centre preparation and response

Health care system and policy responses to COVID-19 are evolving rapidly. Haematologists and oncologists should regularly review and follow institutional, specialist college, state level and federal government recommendations. We encourage haematology and oncology representatives to engage with, and participate in, pandemic planning within their organisations.

As many patients with cancer may be at increased risk of severe COVID-19 manifestations, we suggest a proactive approach. In Box 1, we propose actions to consider, phased according to the presence or absence of community spread of COVID-19 locally, and the capacity of health care services to deliver routine care. The suggested actions will not be appropriate for all settings, and are not exhaustive, but are intended to prompt discussion among clinicians planning their service's COVID-19 response. At each phase, clinicians should review actions they could take to prepare for the subsequent phase; some units may elect to initiate later phase actions at an earlier phase. The actions are cumulative — the measures in phases B and C are suggested in addition to those of phase A. Measures should be reviewed regularly, and reversed once the situation allows. Institutional, local, statewide and national policies and recommendations (including for social distancing, isolation, quarantine or personal protective equipment use) are likely to cover some or all of these actions, and should take priority.

Social distancing measures, quarantine and visitor limitations will limit opportunities for family support and advocacy, affecting an important sense of connection and source of strength and wellbeing, particularly for Indigenous peoples. We recommend services recognise these impacts and seek to counterbalance them with measures to ensure safe non-physical contact and support, such as facilitation of video and telephone contact. Refer to guidance for the delivery of culturally safe care.[26,27]

The spread of COVID-19 can be rapid, and may overwhelm primary and acute care facilities.[1,28] This may be compounded by COVID-19 infection of medical personnel, quarantine requirements and school closures, all of which may impact staffing levels,[3] and by disruption to supply chains, affecting medical supplies. If acute care facilities are overwhelmed, institutions might make alternative provisions for the care of patients with cancers. Adaptive measures could include increased use of community care (including hospital-in-the home services) or private facilities. Clinicians may need to work flexibly to facilitate safe service provision in alternative settings.

Resource constraints may mandate prioritisation or modification of patients' cancer therapies. While it is anticipated that institutions will develop their own plans, which will take priority, we suggest individual patient decisions should be the responsibility of clinicians who are familiar with the malignancy, its treatment, and other therapeutic options. Clinicians will have to balance the relative risks of patients developing COVID-19 while severely immunosuppressed, or of developing a severe treatment complication, against the risks of tumour progression, while considering the prevailing state of the health care service, and current or incipient medicine supply constraints.

We suggest discussing risks and benefits of any treatment modifications among clinical peers. Take particular account of the need to protect vulnerable populations, including Indigenous

1 Actions to consider, according to community level COVID-19 transmission and health care capacity*

Phase	Aims	Issues	Actions to consider
A: No apparent community level COVID-19 transmission	• Reduce risk of nosocomial acquisition of respiratory viruses • Inform and educate patients and staff	Staff education	• Education or re-education, including of receptionists/administrators, ward/day unit staff, clinicians, allied health teams, radiation therapists and staff at patient hostels: ▸ hand hygiene practices ▸ use of personal protective equipment ▸ institutional policies for respiratory virus isolation ▸ policies to limit unwell ward visitors ▸ importance of staying away from work if unwell with fever or respiratory symptoms • Re-education regarding communication skills required for effective goals of care conversations
		Early identification of potential cases	• Discuss patients hospitalised with febrile respiratory illnesses and no identified cause with infectious diseases or microbiology team regarding role of investigation for COVID-19
		Vaccination	• Encourage staff and patient uptake of seasonal influenza vaccination
		Advice to patients	• Advice for concerned patients (see "Patient information" in the main text) • Instruction on how to present if febrile with respiratory symptoms • Smoking cessation advice • Proactive engagement regarding goals of care and advance care planning for all patients to assist future decision making
B: Community level COVID-19 transmission; health care service provision as normal	• Reduce risk of nosocomial SARS-CoV-2 acquisition • Reduce risk of staff acquisition of SARS-CoV-2 • Support any recommended social distancing measures	Clinics	• Screen for COVID-19 symptoms before clinic or radiation treatment (eg, via written information, telephone contact or direct symptom enquiry) • Conduct outpatient clinics away from acute care facilities • Conduct selected consultations remotely (via telephone, video, written advice) • Defer some non-urgent new and follow-up appointments • Limit visitors attending with patients
		Routine investigations	• Review frequency and location of routine tests (eg, blood tests, scans) which may bring patients with cancer into contact with those with respiratory symptoms
		In-department isolation/assessment facility (eg, fever clinic)	• Establish COVID-19 isolation/assessment process for haematology/oncology patients, aiming to avoid exposure to SARS-CoV-2 and to separate from other haematology/oncology waiting and treatment areas • Stagger treatment times or locations
		Cancer therapy and supportive care	• Optimise prophylactic measures (eg, granulocyte colony stimulating factor, antimicrobial prophylaxis, immunoglobulin replacement) to reduce risk of infections requiring inpatient therapy • Employ alternatives to transfusion (see "Transfusion" in the main text) • Reduce unnecessary immunosuppression if safe to do so • Defer or delay selected non-time critical cancer therapies, including radiation treatment, if it will not compromise outcome • Use shortened radiation protocols where safe to do so and compensate for breaks in treatment using appropriate fractionation schedules • Ensure adequate supplies of all medicines and equipment required, including for symptom management and end-of-life care (eg, opioids, syringe drivers)
		Community or hospital-in-the-home services	• Enhance capacity for community care as alternative to cancer centre or inpatient care
		Wards/inpatient care	• Limit ward visitors • Minimise non-essential hospital admissions • Consider early discharge from hospital if safe to do so • Reduce non-essential staff and student contact with inpatients
		Clinical meetings	• Limiting meeting attendance to key attendees • Use teleconferencing facilities when possible
		Education	• Postpone non-essential face-to-face educational meetings • Provide education via teleconferencing or other electronic formats • Provide education into the management of COVID-19, including symptoms
		Staff working arrangements and leave	• Ask staff to work from home when not required in person • Review upcoming annual and study leave to provide contingency for sickness/absence • Define minimum staffing for provision of skeleton service • Establish clear collaboration with specialist palliative care services across all settings with clear lines of responsibility for treatment decisions

Continues

1 continued

Phase	Aims	Issues	Actions to consider
C: Community level COVID-19 transmission; health care service capacity exceeded	• Reduce demand on acute services • Prioritise and deliver urgent and essential cancer therapies • Reduce risk of treatment complications that cannot be adequately managed • Ensure adequate staffing for essential services	Alternative treatment delivery settings	• Implement any plans to deliver cancer investigation and treatment in alternate settings (eg, in community or private health care facilities) • Maximise use of remote consultations (telephone, video, written advice) • Implement plans to deliver end-of-life care in designated settings
		Treatment prioritisation and demand limitation meetings	• Prioritise urgent and potentially curative treatments • Ensure equity, proportionality and transparency at all stages of illness and regarding all treatments; refer to ethical and regulatory guidance. Consider pre-identification of patients whose disease status would limit escalation of hospital-based treatment and allow primary care decision makers the ability to minimise hospital inpatient overload • Document decisions and review regularly
		Treatment modifications	• If necessary, clinician-led modification of cancer treatments on case-by-case basis. Risk/benefit will vary. Seek peer review and support. Examples could include: ▸ oral alternatives to parental therapy ▸ selection of less myelosuppressive regimens ▸ abbreviated or shorter-course treatments ▸ schedules requiring less frequent cancer centre attendance ▸ deferral of treatment where appropriate • Document and communicate decisions clearly, including to patients • Arrange review of decisions at appropriate interval • Telephone consultation/support between primary oncology care and specialist palliative care, with likely decrease in face-to-face patient assessments
		Transfusion support	• Adopt restrictive transfusion thresholds (see "Transfusion" in the main text)
		Staff leave	• Cancel annual and study leave • Implement plans for skeleton service provision

* The lists of actions to consider are cumulative; actions suggested during phase B are in addition to those during phase A, and actions from all phases should be considered during phase C. ◆

peoples, who experience a higher burden of both cancer and infectious disease.[29–33] We suggest clearly documenting any treatment modifications, and the reasons for them, in each patient's medical record, and communicating them to the patient and their primary care physician. Consider reviewing treatment modifications once resource availability allows; in some circumstances it may be appropriate to resume a postponed treatment, or to complete an abbreviated treatment course.

The ethical principles of equity, proportionality and transparency apply to resource allocation decisions. Refer to relevant regulatory guidance, such as that provided by the Medical Council of New Zealand's *Safe practice in an environment of resource limitation*,[29] and to ethical frameworks, as outlined in the *Australian health sector emergency response plan for novel coronavirus (COVID-19)*.[30] If crisis standards of care replace normal standards, conflicts with and between other ethical principles including justice, non-maleficence, beneficence and autonomy may become acute, and need to be openly acknowledged and addressed. Where available, objective national guidelines should be followed, and a fair decision-making process adopted and shared between appropriate senior medical staff. Staff involved with such decisions should be supported during and after the crisis has resolved.

Patient information

Many patients with cancer, and their families, will be concerned or distressed about the impacts of COVID-19. A list of suggested messages for clinicians to communicate to their patients with cancer is outlined in Box 2.

As COVID-19 recommendations are likely to change frequently, clinicians should direct patients towards the most up-to-date resources from the Department of Health in Australia (https://www.health.gov.au/news/health-alerts/novel-coronavirus-2019-ncov-health-alert) and the Ministry of Health in New Zealand (https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus).

Patients with family members or other close contacts who have suspected or confirmed COVID-19 should aim to remain isolated from these contacts, and should inform their cancer centre of any quarantine requirements. The recommendations of the relevant health department regarding quarantine and isolation should be followed.

Steps should be taken to reduce the risk of patients with symptoms of COVID-19, or with a known SARS-CoV-2 contact, presenting unannounced to cancer centres or clinics. We suggest that cancer centres inform patients of the symptoms of COVID-19, indicate criteria for seeking medical advice, and state the appropriate mode of presentation. This may include use of a triage line, assessment in an acute care setting with isolation and testing facilities, or use of a dedicated community assessment facility. Advice should be consistent with institutional, state or federal guidance, and should be disseminated to receptionists, nursing and clinical staff, as well as to patients themselves. Advice should take account of the possibilities that cancer patients presenting with fever may be at elevated risk of bacterial or fungal infection requiring prompt antimicrobial therapy, and that the differential diagnosis of fever should not be limited to COVID-19 (see "Management of COVID-19" above).

Measures that might be widely implemented in a pandemic setting, and which may warrant modification for immunocompromised patients, include community-based assessment; home treatment of COVID-19; cohorting with other infected patients in a non-specialist ward; and symptomatic COVID-19 treatment without confirmatory investigations or without empiric antibiotics. During the pandemic, patients may be assessed and

2 Communication points regarding COVID-19 for patients with cancer and their carers

- Severe COVID-19 disease is possible in any individual, but patients with cancer may be at higher risk due to their disease and/or its treatment.
- Preventing transmission of infection should be a high priority for patients and carers. Review, monitor and closely adhere to recommendations from the Department of Health (Australia) or Ministry of Health (New Zealand) regarding hand hygiene, social distancing and other measures to avoid COVID-19.
- Reiterate smoking cessation advice.
- No vaccine for COVID-19 is available, but vaccination against influenza (and against other infections if appropriate) and adherence to other recommended measures to reduce infection risk (eg, prophylactic antimicrobials, limiting dusts and soil exposure if prolonged severe neutropenia) may reduce risk of other infections.
- Provide advice on when, how and where to present for assessment if patients have symptoms suggesting COVID-19, or have had recent contact with a person with COVID-19; and advise patients not to present unannounced to the cancer centre or clinic.
- COVID-19 is not the only potential cause of fevers or respiratory symptoms; patients must still follow febrile neutropenia recommendations if applicable, and be alert to other side effects of treatment (including pneumonitis, if applicable).
- Patients should communicate their cancer diagnosis and any current treatments to clinicians, or to telemedicine advice providers, if under assessment for possible or proven COVID-19 or exposure. Consider providing patients with a copy of a recent clinic letter to carry.
- Provide advice on how to contact the cancer centre in case of difficulty obtaining medications as a result of increased demand or supply constraints.
- If considering domestic or overseas travel, patients should follow government advice, advise their clinician, and ensure they have sufficient medication for their journey, taking the risk of quarantine into account.
- Direct patients towards information resources regarding COVID-19 specifically for cancer patients and their carers if available.

managed by clinicians unfamiliar with their medical history; we suggest that patients be aware of and inform clinicians of their malignancy and its treatment.

We recommend that patients with cancer review governmental advice and restrictions before undertaking domestic and overseas travel. Patients should ensure they travel with a sufficient supply of their medicines, accounting for the risk of quarantine during or after their journey. Patients must be aware that in addition to a higher risk of infection with SARS-CoV-2, access to medical services may be limited in regions where the COVID-19 caseload has exceeded health care capacity.

Transfusion

Transfusion support for patients with cancer and blood disorders accounts for most outpatient red cell and platelet utilisation, and for a large proportion of inpatient transfusions.[34]

Transfusion requires close patient monitoring, placing demands on inpatient and outpatient cancer services, which could fall under strain during the pandemic. Visits to acute care facilities for transfusions expose immunocompromised patients to other patients and staff, some of whom could be shedding SARS-CoV-2. Community spread of COVID-19 may reduce the blood donor pool and threaten blood supplies due to deferral of donors, blood service staff shortages, or shortages of consumables and reagents. Finally, although there is no precedent for transfusion transmission of respiratory viruses, SARS-CoV-2 viral RNA can be detected in the plasma of people with COVID-19, and donor deferral is the only current mechanism in place to prevent transmission via blood components.[35] Although pathogen reduction technologies for platelets and plasma are effective for other coronaviruses, these are not in routine use in Australia or New Zealand, and no licensed pathogen reduction technology is available for whole blood or red cells.[35] Updated information on risk of transfusion transmission and donor deferrals is provided by Australian Red Cross Lifeblood (https://www.transfusion.com.au) and the AABB.[36] The National Blood Authority response to COVID-19 and the National Blood Supply Contingency Plan are available at https://www.blood.gov.au,[37] and the World Health Organization provides guidance for national blood services on managing blood supplies.[38]

Community spread of COVID-19 has the potential to diminish the donor pool, to threaten the capacity of cancer services to provide routine transfusion support, and to increase the risks that transfusion-dependent patients will come into contact with other individuals with SARS-CoV-2. This may favour the adoption of more restrictive transfusion practices during the pandemic, especially when health care services experience capacity constraints.

Restrictive red cell transfusion strategies have been assessed in a variety of settings. Although optimal thresholds for outpatient transfusion of patients with haematological malignancies have not been established,[39] and practice varies widely,[40] preliminary data suggest that more restrictive transfusion thresholds require fewer red cells.[41] Red cell transfusion thresholds have been reviewed elsewhere,[42] and the most highly restrictive thresholds may be inappropriate in patients with cardiovascular disease.[43] For some patients, iron, folic acid, vitamin B12 or erythropoietin may present alternatives to red cell transfusion and should be considered, to limit transfusion need.

Due to their short shelf-life, platelets may be impacted by blood supply shortages early. While prophylactic platelet transfusion reduces risk of bleeding following intensive chemotherapy for haematological cancers, an impact on survival has not been demonstrated.[44] International guidelines recommend no prophylactic platelet transfusions for asymptomatic patients with chronic bone marrow failure (including during low dose oral chemotherapy or azacitidine), and to consider no prophylactic platelet transfusions for well patients without bleeding after autologous stem cell transplantation.[45] An ongoing trial is assessing efficacy and safety of prophylactic tranexamic acid during severe thrombocytopenia after intensive chemotherapy.[46] In the event of health care capacity constraints or a threat to the supply of platelets for transfusion, clinicians should consider transfusing only patients at highest risk of bleeding, and consider alternatives to platelet transfusion (such as tranexamic acid), restrictive platelet transfusion criteria and deferral of non-urgent therapies likely to require platelet transfusion support.

Haematopoietic stem cell transplantation and cellular therapies

Both autologous and allogeneic HSCT, and cellular cancer therapies, such as chimeric antigen receptor T cell therapies, present specific challenges, as they place recipients at high risk of infection, often for an extended period. Moreover, if health care services are overwhelmed by demand, there is a risk that recipients will be unable to receive prompt intensive care therapy.

Regulatory and ethical considerations for modifying or deferring bone marrow transplants and cellular therapies mirror those for non-cellular therapies (see "Cancer centre preparation and response" above). Team-based discussion, application of the

principles of equity, transparency and proportionality, and clear documentation of decisions and their reasons, with subsequent review once capacity allows, are recommended.

Recipients of autologous and allogeneic transplantation. Infection with respiratory viruses presents an increased mortality risk for HSCT recipients,[47] and transplantation in recipients with active respiratory infections is often delayed where possible. Community transmission of SARS-CoV-2 should be taken into account when considering risks and benefits of transplantation, which are likely to differ on a case-by-case basis. During community SARS-CoV-2 transmission, transplant recipients should be advised to self-isolate before the procedure. Inclusion of SARS-CoV-2 in pre-transplant infectious disease screening of symptomatic recipients should be considered if community transmission is present, and some specialist societies are now recommending this for all recipients,[25] with a positive result prompting consideration of deferral.

Post-transplant care should be guided by the principles outlined in previous sections, with particular attention to the period before immune recovery. Among adult HSCT recipients, the immunodeficiency scoring index, initially developed for respiratory syncytial virus, might help evaluate the risks of lower respiratory tract disease and of mortality.[48] The immunodeficiency scoring index has been applied to HSCT recipients with influenza virus infection,[49] but is not yet validated for SARS-CoV-2 infection. Consideration should be given to early vaccination for respiratory pathogens (seasonal influenza and *Streptococcus pneumoniae*).

Stem cell donor and logistical considerations. Most unrelated donor stem cell products in Australasia come from international donors.[50] The complex logistics of international stem cell donation are vulnerable to disruption by the COVID-19 pandemic, which could affect donor availability, donor site staffing, border restrictions, international flight changes, courier availability, and specialist laboratory staffing. Donor cancellation may occur at short notice between donor assessment and stem cell harvest, presenting a risk that recipients lack a stem cell product after myelosuppressive conditioning. Contingency planning could include securing back-up donors if possible, or collection, transportation, cryopreservation and storage of stem cell products at the transplant unit before commencing recipient conditioning.

It is unclear whether SARS-CoV-2 is transmissible by cellular therapy products. Viral RNA can be detected in plasma of COVID-19 patients, but the presence of infectious virus has not been reported.[36] At present, no recommendation can be made for donor SARS-CoV-2 testing, owing to variable availability of polymerase chain reaction testing at donor collection centres and the lack of a serologic assay, but donor testing may be adopted in the future. Donors in all regions should be assessed for risk based on current knowledge of local COVID-19 prevalence, travel history, exposures and symptoms. Position statements have been provided by a number of transplant organisations including the World Marrow Donor Association.[51] Donor registries and bone marrow transplant and cellular therapy societies have produced guidelines and position statements,[25,51–53] which are frequently updated.

The impact of COVID-19 on international transport may also affect the supply chain for autologous chimeric antigen receptor T cells. As for stem cell recipients, patients awaiting chimeric antigen receptor T cell therapies should consider self-isolation to minimise the risk of SARS-CoV-2 exposure during the period of greatest vulnerability.

Radiation oncology

Provision of radiation therapy should be guided by the principles outlined above in "Cancer centre preparation and response". The lead time between radiotherapy planning and treatment may be days to weeks, while cessation of radiation therapy partway through a treatment course may compromise outcomes. Radiation oncology services should attempt to anticipate staffing and other capacity constraints, which will be difficult in a rapidly changing situation. Consider use of shorter fractionation schedules where this is an option,[54] deferral of therapy, or omission of radiotherapy if the clinical benefit is low and the risk is high. Radiation oncology services should screen patients for symptoms suggestive of COVID-19, and adopt infection control measures. For some centres, this may include consideration of dedicating a linear accelerator for those with suspected or confirmed COVID-19.[54,55]

Clinical trial participants

The ICH guideline (paragraph 2.3) states that the "rights, safety, and well-being of the trial subjects are the most important considerations and should prevail over interests of science and society".[56] At phases B and C (see "Cancer centre preparation and response" above and Box 1), it may be necessary to reduce routine follow-up appointments, institute remote or telehealth reviews, or modify treatment plans and strategies for treatment delivery in the interests of the study participant. If this will lead to protocol deviations or violations, clinicians should contact the medical monitor or sponsor of their study, and contact the relevant human ethics committee. International travel restrictions could affect trial monitoring, start-up and investigator meetings, and distribution of investigational products and laboratory samples. When enrolling new participants, principal investigators should take reasonable steps to ensure that a trial is proceeding as usual, and consider the potential impact of COVID-19 on the capacity of their own centre to conduct study procedures according to the trial protocol. Consideration should be given to suspending accrual of new patients to ongoing trials and delaying opening of new trials based on availability of local resources.

Palliative care

Palliative care will play a critical role during the COVID-19 pandemic, and will be a responsibility for all health care professionals.[57] Cancer services should collaborate with specialist palliative care services when developing COVID-19 contingency plans.

Palliative care will involve managing symptoms of cancers and COVID-19 at all stages, including at the end of life. Other roles include rapid reassessment of an individual patient's goals if treatment plans are changed, helping patients and families navigate end-of-life care decisions during a period of societal and economic disruption, supporting care in the community to avoid unnecessary hospitalisations, and delivering care in a culturally safe and responsive manner.[26,27]

At the same time as raising demand, COVID-19 presents a threat to palliative care service staffing and capacity. Palliative care delivery will frequently need to be undertaken by primary treating teams, under guidance of specialist palliative care services. Throughout the pandemic, clinicians should proactively discuss goals of care with patients with advanced cancers, and clearly document enduring powers of attorney or advance care plans.

Visitor restrictions on wards, quarantine or isolation requirements, and travel restrictions or social distancing measures are likely to complicate the planning and delivery of palliative care and compete with cultural rituals and norms for end-of-life care and death. Increased use of telephone or video consultation will become necessary. Issues of trust, isolation, disconnectedness and worries about abandonment should be proactively addressed.[58] In particular, the impact of restriction or banning of hospital visitors on the presence of family and friends at life's end needs to be addressed with compassion and humanity. At all stages of the COVID-19 pandemic, for all patients, clinicians should strive to follow the principle of non-abandonment.

Conclusion

The COVID-19 pandemic presents a challenge of global reach and significance which is unprecedented in the era of modern haematology and oncology. We present interim guidance for clinicians caring for patients with cancer who may be particularly vulnerable both to severe COVID-19 and the potential impact of the pandemic on the provision of cancer investigations and treatment.

This is a rapidly evolving situation, and we emphasise again that clinicians must regularly review and implement institutional, local, state and national policies, modifying or adapting the suggestions provided here as needed. Finally, given the potential severe impact of COVID-19 on people with cancer, we propose that oncologists and haematologists advocate for the timely application of public health measures, vaccines or treatments that might contain, delay or mitigate the spread of COVID-19.

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1 Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020; 323: 1239–1242.

2 Hirsch HH, Martino R, Ward KN, et al. Fourth European Conference on Infections in Leukaemia (ECIL-4): guidelines for diagnosis and treatment of human respiratory syncytial virus, parainfluenza virus, metapneumovirus, rhinovirus, and coronavirus. *Clin Infect Dis.* 2013; 56: 258–266.

3 Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020; https://doi.org/10.1001/jama.2020.1585 [Epub ahead of print].

4 Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol* 2020; 21: 335–337.

5 Xia Y, Jin R, Zhao J, et al. Risk of COVID-19 for patients with cancer. *Lancet Oncol* 2020; 21: e180.

6 Wang H, Zhang L. Risk of COVID-19 for patients with cancer. *Lancet Oncol* 2020; 21: e181.

7 Eichenberger EM, Soave R, Zappetti D, et al. Incidence, significance, and persistence of human coronavirus infection in hematopoietic stem cell transplant recipients. *Bone Marrow Transplant* 2019; 54: 1058–1066.

8 Guan W-J, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020; 382: 1708–1720.

9 Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020; 395: 497–506.

10 Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020; 395: 1054–1062.

11 Li W, Cui H, Li K, et al. Chest computed tomography in children with COVID-19 respiratory infection. *Pediatr Radiol* 2020; https://doi.org/10.1007/s00247-020-04656-7. [Epub ahead of print].

12 Xia W, Shao J, Guo Y, et al. Clinical and CT features in pediatric patients with COVID-19 infection: different points from adults. *Pediatr Pulmonol* 2020; https://doi.org/10.1002/ppul.24718. [Epub ahead of print].

13 Bodey GP. Unusual presentations of infection in neutropenic patients. *Int J Antimicrob Agents* 2000; 16: 93–95.

14 Zimmermann P, Curtis N. Coronavirus infections in children including COVID-19. *Pediatr Infect Dis J* 2020; 39: 355–368.

15 Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020; 395: 514–523.

16 Chen Z, Xiong H, Li JX, et al. COVID-19 with post-chemotherapy agranulocytosis in childhood acute leukemia: a case report. *Zhonghua Xue Ye Xue Za Zhi* 2020; 41: E004.

17 Engelmann I, Dewilde A, Lazrek M, et al. In vivo persistence of human rhinoviruses in immunosuppressed patients. *PLOS One* 2017; 12: e0170774.

18 Young BE, Ong SWX, Kalimuddin S, et al. Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore. *JAMA* 2020; 323: 1488–1494.

19 Centers for Disease Control and Prevention. Interim clinical guidance for management of patients with confirmed coronavirus disease (COVID-19). https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html (viewed Mar 2020).

20 Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol* 2020; 21: 335–337.

21 Ogimi C, Englund JA, Bradford MC, et al. Characteristics and outcomes of coronavirus infection in children: the role of viral factors and an immunocompromised state. *J Pediatric Infect Dis Soc* 2019; 8: 21–28.

22 Couch RB, Englund JA, Whimbey E. Respiratory viral infections in immunocompetent and immunocompromised persons. *Am J Med* 1997; 102: 2–9; discussion, 25–26.

23 Hakki M, Rattray RM, Press RD. The clinical impact of coronavirus infection in patients with hematologic malignancies and hematopoietic stem cell transplant recipients. *J Clin Virol* 2015; 68: 1–5.

24 Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting, and evaluation in health care. *Prev Med* 2010; 51: 421–424.

25 European Society for Blood and Marrow Transplantation. Coronavirus disease COVID-19: EBMT recommendations, update April 7, 2020. https://www.ebmt.org/covid-19-and-bmt (viewed Apr 2020).

26 Cancer Australia. Optimal care pathway for Aboriginal and Torres Strait Islander people with cancer. Canberra: Australian Government. https://canceraustralia.gov.au/publications-and-resources/cancer-australia-publications/optimal-care-pathway-aboriginal-and-torres-strait-islander-people-cancer (viewed Mar 2020).

27 Medical Council of New Zealand. Statement on cultural competence and the provision of culturally-safe care. Wellington: MCNZ, 2019. https://www.mcnz.org.nz/assets/MediaReleases/106b878389/1.-MCNZ-Statement-on-cultural-competence-and-the-provision-of-culturally-safe-care-consultation-May-2019.pdf (viewed Mar 2020).

28 Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. *JAMA* 2020; 323: 1545–1546.

29 Medical Council of New Zealand. Safe practice in an environment of resource limitation. Wellington: MCNZ, 2018. https://www.mcnz.org.nz/our-standards/current-standards/medical-care-and-prescribing/safe-practice-in-an-environment-of-resource-limitation/ (viewed Mar 2020).

30 Australian Government Department of Health. Australian health sector emergency response plan for novel coronavirus (COVID-19). Canberra: Commonwealth of Australia, 2020. https://www.health.gov.au/resources/publications/australian-health-sector-emergency-respo

nse-plan-for-novel-coronavirus-covid-19 (viewed Mar 2020).

31 Teng AM, Atkinson J, Disney G, et al. Ethnic inequalities in cancer incidence and mortality: census-linked cohort studies with 87 million years of person-time follow-up. *BMC Cancer* 2016; 16: 755.

32 Cunningham J, Rumbold AR, Zhang X, Condon JR. Incidence, aetiology, and outcomes of cancer in Indigenous peoples in Australia. *Lancet Oncol* 2008; 9: 585–95.

33 Carville KS, Lehmann D, Hall G, et al. Infection is the major component of the disease burden in Aboriginal and non-Aboriginal Australian children: a population-based study. *Pediatr Infect Dis J* 2007; 26: 210–216.

34 Karafin MS, Bruhn R, Westlake M, et al. Demographic and epidemiologic characterization of transfusion recipients from four US regions: evidence from the REDS-III recipient database. *Transfusion* 2017; 57: 2903–2913.

35 Chang L, Yan Y, Wang L. Coronavirus disease 2019: coronaviruses and blood safety. *Transfus Med Rev* 2020; https://doi.org/10.1016/j.tmrv.2020.02.003. [Epub ahead of print].

36 AABB. Update: impact of 2019 novel coronavirus and blood safety. 25 Feb 2020. http://www.aabb.org/advocacy/regulatorygovernment/Documents/Impact-of-2019-Novel-Coronavirus-on-Blood-Donation.pdf (viewed Mar 2020).

37 National Blood Authority. National Blood Supply Contingency Plan 2019. https://www.blood.gov.au/nbscp (viewed Apr 2020).

38 World Health Organization. Protecting the blood supply during infectious disease outbreaks. guidance for national blood services. Geneva: WHO, 2019. https://www.who.int/bloodsafety/publications/protecting-blood-supply/en/ (viewed Mar 2020).

39 Mueller MM, Van Remoortel H, Meybohm P, et al. Patient blood management: recommendations from the 2018 Frankfurt Consensus Conference. *JAMA* 2019; 321: 983–997.

40 Mo A, McQuilten ZK, Wood EM, Weinkove R. Red cell transfusion thresholds in myelodysplastic syndromes: a clinician survey to inform future clinical trials. *Intern Med J* 2017; 47: 695–698.

41 Stanworth SJ, Killick S, McQuilten ZK, et al. Red cell transfusion in outpatients with myelodysplastic syndromes: a feasibility and exploratory randomised trial. *Br J Haematol* 2020; 189: 279–290.

42 Carson JL, Stanworth SJ, Roubinian N, et al. Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion. *Cochrane Database Syst Rev* 2016; (10): CD002042.

43 Docherty AB, O'Donnell R, Brunskill S, et al. Effect of restrictive versus liberal transfusion strategies on outcomes in patients with cardiovascular disease in a non-cardiac surgery setting: systematic review and meta-analysis. *BMJ* 2016; 352: i1351.

44 Stanworth SJ, Estcourt LJ, Powter G, et al. A no-prophylaxis platelet-transfusion strategy for hematologic cancers. *N Engl J Med* 2013; 368: 1771–1780.

45 Estcourt LJ, Birchall J, Allard S, et al. Guidelines for the use of platelet transfusions. *Br J Haematol* 2017; 176: 365–394.

46 Estcourt LJ, McQuilten Z, Powter G, et al. The TREATT Trial (TRial to EvaluAte Tranexamic acid therapy in Thrombocytopenia): safety and efficacy of tranexamic acid in patients with haematological malignancies with severe thrombocytopenia: study protocol for a double-blind randomised controlled trial. *Trials* 2019; 20: 592.

47 Campbell AP, Guthrie KA, Englund JA, et al. Clinical outcomes associated with respiratory virus detection before allogeneic hematopoietic stem cell transplant. *Clin Infect Dis* 2015; 61: 192–202.

48 Shah DP, Ghantoji SS, Ariza-Heredia EJ, et al. Immunodeficiency scoring index to predict poor outcomes in hematopoietic cell transplant recipients with RSV infections. *Blood* 2014; 123: 3263–3268.

49 Kmeid J, Vanichanan J, Shah DP, et al. Outcomes of influenza infections in hematopoietic cell transplant recipients: application of an immunodeficiency scoring index. *Biol Blood Marrow Transplant* 2016; 22: 542–548.

50 Australasian Bone Marrow Transplant Recipient Registry. Annual data summary 2018. Sydney: ABMTRR, 2018.

51 World Marrow Donor Association. COVID-19 - impact on registry operations. https://share.wmda.info/display/LP/COVID-19+-+Impact+on+Registry+Operations#/ (viewed Mar 2020).

52 National Bone Marrow Donor Program. Response to COVID-19. https://network.bethematchclinical.org/news/nmdp/be-the-match-response-to-covid-19/ (viewed Mar 2020).

53 Szer J, Weisdorf D, Querol S, et al. The impact of COVID-19 on the provision of donor hematopoietic stem cell products worldwide: collateral damage. *Bone Marrow Transplant* 2020; https://doi.org/10.1038/s41409-020-0873-x [Epub ahead of print].

54 Simcock R, Vengaloor Thomas T, et al. COVID-19: global radiation oncology's targeted response for pandemic preparedness. *Clin Transl Radiat Oncol* 2020; 22: 55–68.

55 Mukherjee RK, Back MF, Lu JJ, et al. Hiding in the bunker: challenges for a radiation oncology department operating in the severe acute respiratory syndrome outbreak. *Australas Radiol* 2003; 47: 143–145.

56 Therapeutic Goods Administration. ICH guideline for good clinical practice. Canberra: TGA, 2018. https://www.tga.gov.au/publication/note-guidance-good-clinical-practice (viewed Mar 2020).

57 Downar J, Seccareccia D. Associated Medical Services Inc., Educational Fellows in Care at the End of Life. Palliating a pandemic: "all patients must be cared for". *J Pain Symptom Manage* 2010; 39: 291–295.

58 Leong IY, Lee AO, Ng TW, et al. The challenge of providing holistic care in a viral epidemic: opportunities for palliative care. *Palliat Med* 2004; 18: 12–8. ■