Service capability framework

A guide for Victorian health services providing radiation therapy to children and adolescents with cancer

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Paediatric Integrated Cancer Service

A statewide cancer service for children

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1. Overview of the service capability framework

1.1 Objectives

The objectives of this framework are to:

- describe a coordinated system of care for delivering radiation therapy (RT) to children and adolescents with cancer
- support a sustainable model of care with an efficient use of resources
- support and advocate for patient safety through describing minimum recommended capability
- provide clear and consistent language
- build on current capacity in the adult radiation oncology sector to meet the unique needs of children and adolescents with cancer, and their families.

1.2 Context

Childhood cancer is rare. In Victoria, approximately 150 children aged under 15 years are diagnosed with cancer each year.[1] RT is an essential part of many paediatric oncology trials and is used to treat malignancies of the central nervous system (CNS), solid tumours and Hodgkin lymphoma.[2] RT is also used to deliver total body irradiation (TBI) as conditioning for haematopoietic stem cell transplantation (HSCT), as well as for managing CNS and testicular disease in leukaemia.[3] RT has also been shown to be effective in managing symptoms of metastatic disease in end-of-life care, such as bone pain, as well as managing oncological emergencies such as spinal cord compression.[4] RT has contributed to the current 80 per cent[5] five-year overall survival rate in childhood cancer, but as a modality, it carries with it considerable risk of long-term side effects on growth and development. As such, therapy is often delayed or avoided (if at all possible) to mitigate these effects.[3] However, new methods of delivery and the completion of the first generation of paediatric clinical trials involving 3D conformal RT and intensity-modulated RT have increased its role in clinical care. These more conformal treatments have helped reduce the total dose delivered to normal healthy tissue and, in turn, decreased unwanted side effects without affecting local control of disease.[6] RT is a multidisciplinary specialty requiring efficient planning, verification, monitoring and continuous quality improvement at the patient, organisational and technological levels.[7]

In Australia RT is provided within adult-based centres due to the small numbers of children and adolescents accessing the service. Providing RT to children and adolescents within adult services is an appropriate use of finite resources, and centrally locating highly specialised disciplines has been shown to improve outcomes and overall survivorship: the 'volume effect'.[8] However, the location of paediatric and adolescent RT services in adult healthcare settings gives rise to specific social and emotional challenges, and health services need to acknowledge the psychosocial vulnerability of children and their families coming into an adult oncology environment[3,9] in order to deliver an optimal patient experience and outcome of care.

It is important to note that health services delivering RT to children and adolescents with cancer do so in the context of a complex and diverse model of care, as defined within the *Service capability framework: A guide for Victorian health services providing primary treatment and shared care to children and adolescents with cancer.*[10] This document recommends that all children receiving RT have their treatment managed and coordinated by a level 5 or 6 paediatric cancer service. Level 5 and 6 centres are defined by their high level of service capability to provide the definitive diagnosis, risk stratification, treatment and follow-up of all children and adolescents with cancer. Allied health services for children with cancer are generally provided by Level 5 or 6 centres and are described in the service capability framework for paediatric oncology.[10]

The Paediatric Integrated Cancer Service (PICS) supports the development of a coordinated, multidisciplinary approach to delivering evidence-based clinical care that meets the needs of children, adolescents and their families. This framework has been developed in consultation with the PICS partners to support this integrated approach.

1.3 The function of the service capability framework

This service capability framework is intended for all healthcare professionals involved in planning, coordinating and delivering RT to children or adolescents. The framework is also intended for hospital administrators who are responsible for the quality and safety of care delivered to this patient population as a resource for informing capability requirements including personnel and infrastructure.

The framework defines two minimum service categories for delivering RT to children and adolescents with cancer:

- **comprehensive:** a paediatric RT service providing a complete suite of services
- **palliative:** a paediatric RT service for palliative care.

This document primarily addresses the comprehensive service as defined in section 4.

The second category provides an overview of the minimum requirements for delivering RT to children or adolescents where cure has been assessed as no longer achievable. The main aims of a paediatric RT service for palliative care are to minimise distressing symptoms, maximise quality of life and control pain.[4] An overview of the requirements for delivering end-of-life palliative RT to children and adolescents is defined in section 5.

Through articulating minimum requirements of safe, coordinated and appropriate RT services for children and adolescents across Victoria, this framework will support health services to deliver a quality service within an agreed scope of practice and resource capability.

The following terminologies are used throughout this document for the proposed recommendations:

Must: indicates a critical, evidence-based recommendation and/or clinical guideline, with a potential risk of harm to the child or adolescent if the recommendation is not followed

Should: indicates a clinical recommendation based on best practice and expert consensus, where potential risk or harm to the child or adolescent is minimal.

2. Characteristics of radiation therapy

2.1 Radiation therapy modalities

The aim of RT is to use ionising radiation to treat malignant disease by delivering the appropriate clinical dose of radiation to the tumour while sparing as much of the healthy tissue as possible.[11] This can be achieved using several techniques and various technologies. The following techniques should be available to paediatric and adolescent patients.[12]

3D conformal radiation therapy

This technology uses radiologically derived target volumes to plan three-dimensional (3D) radiation treatment. The radiation fields used may be coplanar or non-coplanar beams that are carefully shaped to conform to the tumour using various forms of shielding. Beam modifiers may be employed to create an even dose distribution.

Intensity-modulated radiation therapy (IMRT)

This technology uses external beam radiation with computer optimisation to cause the radiation dose to conform very tightly to the shape of the tumour by constantly changing the intensity of the radiation beam during delivery. This further enhances the sparing of nearby healthy tissue.

Volumetric-modulated radiation arc therapy (VMAT)

This technology is a highly sophisticated method of delivering external beam radiation therapy (EBRT). VMAT delivery involves dynamic movement of the linac gantry around the patient during radiation beam delivery. The rate of gantry movement, movement of internal multi-leaf collimator leaves and the rate of dose delivery are continually adjusted to allow the radiation dose to conform closely to the target shape. The high dose conformity and reduced treatment times provided by VMAT make this technology particularly useful for the paediatric population.

Stereotactic radiation treatments

This technology involves a series of extremely precise radiation beams aimed at a tumour from many directions. It is often used for tumours that would be inaccessible or inappropriate for open surgery. Treatments include stereotactic radiation therapy (SRT), stereotactic radiosurgery (SRS) and stereotactic ablative radiation therapy (SABR), also known as stereotactic body radiation therapy (SBRT).

Radionuclide therapy

This technique involves administering oral or intravenous radioactive material to deliver therapeutic doses of RT to the site of the disease. The use of radionuclide therapy is further expanded in section 2.3.

Brachytherapy

Brachytherapy (BT) involves placing catheters into the targeted area that can be after-loaded with radioactive sources. This results in very tight, high-dose regions around the catheters – effectively delivering radiation therapy from inside, reducing the dose to normal tissues. Radioactive sources can be loaded over a few minutes per interval, over several days, or, with the use of intra-operative high-dose brachytherapy, providing a single dose during a procedure following resection while the patient is anaesthetised. Consideration of the use of brachytherapy in paediatric and adolescent cancer is further expanded in section 2.4.

Proton beam therapy

This modality uses proton beams instead of photon radiation, which can reduce the normal tissue dose during treatment. Proton beam therapy (PBT) uses the very rapid fall-off of dose after the Bragg peak to spare normal tissues and has particular application in brain, CNS, eye and sarcoma tumours. This technology is currently not available in Australia and referrals, as appropriate, are made to overseas proton centres.

Orthovoltage therapy

This modality uses lower energy x-rays than other modalities and can be useful to palliate bony metastatic disease. It involves less planning time and can typically be delivered on the same day.

2.2 Medical imaging

To ensure precise tumour targeting, advanced imaging for treatment planning must be available including onsite access to computed tomography (CT), positron emission tomography (PET), magnetic resonance imagining (MRI), four-dimensional CT and single-photon emission CT (SPECT). Advanced imaging has been shown to further influence RT design in paediatric oncology.[13]

2.3 Radionuclide therapy in children and adolescents

Systemic irradiation approaches, such as radionuclide therapy, are sometimes warranted to treat metastatic disease. As opposed to EBRT, this is achieved 'internally' by delivering a radioactive formulation via the oral or intravenous route. The primary indication in paediatrics for radionuclide therapy is in the use of radiolabelled metaiodobenzylguanidine (i-MIBG) to treat neuroblastoma (NBL). The use of i-MIBG has demonstrated response rates of up to 25 per cent in refractory or recurrent NBL.[14] As a result, consideration is currently being made to introduce i-MIBG as upfront therapy for NBL.[14]

Due to the nature of the treatment, there are specific requirements for managing a child or adolescent requiring radionuclide therapy. The only exit site for i-MIBG is through excretion. Therefore, the child remains radioactive for up to several days, requiring a hospital admission in a lead-shielded isolation room. Many of these patients have current comorbidities and therefore require other specific medical care. Proper management of the psychosocial needs of young children who remain isolated from their family and staff for prolonged periods of time is crucial. All this is in contrast to delivering EBRT, which is generally outpatient-based.

Consideration of radionuclide therapy needs to be made early to ensure an appropriate treating centre is available for timed therapy. The table below lists the minimum criteria for delivering radionuclide RT.[4,15,16]

Minimum service capability requirements for delivering radionuclide therapy to children and adolescents
Minimum RT service capability requirements outlined within this framework, plus the following:
Documented policy and procedure manual governing the overall management of radionuclide therapy in children and adolescents
Paediatric oncologist available on site during business hours and on call after hours
Child life therapist available on site during business hours
Paediatric nursing support available 24/7
Paediatric medical emergency support team available on site 24/7
Physicists available onsite during business hours and on call after hours for dosimetry and radiation protection support
Protective lead-shield walls and ensuite, with dedicated plumbing for managing radioactive waste in line with local legislative practices for the safe management of radioactive substances
Use of a dosimeter to measure radiation exposure for staff and carers in contact with the child, with escalation procedures for managing exposure and, as required, prophylaxis therapy
Closed-circuit television for monitoring the patient
Age-appropriate distraction therapy
Age-appropriate education, orientation and psychosocial support for the patient and family
Orientation and education for staff working in the environment

The future of exploring new radionuclides in children should be considered, particularly those that allow shorter periods of isolation and reduce the resultant logistical problems.

2.4 The use of brachytherapy in children and adolescents with cancer

Paediatric BT is practised in North America and Europe; it is not routinely available in Victoria. Decisions to incorporate this treatment modality into standard care will demand much wider consultation and review than this document provides.

The use of BT in adult oncology, particularly in gynaecological and prostate cancer, is well established. Its use in paediatric oncology is largely limited to soft tissue sarcomas such as genitourinary rhabdomyosarcoma (RMS). Historically, it has also had limited use in nasopharyngeal carcinoma, retinoblastoma, neuroblastoma and some CNS tumours.

Although recent papers have demonstrated the efficacy and reduced morbidity of BT in RMS,[17–19] there is no 'gold standard' approach due to the small numbers of patients and expert institutions delivering this therapy.[15] Other data has exemplified this with excellent local control but poor regional control of disease.[20] The overall use of BT is limited in paediatric cancers because most require wide-field irradiation. The decision to use BT should be made on a case-by-case basis with the wider oncology multidisciplinary team, incorporating the patient's history, imaging and pathology. BT should be centralised to a small number of centres with the necessary technical expertise and experience.[15,21,22]

Advantages of using BT in children and adolescents

- It targets much smaller irradiated volumes compared with EBRT.
- Late complications of dose-volume effect on a growing child, such as cognitive defects and secondary cancers, are minimised.[15,21,22]
- Therapy is completed over a much shorter overall timeframe than EBRT (particularly with intraoperative BT), reducing dependence on general anaesthetics and potential harmful delays needed to deliver EBRT.[15,21,22]
- It is an effective choice of therapy over EBRT for treating localised disease in some soft tissue sarcoma.

Capability requirements for delivering BT

In addition to the minimum requirements outlined in this document, BT, particularly intraoperative BT, requires a large, specialised team with surgical and RT expertise. This may require the use of RT services collocated within the paediatric theatre setting to support intraoperative BT. After-loading techniques will still demand the use of specialised surgical expertise and medical imaging interventions in the theatre complex, such as 3DCT.[23] Patients with sealed sources in situ for longer periods of time will need protective isolation similar to i-MIBG therapy (item 2.3). With only small numbers of candidates accruable each year, the service would need to be centralised to ensure the 'volume effect' of good clinical outcomes.[8] There is limited nursing literature for the bedside care of these children, and much must be garnered from an adult perspective.[4] It could be argued that, in Australia, BT could be well served within very few referral centres.

3. Factors influencing the individual needs of children or adolescents undergoing radiation therapy

Age

The significant side effects of craniospinal RT to infants and young children have been recognised since the 1960s.[24,25] Irradiating the growing brain, particularly in younger children, can have a significant impact on the child's growth and development.[26]

Acuity of disease, current clinical condition and comorbidities

Delivering RT to a child on a high-toxicity treatment regimen, particularly when combined with sedation and anaesthesia, demands a greater capacity for paediatric medical and nursing specialty involvement within an adult-based RT service.

Dosage, field of treatment and perceived toxicities

The radiation dose, number of required treatments (called fractions) and the anatomical area that receives the RT will impact on toxicity. As RT is usually provided on an outpatient basis, it is important for staff to be able to provide education and information to patients and families on the anticipated side effects and their management when at home.[3]

Combined modality therapies

Acute toxicities of therapy may be increased with combined chemotherapy–RT regimens,[3] which need paediatric management.

Patient compliance and the need for sedation

Younger children or those with cognitive impairment may not have the understanding or the requirements to lie still during treatment and may require sedation or general anaesthesia (GA).[11]

Age-appropriate psychosocial care from birth to late teens

It is important that health professionals have the skills to effectively manage children or adolescents and their families, and understand their behavioural, developmental, cognitive and medical needs according to their age.[3,9]

Cultural and linguistic diversity of the patient and their family

Consideration needs to be given to the individual patient and family when planning and delivering RT to a patient with cultural diversity and where the preferred language is not English.

Clinical trial demands

For children enrolled in a clinical trial, there may be additional mandatory clinical trial compliance requirements and resource implications on the health service, both patient- and systems-related.

4. Description of the service capability framework

4.1 The care pathway

Care pathway: radiation therapy for a child or adolescent with a cancer diagnosis
(all paediatric cases within the RT service should be given priority)

Diagnosis and risk assessment	The diagnosis and risk assessment for all children and adolescents who are planned to receive RT must be undertaken at the primary treatment centre (PTC) with multidisciplinary participation from the RT service
Referral	The decision to refer will be discussed and documented as part of the patient's MDM. There will be a timely written referral for all patients receiving RT, and all relevant documentation will be available to the RT service
Orientation and education	Family and patient orientation to the RT service and age-appropriate education will take place in advance of any treatment, conducted by designated staff with paediatric subspecialty experience
Final planning and verification	Patient assessment for sedation and anaesthesia (with referrals as required), consent, medical imaging, planning for immobilisation and the necessary quality asurance testing of equipment, dosage and field plan are all required prior to delivery of RT
Treatment	Clinical assessment and identification of the patient, and delivery of RT by appropriately-qualified staff in an age-appropriate environment
Supportive care	Collaboration with the PTC for psychosocial support. Designated RT staff for education of home care and management of any potential toxicities of RT. Follow-up review will then transition back to the PTC
Surveillance and late effects	The RT service will work closely with the PTC in the screening and management of late effects

Note: Grey led by RT service; blue led by the primary treatment centre

4.2 Essential infrastructure

Emergency care

Must: There must be onsite resuscitation facilities and competent staff (defined by the credentialing policy of the individual organisation) with the ability to stabilise acutely unwell children or adolescents, with appropriate escalation and transfer guidelines to a paediatric health facility.

There must be availability of staff, onsite, who are competent in accessing a central venous access device to ensure timely life-saving interventions, as required.

Developmentally appropriate medical, resuscitation and diagnostic equipment must be available at all times.[27,28]

Should: The service should adopt a paediatric observation and response chart to support early referral for medical emergencies.

If the child or adolescent is receiving palliative RT, there should be adequate communication from the primary treatment centre (PTC) regarding the resuscitation status of the patient.

Environment

Must: There must be facilities for the parent or caregiver to be able to stay as close as possible to their child/adolescent, at all times.[27, 28]

For younger children, safe and appropriate sleeping facilities must be provided, if required.[29]

There must also be an orientation to the new environment before any therapy is delivered. Unfamiliarity with the routines and environment of another hospital can lead to a feeling of disempowerment and anxiety for the child/adolescent and family.[9, 30]

Should: The waiting area and clinical environment should be temporally and spatially located away from the adult services.

The environment should be child-, adolescent- and family-friendly, in line with the Royal Australasian College of Physicians *Standards for the Care of Children and Adolescents in Health Services*.[27]

Services should be accessible for wheelchairs and prams and provide baby changing facilities.[27]

There should be appropriate waste management facilities, particularly for patients on concurrent chemotherapy.

The waiting area should provide relevant additional information (booklets, pamphlets, etc.) related to the treatment. It should also provide relevant and age-appropriate games/equipment for children and adolescents. Ideally there would be a specialist waiting area for children and another for adolescents.

Information technology

Must: Access to pathology, radiology and hospital patient records must be available to all staff, collocated in the clinical area.

Should: Videoconference/telehealth systems should be available to participate in multidisciplinary discussions with the PTC across sites.

Systems should be in place to share the electronic communication of shared care across sites. Data systems integrated with relevant cancer registries and clinical trial partners to facilitate information sharing should be available, as required.

On-site IT services should also be considered for patient use. This would particularly target the adolescent population for communication, entertainment and record keeping. Some may even have their own personalised e-health records.

4.3 Specialty services

Multidisciplinary meetings

Early detection, accurate diagnosis and appropriate treatment depend on a multidisciplinary approach for children and adolescents with cancer.[31] The multidisciplinary team (MDT) is of particular importance in the field of paediatric tumours and RT because of the rarity of cancer, and their complexity in management.[15]

Must: There must be demonstrated access to, and active membership of, a multidisciplinary meeting structure hosted by the PTC to discuss all patients referred to RT services.

Should: There should be a regular meeting structure within the paediatric RT team to discuss the individual needs of patients in the service – in planning, delivery and follow-up. The local paediatric RT MDT should include radiation oncologists, radiation therapists, child life therapists, nurses, anaesthetists (as required) and physicists.[15]

Laboratory

Must: There must be access to real-time laboratory services for managing deteriorating paediatric patients, including immediate interpretation of blood gases, clinical chemistry, haematology and coagulation assays, performed on paediatric samples, with up-to-date paediatric reference ranges. Laboratory facilities must have NATA/RCPA accreditation to ISO 15189.[32]

Medical imaging

Must: During business hours there must be access to a radiologist with specific expertise in reporting on paediatric images as well as radiographers with paediatric experience.

There must be demonstrated access to support for calibration, dosimetry and quality assurance of imaging systems including expertise in the ALARA (as low as reasonably achievable) principle of dose reduction.

There must be paediatric-specific imaging protocols in place to ensure validation of dose reduction.

Should: There should be access to a picture archiving and communication system (PACS) that enables real-time transfer of images between health services.

Procedural management

Children and adolescents undergoing RT frequently experience distress, despite the non-invasive and painless nature of the treatment. Reactions can occur due to unfamiliarity, previous painful medical procedures, separation from parents, the need to utilise immobilisation devices and the sights and sounds of the RT equipment.[33] To manage this, implementing developmentally appropriate interventions are warranted.

Must: Staff directly caring for children and adolescents must have knowledge, training and skills in paediatric pain management and developmentally appropriate communication.[27]

The child and their carers must be offered a familiarisation tour of the RT department treatment and planning areas prior to undergoing any procedures.

Should: The RT service should endeavour to meet the need for play (including using a child life therapist) for all children. Play is noted as an important tool for helping children understand treatment and assist recovery.[27]

Access to the services of a child life therapist (see glossary) should be available for paediatric RT services from the initial consultation and remain part of the MDT wherever possible.

Anaesthesia

Sedation or a GA can be necessary in young children for immobilisation during RT. Although procedures are generally short, the need to provide sedation or a GA may represent a significant increase in the service's resources and time[34] and comes with a higher degree of clinical risk. The service is generally located in an adult

institution outside of the children's hospital; children are at times receiving concurrent chemotherapy and may be clinically unwell. Due to the occupational health and safety demands in the local environment during RT, staff are not able to remain in the same room as the child.

Must: Each organisation must develop a policy detailing the criteria for managing anaesthesia and nursing care of children post anaesthetic, and staff involved in delivering care to an anaesthetised child must have appropriate training in the care of infants and children.[28] Paediatric trained and experienced staff must also be available to safely recover the patient.

A paediatric GA must be provided by a paediatric specialist anaesthetics team.

As RT treatments are repeated over multiple sessions, often over many weeks, a documented anaesthetic plan for each child must be present in their medical file.[15]

Remote monitoring of the child via closed-circuit technology must be used, with cameras focused on the patient, the anaesthetic machine (if applicable) and vital signs monitoring.[35,36]

The environment must be climate-controlled to maintain the body temperature of infants and young children throughout the procedure and recovery.[28]

Should: Drawing on the best available evidence, services should aim to reduce the number of GAs in RT and medical imaging through alternative methods such as distraction and age-appropriate education, with ongoing assessments of younger children for compliance by the child life therapist.

Immobilisation

Increased conformity of RT with new technologies demands a greater accuracy of patient position and limited movement during treatment.[35] It is critical that each fraction of RT delivered is accurate and reproducible; therefore, proper immobilisation is essential for high-quality RT.[15] This is of particular importance in treating brain, spine or head and neck tumours.[4] It is also important in paediatrics in general, where volumes are smaller, meaning less margin for side effects to normal tissue.

Must: There must be access to the latest techniques for immobilisation. These may include thermostatic moulds, body frames and body vacuum moulds. Less invasive techniques must be continually investigated to reduce the anxiety of therapy.

There must be time allocated to plan and familiarise the child with the appropriate immobilisation devices.

Should: The use of age-appropriate play therapy and distractions should be incorporated at this time, led by a qualified child life therapist, to improve patient understanding, reduce anxiety and reduce the need for a GA in younger children.[4]

Late effects

Studies have reported that two-thirds of childhood cancer survivors experience at least one chronic treatment-related medical condition in adulthood.[37] The potential late effects of RT include decreased sexual and reproductive function, neurocognitive defects, hormone deficiencies, visual and hearing deficits, growth defects and secondary malignancies.[15,38] General factors influencing toxicity and late effects include daily fraction size, cumulative dosage, the age of the patient at the time of irradiation, the type of radiation used and the anatomical area irradiated.[39]

It is important to note that in managing the late effects of childhood cancer, the health service needs to consider all treatment modalities including RT, chemotherapy and surgery.

Must: The PTC team must ensure that all children and adolescents who have received RT are referred to an appropriate late effects service within the PTC.[10]

The RT team must actively participate in the late effects service, have active membership and collaborate with the adult late effects service for adolescents transitioning into adult care.

The RT team must, at a minimum, ensure all radiation fields, total radiation dose to each field and the age of the first dose of RT be included in the child's late effects summary at the PTC.[39]

Fertility and genetic counselling services

Must: The issue of future fertility must be considered. There must be reproductive preservation and fertility options presented to the patient and their carers (as clinically indicated) by suitably qualified staff.

Should: A level 6 paediatric service should provide an onco-genetic service and be able to support patients with relevant information to advise on genetic-related disease risks or to enable future choices (for example, mutation of the retinoblastoma gene can be inherited).

Translation services

Must: There must be timely access to translation services to ensure effective communication of care and education for children and adolescents where English is not the preferred language, during each consultation and procedure.

Indigenous services

Must: There must be access to Aboriginal liaison staff for families of Aboriginal or Torres Strait Islander background.

4.4 Workforce

Overview

Must: The parent or caregiver must be recognised as an integral part of the healthcare team and must be consulted and kept informed of the ongoing care of their child/adolescent.[27]

For staff whose occupational duties may involve unsupervised, direct contact with children, they must comply with the relevant statutory Working with Children Check scheme.

There must be a designated worker to liaise between the RT and paediatric oncology teams.

Should: Representative members of the paediatric RT team should attend regular meetings to discuss the individual needs of the patient.

Medical

Must: There must be more than one radiation oncologist (to enable consultant crossover arrangements) with specific expertise in treating children and adolescents with cancer employed by the RT centre.[40] The radiation oncologist must attend the paediatric oncology MDT, hosted by the PTC.[15]

Should: The radiation oncologist should have affiliation and membership with relevant cooperative study groups where RT is delivered as part of the clinical trial and have honorary status at the PTC.

Radiation therapists

Must: Radiation therapists must have experience in planning and delivering RT to children and adolescents.

Nursing

Must: There must be radiation oncology nursing staff, as well as an onsite paediatric oncology liaison nurse, to support coordination and communication between services, as well as advocating for paediatric care.[15,28]

There must be anaesthetic nursing staff available with experience in managing infants, children and adolescents requiring sedation or a GA.

Should: There should be adequate staff available in RT services to ensure appropriately skilled cover when key nursing staff are on leave.

Medical imaging nursing staff in the RT service should have experience in caring for children and adolescents.

Technical staff

Must: There must be appropriate technical staff with paediatric experience (such as radiation therapists and medical physicists) to provide specialist planning of therapy. Delivering high-risk therapy to children, particularly TBI and craniospinal radiation, relies heavily on dose calculations, calibration and achieving consistency in delivering the same dose under the same conditions.[41]

Child life therapist

Play is the medium children use to learn about themselves and their environment.[42] Play helps promote empowerment and coping, and helps children understand the situation at hand.[15] Child life therapists are able to provide support in the forms of preparation, distraction, emotional support, advocacy and sibling support.[15] Therapeutic play has been shown to significantly lower anxiety, increase cooperation and reduce the need for a GA during RT procedures.[43,44]

Should: There should be a child life therapist, as defined by the Association of Child Life Therapists Australia,[45] available during paediatric encounters at the RT service. Other distractive techniques such as art or music therapy should also be considered.

4.5 Education

Overview

Must: Staff working with paediatric patients must be able to develop age-appropriate communication skills and build rapport with children and adolescents, tailored to their individual needs.[9] Good paediatric communication skills have also been shown to comfort parents.[46]

Should: There should be provision for training in paediatric aspects of care and communication skills, as well as training in the technical aspects of paediatric RT, as part of the orientation and induction for new staff.[15] Equally important are parental communication skills. Paediatric cancers cause significant stress and emotional pressure on the child's parents; staff working with these parents must also be able to build rapport with these key adults. It should not be assumed that all health service adult staff are parents and will automatically understand or relate to the patient's parents. Communication and relationship training should be offered to specialist paediatric RT staff.

Medical

Must: All radiation oncologists, radiation therapists and radiation oncology physicists must be appropriately qualified, maintain eligibility in professional associations and meet the requirements of regulatory bodies.[33,47–49] Ongoing professional development and training is necessary to meet advances in technology.[50]

Should: There should be provision for paediatric oncology input within educational requirements, as well as opportunities for honorary appointments with the PTC.

Nursing

Must: Nursing staff in cancer services must be appropriately qualified and meet the demands of their regulatory bodies.[51]

Where a paediatric oncology nurse liaison is employed, he/she must have completed a recognised comprehensive education and training program in caring for children with cancer[52] and have general paediatric foundations training, including growth and development, assessment and caring for the child and family.[53]

Should: All nursing staff providing direct, ongoing patient care to children and adolescents should also be encouraged to complete paediatric foundations training.

Patient and family

The patient's family or significant carers are critical members of the healthcare team. The delivery of family/carer-centred education regarding how radiation therapy works, what it will involve for the child and family, how to recognise and respond to side effects and deterioration in the child, as well as the sensory and procedural aspects of the RT experience, is essential to excellent cancer care.

Must: Teaching priorities in delivering RT to children and adolescents must include:[54]

- a step-by-step guide through all events leading up to treatment
- the length of time each intervention will take (including planning and simulation)
- an introduction to the RT suite and planning environment
- an explanation of the intent of treatment (curative or palliative)
- information about toxicity and potential adverse events in relation to RT
- demystifying: reassurance that the child receiving EBRT is not 'radioactive' (excluding radionuclide therapy)
- measures the family and child can take to reduce the impact of RT side effects when at home
- discussion of potential delayed or late effects and supports to manage these now and in the future
- an explanation of the types of follow-up required.

Should: For a younger child, play should be incorporated to facilitate understanding. Visual and sensory information should accompany written and verbal instruction for both children and adolescents.[4]

Support to other services

The radiation oncology team should provide a review of education and training materials for staff caring for children undergoing RT.

4.6 Clinical trials

Evidence demonstrates that participation in clinical trials improves cancer patient experiences and outcomes. In the context of paediatric RT this includes reductions in target volumes (while maintaining survivorship), improved control of high-risk disease with concurrent chemotherapy, maintaining the functional outcome of exposed organs in late effects and the potential to reduce or remove RT interventions in some diseases due to individual prognostic markers.[6]

Must: Organisations delivering RT to children and adolescents must be accredited with national and international paediatric oncology clinical trials groups and have established communication pathways in conducting and coordinating paediatric oncology clinical trials. As with all clinical trial organisations, regulatory and good clinical practice requirements must be adhered to.

4.7 Quality and clinical governance

Safe transfer of paediatric patients

RT treatment is commonly delivered in a different environment than the PTC. As such, some inpatients will require transfer between the PTC and the RT service. This includes patients receiving combined chemotherapy–RT regimens as well as children receiving TBI as part of their HSCT conditioning. Some of these patients may be unwell and, in the case of transplant, be at risk of infection due to their immunocompromised status.

Timely transfer of patients also supports the daily workflow in the RT centre where availability of RT slots is in high demand.

Must: Both the PTC and the RT team must:

- have documented guidelines for safe interhospital transfer for children and adolescents

- have escalation and risk criteria for determining the mode of transport such as private, nurse escort or paramedic; escalation guidelines should include, at a minimum
  - the level of impaired immunity
  - ongoing medical interventions
  - the level of the current acuity of care
  - the age of the child
  - family supports
  - compliance
- have resources for providing the necessary staff to provide interhospital escort, as required
- have resources for accessing timely ambulance services, as required
- have a documented clinical handover process.

The decision to transfer a patient is the responsibility of the referring (sending) hospital. The PTC should take into account the acuity of the patient and be aware of the capability of the RT service before any transfer takes place. It is important that patient care is not compromised by the method of transfer.

Guidelines

Must: There must be onsite access to paediatric clinical practice guidelines in both the supportive care of children with cancer and paediatric emergency and resuscitation.

Quality activity

Should: RT services should ensure they are working towards standards set out in the document *Radiation Oncology Practice Standards: A Tripartite Initiative*,[48] as well as the *Tripartite National Strategic Plan 2012–2022*.[55] The latter document identifies standards across facility management, treatment planning and delivery, and safety and quality management. It is envisaged the service capability framework will accompany this document in health service planning.
All standards must be compliant with the Australian Commission on Safety and Quality in Healthcare's National Safety and Quality Health Service Standards.

4.8 Service links

Community engagement

Should: There should be demonstrated relationships and referral pathways with community support groups for children and adolescents with cancer and their families.

Consumer engagement

Should: There should be evidence of consumer engagement in the service, with consumer attendance on relevant steering groups and committees.

Interhospital linkages

Should: There should be demonstrated linkages with other services, including referral mechanisms both in and out of the RT service.

PICS

Should: There should be integration of services into the PICS model to strengthen quality, consistency and integration of cancer care.

Medical imaging

Should: There should be access to image-sharing software for communicating medical images between sites.

5. The role of radiation therapy in paediatric palliative care

5.1 Background and considerations

RT is an effective palliative intervention, particularly for managing metastatic disease in bone, brain, liver and soft tissue cancers in children and adolescents.[56–59] RT has been shown to effectively control bone pain despite the successes being varied, ranging from 25 per cent[60] to 90 per cent.[61] RT also has a role in minimising the distressing symptoms associated with advanced disease, such as control of bleeding, relief of spinal cord compression, shortness of breath (lung metastasis) and relief of distressing neurological symptoms in children with brain metastases.[4]

Despite its success in symptom control and quality of life, there is a dearth of high-quality literature that evaluates RT in the paediatric palliative care setting. In the adult context, estimations for using RT in palliative care have been as much as 50 per cent of the workload in the radiation oncology context.[62] However, the landscape is different for children. Retrospective studies from North America have demonstrated that the frequency of RT in paediatric palliative care is as little as two per cent of all cases,[63] but these numbers may not reflect Australian and New Zealand data.

RT has a variety of applications in the palliative setting. It can be used to support the quality of life in patients where a cure is not possible but who have an extended period to live, through to patients with a short life expectancy as an aid in making them as comfortable as possible in the end-of-life setting. RT in paediatric palliative care appears to be less understood and underutilised by paediatric oncologists.[64] Reasons identified for this include distance from tertiary RT centre, poor communication regarding end-of-life care and the lack of training and experience in palliative care.[64]

These issues highlight the need for several important considerations in making recommendations for using RT in the paediatric palliative care setting (discussed below).

Education

Careful explanation of the length of treatment and limited toxicities in palliative RT has been shown to encourage its use.[65,66] However, families need to understand that this is not delivered with curative intent and they must be made fully aware of all the facts, including the efficacy of treatment and the consequences of its use.

Must: Families and adolescents must be active members of the treatment decision[4] and, with support from the team, be able to weigh the benefits of RT against the expenditure of time, travel and potential discomfort.[67]

Should: The use of RT in palliative care should be part of the training program for all health professionals providing care to children and adolescents with cancer, particularly regarding symptom control. Establishing guidelines for using RT in paediatric palliative care should be encouraged.

Timing

Should It is important that referrals to the RT team are timely to ensure services are coordinated and provided efficiently.

The number of fractions delivered should be minimised to reduce the number of visits and the impact of travel for the family, and to provide optimal management and relief of symptoms without creating undue toxicity. However, there is still no consensus on the number of fractions to be delivered in palliative care, for example, in managing bone pain.[62] Patient views on this matter unanimously prefer a single treatment.[68] Limitations in the recommendations of timing are related to the small numbers of quality studies in the literature.

Observation

Must: Accurate observations prior to and following palliative RT must be made to assess the efficacy of treatment. The PTC should conduct these measures.

Role of the radiation therapy team in the multidisciplinary approach to palliative care

Should: Members of the palliative care team should have engagement and involvement in the multidisciplinary oncology team caring for a child with incurable cancer. Early integration should be made in any case where prognosis is poor and RT may be considered a potential treatment option in the palliative care process.

5.2 Minimum requirements for health services providing paediatric palliative radiation therapy

Rationale

RT can be an effective palliative intervention in managing pain and other adverse symptoms in children with refractory cancer. With shorter treatment durations, less toxicities and less focus on reducing significant late effects, palliative RT in children has the potential to be delivered in an RT department outside the primary paediatric RT centres. This may benefit children or adolescents from regional or rural areas, where decisions to utilise palliative RT have been shown to be influenced by geography and place of residence. Providing therapy closer to home will also help reduce the burden of care on the patient and their family.[69]

Should: Treatment decisions for providing palliative RT in centres outside the primary paediatric RT service should be made in consultation with the wider paediatric oncology MDT and after the health service has met the minimum necessary requirements and agreed to provide this level of care. Even in the services that are not paediatric specialist RT services there should still be some expertise in paediatric communication. MDT consideration to proceed with palliative RT in an environment outside the primary paediatric RT service will need to take into account the child's age, level of compliance, understanding and acuity and the perceived direct benefits of providing the therapy.

Workforce

Must: The patient's parent or caregiver must always be recognised as an integral member of the healthcare team.

During business hours there must be an appropriately qualified radiation oncologist onsite, with access to phone consultations with a radiation oncologist with a paediatric subspecialty.

During business hours there must be a radiation therapist onsite, with access to phone consultations with a radiation therapist with a paediatric subspecialty.

There must be appropriate technical staff to provide quality assurance of RT measured against radiation oncology practice standards.

The health service must identify a responsible liaison staff member to coordinate and communicate the care with the paediatric oncology service.

All staff must comply with the relevant statutory Working with Children Check scheme.[70]

Environment

Should: Wherever possible, appointments and delivery of therapy should be spatially and temporally separate from adult services.

Emergency care

Must: There must be onsite paediatric resuscitation facilities and competent staff to deliver basic paediatric life support, with appropriate escalation guidelines to an appropriate paediatric healthcare facility.

There must be adequate communication from the PTC regarding the resuscitation status of the patient, with an advance care plan documented and in place.

Information technology

Should: There should be access to a PACS for the real-time transfer of digital medical images between health services.

Multidisciplinary care

Must: There must be demonstrated access to phone consultations with the child or adolescent's paediatric oncologist and radiation oncologist.

Should: There should be opportunities to participate in multidisciplinary meetings conducted within the paediatric oncology service.

RT planning

Must: Planning of paediatric RT must be done in close consultation with a radiation oncologist with a paediatric subspecialty.

6. Glossary

CALD Cultural and linguistically diverse. Refers to the range of different cultures and language groups represented in the population who identify as having particular cultural or linguistic affiliations by virtue of their place of birth, ancestry or ethnic origin, religion, preferred language or language spoken at home.[71]

Child life therapist Trained healthcare professionals, specialising in child development. Child life therapists utilise their knowledge and skills to work with children 0–18 years in the hospital setting using evidence based practice.[45] (Previously called hospital play therapists in Australia).

Clinical trials Research investigations in which people volunteer to test new treatments, interventions or tests as a means to prevent, detect, treat or manage various diseases or medical conditions.

Consumer Children and adolescents with cancer, their immediate and extended families and social networks.

Dosimetry The calculation of intended, or measurement of actual, doses of radiation used to treat cancer.[15]

Fraction A portion of the overall radiation treatment dose usually given.

MDM Multidisciplinary meeting. A regularly scheduled meeting of core and invited team members of the health service for the purpose of prospective treatment and care planning of newly diagnosed cancer patients as well as those requiring a review of their treatment plan or palliative care.[72]

Onsite Services located within the institution or at an immediately adjacent campus.

PACS Picture archiving and communication system. A system that enables medical images to be shared electronically across sites via a host.

PTC Primary treatment centre. The tertiary paediatric cancer service responsible for diagnosing and treating children with cancer.

Timely access Ability to access a service or the skills of a suitably qualified person – without difficulty, delay or detriment to the patient.

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