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Developing clinical practice guidelines in paediatric and adolescent oncofertility

Harjot Kaur [a], Michael Assis [a,b,c,d], Apoorva Bhargava [a,b,c], Zobaida Edib [a,b], Diana Navarro-Perez [a,b,c], Devini Ameratunga [k,l,m], Antoinette Anazodo [e,f], David Handelsman [g,h], Shital Julania [i], Maria McCarthy [a,c,d], Michelle Peate [a,b], Laura Raiti [c,n], Genia Rozen [b,d,j], Patrick Western [o], Yasmin Jayasinghe [a,b,c,d,*], on behalf of for the Australian New Zealand Consortium in Oncofertility Clinical Trials Network Guidelines Group1

[a] Department of Obstetrics, Gynaecology and Newborn Health, University of Melbourne, Parkville, VIC, Australia
[b] The Royal Women's Hospital, Parkville, VIC, Australia
[c] Gynaecology, The Royal Children's Hospital, Parkville, VIC, Australia
[d] Murdoch Children's Research Institute, Parkville, VIC, Australia
[e] Kids Cancer Centre, Sydney Children's Hospital, Sydney, NSW, Australia
[f] School of Medicine, University of New South Wales, Sydney, NSW, Australia
[g] ANZAC Research Institute, University of Sydney, Sydney, NSW, Australia
[h] Department of Andrology, Concord Hospital, Concord West, NSW, Australia
[i] Department of Gynaecology, Perth Children's Hospital, Perth, WA, Australia
[j] Genea Fertility, East Melbourne, VIC, Australia
[k] Life Fertility Clinic, Bowne Hills, QLD, Australia
[l] Royal Brisbane and Women's Hospital, Brisbane, QLD, Australia
[m] University of Queensland, Brisbane, QLD, Australia
[n] The Hospital for Sick Children, Toronto, ON, Canada
[o] Hudson Institute of Medical Research at Monash University, Australia

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ABSTRACT

Recent international guidelines in child, adolescent, and young adult (CAYA) oncofertility uniformly recommend fertility discussion before cancer treatment, and individualised decision-making for fertility preservation procedures. Yet significant disparities remain across the globe. Various aspects of oncofertility care are in different stages of translation and the boundaries between experimental, innovative and established techniques are not always clear to patients, clinicians and policymakers. This poses barriers for implementation of high-quality care and for the allocation of resources required. International and national guidelines play a key role in promoting equitable care. In 2019, members of the Australian New Zealand Consortium in CAYA Oncofertility (ANZCO) called for national guidelines to standardise care and improve connectedness amongst Australian New Zealand Haematology Oncology Group (ANZCHOG) centres. A clearer understanding of the similarities and differences amongst key guidelines was deemed

* Corresponding author. Department of Obstetrics, Gynaecology and Newborn Health, University of Melbourne, Parkville, VIC, Australia.
E-mail address: yasmin.jayasinghe@unimelb.edu.au (Y. Jayasinghe).

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useful for closing knowledge gaps in the local context and identifying the priorities of key stakeholders with respect to guideline development. This paper provides an overview of CAYA oncofertility guidance from six peak bodies from four continents (Australia, Europe, North America, Asia). A review of recommendations and levels of evidence followed by a Delphi consensus of ANZCO members to develop priority questions is described. ANZCHOG guidelines tailored to the local CAYA context were deemed a high priority, in order to provide a common purpose, direction and governance for providers of paediatric care.

1. Introduction

Globally, over 290 000 children under 15 years and 500 000 adolescents and young adults up to 25 years of age (CAYA) are diagnosed with cancer annually [1,2]. Australia has one of the highest incidences of childhood cancer, with an age-specific cancer incidence rate for population aged 0–19 estimated 20 cases per 100 000 in 2021 [3]. Advances in diagnostic methods, cancer treatments and supportive care have substantially improved the 5-year survival rate for CAYA to >84 % [4]. However, cancer treatments can be gonadotoxic and result in infertility and hypogonadism. The risk of infertility varies according to the cancer type, age at the time of first treatment and treatment regimen [5]. Male childhood cancer survivors receiving modern alkylators have a 40 % reduced chance of parenthood [6], though this may be an underestimate. CAYA females have around a 16 % reduced chance, which can reach 40 % by the third decade [6,7].

Infertility is recognised as a major survivorship concern and can contribute to grief, anxiety, depression, panic, and social isolation for decades after diagnosis [8,9]. Lack of fertility consultation is one of the highest unmet needs at diagnosis and throughout the cancer journey [10]. In 2015, a survey of 346 female survivors, aged 18–35 years, who were cancer-free for at least a year, reported that 43–62 % still had unmet fertility needs, reproductive concerns, and decisional conflict about future parenthood [11]. Patients and families should be informed about the impact of cancer treatment on fertility and potential fertility preservation options, regardless of the infertility risk, at all stages of the cancer journey [12–22]. While there are fertility preservation options for patients, techniques are in various developmental stages from experimental to standard practice (Table 1) [13–22]. Some procedures considered standard in adults are innovative in children and adolescents (not experimental but have no or limited pregnancy outcome data) and due to the differences in individual guidelines, implementation can be challenging [12]. However, provision of information, and referral to expert oncofertility services in a timely manner, reduces long-term psychosocial morbidity by providing survivors with a potential opportunity to attempt biological parenthood if desired [8,9].

1.1. Barriers to oncofertility care in young patients

While oncofertility discussion should be universal for all patients with curative intent, fertility preservation procedures should only be offered if they are medically and ethically appropriate and any potential risks safely mitigated [17]. Shared decision-making between parent, clinician, and child depending on maturity (and partner where appropriate) is best practice. A collaborative multidisciplinary team approach is strongly encouraged to address the medical and ethical challenges (Table 2) [13–21]. It is increasingly recognised that young people of increasing maturity and mature minors, may wish to contribute to decisions that affect their health [23]. Parents or guardians are often key-decision makers for pre-pubertal children or those who are vulnerable from recency of cancer diagnosis [24,25]. In a follow-up study of 108 parents and 30 cancer survivors, decision regret was demonstrated in 18 % of

Table 1
Status of fertility preservation strategies in prepubertal, peripubertal and postpubertal adolescents [13–22].

	Prepubertal	Peripubertal/postpubertal adolescents
Males	Testicular tissue cryopreservation (research[a])	Sperm cryopreservation *via* masturbation Sperm cryopreservation by - Electroejaculation (innovative), - Testicular sperm extraction (TESE) (innovative[b]), - Testicular tissue cryopreservation (innovative[b])
Females	Ovarian tissue cryopreservation (innovative[b]) Ovarian transposition Oocyte collection (research[a]) Ex vivo maturation of immature eggs (research[a])	Oocyte cryopreservation (innovative in peripubertal[b]) Ovarian tissue cryopreservation Embryo cryopreservation (where appropriate) Uterine transplantation (research[a]) Oocyte in vitro maturation, collected in vivo (innovative[b]) Ex-vivo maturation of immature eggs (research[a]) Gonadotrophin releasing hormone analogues (research[a]) Ovarian transposition Uterine transposition (research[a])

Research[a]: the technique should only be undertaken under approved research protocols or special institutional new technologies approval.
Innovative[b]: a technique that is has either recently transitioned into clinical practice for that population, or where pregnancy and livebirth data for that population are limited.

participants, largely due to suboptimal fertility consultation (conversations occurring too late or of insufficient quality to make an informed fertility preservation decision) [24,26]. Unstructured fertility discussions which lack tailored information and include overwhelming medical jargon can also adversely affect understanding of fertility preservation options [27].

Clinician concerns about urgency of cancer care are legitimate. Time constraints, lack of educational resources and training, lack of guidelines and referral pathways, and lack of a supportive institutional culture further pose barriers to oncofertility consultation [8, 28–30]. Healthcare professionals with limited fertility preservation knowledge, or those who lack role-clarity in oncofertility care, or have concerns about family distress, report lower fertility preservation discussion rates compared to other providers [6,32,33]. Gender bias has been reported with a scoping review of 147 papers finding that young females are less likely to receive adequate counselling, or referral for fertility preservation than young males [6]. It is noted that access to oncofertility care for both genders is suboptimal [30]. Another major issue for clinicians is lack of utility and accessibility of clinical guidance at the point of care [8].

2. Current clinical practice guidelines for fertility preservation

Currently, several guidelines in fertility preservation exist, many serving as a blueprint for oncofertility care within their regional networks [13–22,34,35]. Guidelines may vary according to cultural context as evident in guidelines from peak reproductive and oncology groups, such as the European Society of Human Reproduction and Embryology (ESHRE), PanCareLIFE, American Society of Clinical Oncology (ASCO), American Society of Reproductive Medicine (ASRM), Japan Society of Clinical Oncology (JSCO) and the Clinical Oncology Society of Australia (COSA), who have published updates for birth assigned females (Table 3); and birth assigned males (Table 4) [13–15,18–21]. Their similarities and differences are quite nuanced and may take time to understand. They focus on slightly different populations and use different methods to describe levels of evidence and recommendations (Box 1).

Despite these differences, they make significant contributions to patient care in their cultural context. ESHRE 2020 was the first oncofertility guideline to include transgender males, however, there is no mention of male infertility in the guidelines [13]. Embryo and oocyte cryopreservation are deemed non-experimental in all guidelines however complexities for minors are raised [13–21]. The PanCareLIFE guidelines make strong recommendations for consideration of oocyte and embryo cryopreservation in post-pubertal patients if the cancer prognosis would not be affected [15]. JSCO 2017 is the only guideline stipulating in the recommendation itself that embryo cryopreservation would not be considered for those without a male partner, with no mention of same sex couples [19, 20]. However, JSCO does consider oocyte cryopreservation suitable for single females, as per other guidelines [11,12]. ASRM 2019 was the first guidance to deem ovarian tissue cryopreservation a standard of care [21], followed by ESHRE in 2020 [13], and COSA in 2022 [18]. PanCareLIFE deemed ovarian tissue cryopreservation ethically justifiable in most circumstances without requiring additional governance in 2021 [17]. Clinicians are referred to ethical frameworks for children to help guide fertility preservation decisions in paediatric practice [15,16]. Caution is noted in patients with leukaemia who are often too unwell at diagnosis and at high risk of malignant contamination of gonadal tissue at diagnosis. Tissue cryopreservation after interval chemotherapy or prior to bone marrow transplant in the context of minimal residual disease can be considered [13,17,19,20]. Ovarian transposition (oophoropexy) is deemed viable for female patients undergoing pelvic radiation in all guidelines, however ESHRE additionally suggested it be undertaken in the absence of chemotherapy and simultaneously with ovarian tissue cryopreservation [13]. There is general agreement that gonadotrophin releasing hormone (GnRH) agonist (chemoprophylaxis) not be used as a replacement for other proven forms of fertility preservation, and not for routine use outside of approved protocols for non-breast cancer diagnoses [13–21]. Ex-vivo IVM is under development.

For pubertal and post-pubertal males, both PanCareLIFE and ASRM discuss the possibility of penile vibratory stimulation as a secondary method for sperm collection [16,21]. Electroejaculation and testicular sperm extraction were considered invasive and only for consideration in those at high risk of infertility or where self-collection or penile vibratory stimulation had failed. (However, in clinical practice, ethical concerns about penile vibratory stimulation or electroejaculation procedures in minors or lack of access to suitable equipment can preclude their use in some countries [36]. TESE is a viable procedure, which can also be offered under an anaesthetic at the same time as another procedure and may have more acceptance by patients and families in some regions [16]). For prepubertal males, testicular tissue cryopreservation is an experimental procedure that was recommended for those at high risk of

Table 2
Potential ethical concerns of clinicians or families about fertility preservation [13–21].

Before/at time of treatment	In survivorship
Potential delays to cancer treatment if patient too unwell or disease too advanced. Fertility a secondary concern to cancer treatment.	Impact of treatment on future gonadal function is unknown
Limited awareness of issues by family or clinician. Reluctance/avoidance of discussion of sexual function/masturbation	The ongoing cost to a family of tissue and gamete storage
Experimental nature of some FP technologies: Uncertain outcomes for fertility or offspring health. No guarantees for parenthood.	Posthumous use of tissue or gametes if the child passes away
Young age and surrogate decision making. Discordance between family members in desire to proceed to FP, or lack of awareness of importance of fertility to young person	Pressure felt by survivor to use tissue/gametes
Concern about potential to cause discomfort/distress to the child	Potential reseeding of original disease when tissue reimplanted.
Surgical and anaesthetic risks, impact of comorbidities	Desired parenthood not achieved
Religious and cultural considerations	Regret about the fertility preservation decision

Table 3
Criteria for Fertility preservation (FP) recommendations for children, adolescents, and young adults *with female sex at birth* having gonadotoxic treatment: guidance from ESHRE, PanCareLIFE, ASCO, ASRM, COSA and JSCO [13–21].

FP Techniques		ESHRE 2020[a] *Postpubertal, transgender males*	PanCareLIFE Consortium 2021[b]		ASCO 2018[c]	ASRM 2019[d]	COSA 2022[e]	JSCO 2017[f]
			High gonadotoxic risk[g]	Low gonadotoxic risk[h]				
Embryo cryopreservation	*Additional criteria*		*Postpubertal*	*Postpubertal + high risk of relapse*	*Adults*	*Postpubertal + male partner or donor sperm*	*Postpubertal*	*Postpubertal + male partner*
	Recommendation	**Strong**	**Strong**	**Moderate**	**Established**	**Established**	**Satisfactory**	**Recommended**
	Level of evidence	⊕⊕⊖⊖	⊖⊖⊖⊖	Cited from guidelines	–	–	III-3	Grade B
Oocyte cryopreservation	*Additional criteria*		*Postpubertal*	*Postpubertal + high risk of relapse*	*Adult and postpubertal*	*Postpubertal, sometimes peripubertal*	*Postpubertal*	*Postpubertal*
	Recommendation	**Strong**	**Strong**	**Moderate**	**Established**	**Established**	**Satisfactory**	**Recommended**
	Level of evidence	⊕⊕⊖⊖	⊖⊖⊖⊖	Cited from guidelines	–	–	II	Grade C1
Ovarian tissue cryopreservation (OTC)	*Additional criteria*	(1) *Moderate-high gonadotoxic risk treatment, oocyte freezing unfeasible* (2) *After onset low risk treatment*	*CAYA ≤ 25 years*	*CAYA ≤ 25 years*	*All ages (research required to confirm safety in leukaemia)*	*All ages if no time for ovarian stimulation*	*All ages having high gonadotoxic risk cancer treatment*	*All ages if urgent cancer therapy*
	Recommendation	**(1) Strong** (established) **(2) Weak**	**Moderate** (Established)	**Not recommended**	**Investigational**	**Established**	**Satisfactory** (Established)	**Recommended**
	Level of evidence	(1) ⊕⊕⊖⊖ (2) ⊕⊖⊖⊖	⊕⊖⊖⊖				IV	*grade C1*
Ovarian transposition	*Additional criteria*	*Pelvic radiotherapy + no chemotherapy + performed simultaneously with OTC*	*CAYA ≤25 years + prior to pelvic irradiation*	*[No radiotherapy risk]*	*Prior to pelvic irradiation*	*Prior to pelvic irradiation*	*All ages + prior to pelvic irradiation*	*All ages + prior to pelvic irradiation*
	Recommendation	**Good practice point**	**Moderate**	–	**Can be offered**	–	**Satisfactory**	**Recommended**
	Level of evidence	Clinician expertise	⊕⊖⊖⊖	–	–	–	III-2	Grade B
GnRH agonist [i]	*Additional criteria*	(1) *Breast cancer if proven methods unfeasible* (2) *In other cancers, must discuss uncertain benefit*	*CAYA ≤25 years*	*CAYA ≤25 years*	*Breast cancer if proven methods unfeasible*	(1) *Breast cancer if proven methods unfeasible* (2) *Menstrual management*	*In breast cancer*	(1) *For fertility* (2) *Menstrual management*
	Recommendation	(1) **Strong** (2) **Strong**	**Research-only**	**Research-only**	**May be offered**	-	**Strong**	**(1) Not recommended** **(2) Consider**
	Level of evidence	(1) ⊕⊕⊕⊕ (2) ⊕⊕⊖⊖	Inconclusive evidence	Inconclusive evidence	–	–	I	Grade C2
In-vitro maturation of oocytes	*Additional criteria*	(1) *Oocyte collection + stimulation not feasible* [j] (2) *Ex vivo extraction from tissue* [k]	*Not discussed*	*Not discussed*	*Not discussed*	*(1) Postpubertal* *(2) Peripubertal premenarchal adolescents with careful consideration*	*Not discussed*	*Not discussed*
	Recommendation	**(1) Good practice point**	–	–	–	-	–	–

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Table 3 (*continued*)

FP Techniques	ESHRE 2020[a] *Postpubertal, transgender males*	PanCareLIFE Consortium 2021[b]		ASCO 2018[c]	ASRM 2019[d]	COSA 2022[e]	JSCO 2017[f]
		High gonadotoxic risk[g]	Low gonadotoxic risk[h]				
Level of evidence	**(2) Weak recommendation** (1) Clinician expertise (2) ⊕⊖⊖⊖	–	–	–	–	–	–

[a] European Society of Human Reproduction and Embryology used the Grading of Recommendations Assessment, Development and Evaluation methodology (GRADE) to assess quality of evidence (High ⊕⊕⊕⊕, Moderate ⊕⊕⊕⊖, Low ⊕⊕⊖⊖, Very low ⊕⊖⊖⊖). Each recommendation was categorised as strong or weak correlating to levels of evidence; Good practice points (GPPs) based on clinical expertise; Research only.

[b] PanCareLIFE Consortium used GRADE (as above) to assess quality of evidence. Recommendations were categorised into strong (where benefits significantly greater than risks); moderate (where the benefits greater or equal to the risks); do not recommend (where no benefit/potentially harm).

[c] America Society of Clinical Oncology used the GuideLines Into DEcision Support (GLIDES) methodology with types of recommendations categorised as evidence-based, formal consensus, informal consensus and no recommendation. The strength of recommendations categorised as strong, moderate, weak; strength of evidence defined as high, intermediate, low and insufficient.

[d] American Society of Reproductive Medicine: Committee opinion. Lack of standardised wordings of recommendations and levels of evidence not provided.

[e] Clinical Oncology Society of Australia used the National Health and Medical Research Council (NHMRC) evidence matrix. The levels of evidence defined as Grade A: Evidence can be trusted to guide practice. Grade B: Evidence can be trusted to guide practice in most situations. Grade C: Evidence provides some support for recommendation(s) but care should be taken in its application. Grade D: Evidence is weak, and recommendation must be applied with caution and PP as practice point. The strength of recommendations were defined as A Excellent, B Good, C Satisfactory and D Poor, dependant on grades. The evidence level described as I: systematic review of level II studies. II: evidence from randomized controlled trials, prospective cohort study & accuracy test. III-1: pseudorandomised controlled trial & study of accuracy test. III-2: comparison study with concurrent controls. III-3: comparison study without concurrent controls, diagnostics case-control study & retrospective cohort study. IV: Case studies with post-test or pre-test outcomes & study of patients at different stages of disease [45].

[f] Japanese Society of Clinical Oncology used consensus-based rating with the following levels of evidence Grade A: Recommendation based on full scientific evidence, approach is strongly recommended. Grade B: Recommendation based on scientific evidence, approach is recommended. Grade C1: Presence of limited scientific evidence, approach is recommended. Grade C2: Paucity of scientific evidence, approach is not recommended. Grade D: Scientific evidence for its non-efficacy or harm(s), approach is not recommended. The categories of evidence were level I from a systematic review or meta-analysis of randomized controlled trials (RCTs); level II from 1 or more RCTs; level III from 1 or more non-randomized controlled studies; level IVa from 1 or more analytical epidemiology studies (cohort studies); level IVb from 1 or more analytical epidemiology studies (case–control studies and/or cross-sectional studies); level V from 1 or more descriptive studies (1 or more case reports and/or 1 or more case-series studies) and level VI was based on expert opinion without supportive patient data.

[g] High-dose alkylating agents (Cyclophosphamide-equivalent dose $\geq$6000–8000 mg/m^2), ovarian radiotherapy, or hematopoietic stem cell transplantation (HSCT).

[h] Low-dose alkylating agents (Cyclophosphamide-equivalent dose <6000–8000 mg/m^2) or Cranial radiotherapy.

[i] Gonadotrophin releasing hormone (GnRH) agonist.

[j] Oocytes collection without hormone stimulation (innovative).

[k] In-vitro extraction and maturation of oocytes (experimental).

Table 4
Criteria for Fertility preservation (FP) recommendations for children, adolescents, and young adults *with male sex at birth* patients having gonadotoxic treatment: guidance from PanCareLIFE, ASCO, ASRM, COSA and JSCO [14–22].

FP Techniques		PanCareLIFE Consortium 2021[a]		ASCO 2018[b]	ASRM 2019[c]	COSA 2022[d]	JSCO 2017[e]
		High gonadotoxic risk[f]	Low gonadotoxic risk[g]				
Sperm cryopreservation via masturbation	*Additional criteria*	*Pubertal or postpubertal*	*Pubertal or postpubertal*	*(1) Adult (2) Postpubertal minor*	*Postpubertal*	*Postpubertal*	*Postpubertal*
	Recommendation	**Strong**	**Strong**	**(1) Should discuss (2) Suggest**	**Established**	**Satisfactory**	**Recommended**
	Level of evidence	⊕⊖⊖⊖	⊕⊖⊖⊖	–	–	III-2	Grade B
Sperm cryopreservation via penile vibration stimulation (PVS)	*Additional criteria*	*Pubertal or postpubertal*	*Pubertal or postpubertal*	-	*Peripubertal and postpubertal*	*Not discussed*	*Postpubertal if unable to self-collect*
	Recommendation	**Strong**	**Strong**	**-**	**-**	**-**	**Recommended**
	Level of evidence	⊕⊖⊖⊖	⊕⊖⊖⊖	–	–	–	Grade B
Sperm cryopreservation via electroejaculation	*Additional criteria*	*Pubertal or postpubertal + can't collect via masturbation or PVS*	*Pubertal or postpubertal + can't collect via masturbation or PVS + high risk of cancer recurrence*	–	*Peripubertal or postpubertal if can't collect via masturbation or PVS*	*Not discussed*	*Postpubertal if unable to self-collect*
	Recommendation	**Strong**	**Moderate**	–	–	–	**Recommended**
	Level of evidence	⊕⊖⊖⊖	⊕⊖⊖⊖	–	–	–	Grade B
Testicular sperm extraction (TESE)	*Additional criteria*	*Pubertal or postpubertal + can't collect via masturbation or PVS*	*Pubertal or postpubertal + can't collect via masturbation or PVS + high risk of cancer recurrence*	-	*Males unable to collect via other techniques or have low sperm count*	*Postpubertal if unable to self-collect*	*Postpubertal if unable to self-collect*
	Recommendation	**Strong**	**Moderate**	–	–	**Poor**	**Recommended**
	Level of evidence	⊕⊖⊖⊖	⊕⊖⊖⊖	–	–	IV	Grade B

(*continued on next page*)

Table 4 (*continued*)

FP Techniques		PanCareLIFE Consortium 2021[a]		ASCO 2018[b]	ASRM 2019[c]	COSA 2022[d]	JSCO 2017[e]
		High gonadotoxic risk[f]	Low gonadotoxic risk[g]				
Testicular tissue cryopreservation	*Additional criteria*	*Prepubertal and postpubertal*	*(1) CAYA ≤ 25 years* *(2) Only cranial radiotherapy*	*(1) Adult* *(2) Prepubertal*	*(1) Pubertal* *(2) Prepubertal (Research)*	*(1) Pubertal* *(2) Prepubertal*	*Postpubertal if no sperm in ejaculate*
	Recommendation	**Moderate (Research)**	**(1) No recommendation formulated** **(2) Not recommended**	**(1) Experimental** **(2) Investigational**	-	**(1) Poor** **(2) Poor (Research)**	**Recommended**
	Level of evidence	⊕⊖⊖⊖	Insufficient evidence	–	–	IV	Grade C1

[a] PanCareLIFE Consortium used the Grading of Recommendations Assessment, Development and Evaluation methodology (GRADE) to assess quality of evidence (High ⊕⊕⊕⊕, Moderate ⊕⊕⊕⊖, Low ⊕⊕⊖⊖, Very low ⊕⊖⊖⊖). Recommendations were categorised into strong (where benefits significantly greater than risks); moderate (where the benefits greater or equal to the risks); do not recommend (where no benefit/potentially harm).

[b] America Society of Clinical Oncology used the GuideLines Into DEcision Support (GLIDES) methodology with types of recommendations categorised as evidence-based, formal consensus, informal consensus and no recommendation. The strength of recommendations categorised as strong, moderate, weak; strength of evidence defined as high, intermediate, low and insufficient.

[c] American Society of Reproductive Medicine: narrated review by experts. No levels of recommendations or evidence provided.

[d] Clinical Oncology Society of Australia used the National Health and Medical Research Council (NHMRC) evidence matrix. The levels of evidence defined as Grade A: Evidence can be trusted to guide practice. Grade B: Evidence can be trusted to guide practice in most situations. Grade C: Evidence provides some support for recommendation(s) but care should be taken in its application. Grade D: Evidence is weak, and recommendation must be applied with caution and PP as practice point. The strength of recommendations were defined as A Excellent, B Good, C Satisfactory and D Poor, dependant on grades. The evidence level described as I: systematic review of level II studies. II: evidence from randomized controlled trials, prospective cohort study & accuracy test. III-1: pseudorandomised controlled trial & study of accuracy test. III-2: comparison study with concurrent controls. III-3: comparison study without concurrent controls, diagnostics case-control study & retrospective cohort study. IV: Case studies with post-test or pre-test outcomes & study of patients at different stages of disease [45].

[e] Japanese Society of Clinical Oncology used consensus-based rating with the following levels of evidence Grade A: Recommendation based on full scientific evidence, approach is strongly recommended. Grade B: Recommendation based on scientific evidence, approach is recommended. Grade C1: Presence of limited scientific evidence, approach is recommended. Grade C2: Paucity of scientific evidence, approach is not recommended. Grade D: Scientific evidence for its non-efficacy or harm(s), approach is not recommended. The categories of evidence were level I from a systematic review or meta-analysis of randomized controlled trials (RCTs); level II from 1 or more RCTs; level III from 1 or more non-randomized controlled studies; level IVa from 1 or more analytical epidemiology studies (cohort studies); level IVb from 1 or more analytical epidemiology studies (case–control studies and/or cross-sectional studies); level V from 1 or more descriptive studies (1 or more case reports and/or 1 or more case-series studies) and level VI was based on expert opinion without supportive patient data.

[f] High-dose alkylating agents (Cyclophosphamide-equivalent dose $\geq$4000 mg/m^2), testicular radiotherapy, or hematopoietic stem cell transplantation (HSCT).

[g] Low-dose alkylating agents (Cyclophosphamide-equivalent dose <4000 mg/m^2), cisplatin, or orchiectomy or Cranial radiotherapy.

Box 1

- ESHRE 2020 (post-pubertal females and transgender males) [13]: 78 recommendations, 50 evidence-based, 31 graded strong recommendations, 25 good practice points, 3 research-only. Used the Grading of Recommendations Assessment, Development and Evaluation methodology (GRADE) to describe quality of evidence.
- PanCareLIFE 2021 (pre and postpubertal females and males) [15,16]: 46 recommendations, of which 17 strong, 17 moderate, 10 not recommended, 2 research-only. Used GRADE to describe quality of evidence.
- JSCO 2017 (male and female CAYA) [19,20]: 36 consensus-based recommendations. Used categories of recommendation grades (A to D).
- COSA 2022 (adults and children) [18]: 34 recommendations, 24 evidence-based, 6 consensus-based, 2 practice points. Used the National Health and Medical Research Council (NHMRC) body of evidence matrix [31].
- ASCO 2018 (adults and children) [14]: 18 recommendations. Used the GuideLines Into DEcision Support (GLIDES) methodology [33,34].
- ASRM 2019 (male and female CAYA) [21]: 10 recommendations. Evidence and recommendations based on expert review and committee opinion.

infertility under research protocols only [14,16–22]. For such procedures, morbidity from the intervention must be balanced with the potential opportunity to collect sperm in adulthood.

3. Delphi consensus for guideline development

Oncofertility research related to children is rapidly advancing but not always of sufficient maturity for inclusion into guidelines. This makes it challenging for clinicians to comfortably incorporate even other evidence-based aspects of fertility preservation care into routine practice, such as fertility discussion [37]. The Delphi method is widely used by researchers and experts to reach a consensus particularly when there is lack of empiric evidence [38]. The French Society of onco-gynaecology conducted a modified Delphi approach to evaluate the management of endometrial cancer and optimise clinical practices with engagement from French and Swiss French speaking experts [39]. The study was able to clarify several issues arising from the European Society of Gynaecological Oncology (ESGO), the European Society for Radiotherapy and Oncology (ESTRO), and the European Society of Pathology (ESP) (ESGO-ESTRO-ESP) 2021 recommendations, for development of the new Franco-Swiss guidelines for endometrial cancer [39]. Delphi processes may also be used to seek consensus on guideline development or priorities in care using co-design. The French national college of gynaecologists and obstetricians (Collège National des Gynécologues et Obstétriciens Français (CNGOF)) conducted two Delphi surveys and a final meeting with a steering committee of 14 oncofertility experts to explore items for inclusion in the fertility preservation guidelines for AYA women with benign gynaecologic disease [40]. Twenty-eight items were approved for inclusion in the final set of the French guidelines defining indication for oocyte vitrification in this population. A special interest group on fertility preservation in ESHRE utilised the Delphi method to explore information needs and research priorities related to fertility preservation for women with breast cancer [41]. Two Delphi studies through three online surveys not only identified significant gaps in patient information and the need for tailored communication from clinicians but emphasised essential topics for future research and the necessity of guidelines to improve support and resources for women at risk of breast cancer treatment-related infertility [41]. A group of experts under the European Association of Urology (EAU) conducted a Delphi study to bridge knowledge practice gaps in male infertility [42]. Oncofertility experts have used Delphi methodology to determine 108 competencies in oncofertility clinical care [32]. Although these studies utilised the Delphi method to improve clinical practices for fertility preservation, there has been limited focus on the paediatric oncofertility space.

The development of a framework for the Australia and New Zealand Children's Haematology/Oncology Group (ANZCHOG) CAYA oncofertility guidelines using a Delphi consensus was recently undertaken. ANZCHOG centres treat all paediatric patients and most adolescents in Australia and New Zealand. Most ANZCHOG centres continue to follow cancer patients into young adulthood *via* survivorship programs after successful cancer treatment. In 2019, a study by Skaczkowski found that around 50 % of young Australian cancer survivors were unaware of the possibility of fertility loss prior to their treatment [43]. In 2021, a survey of ANZCHOG centres showed that around 80 % of the centres did not routinely implement fertility discussions in all patients [44]. Furthermore, the governance, guidance, and risk management systems at ANZCHOG centres lacked uniformity and oncologists recommended that national paediatric-specific guidelines be developed to address inequalities and guide fertility discussions [44]. It was proposed that ANZCHOG guidelines would address cultural, geographic and organisational barriers between centres, address emerging technologies and ethical issues, and support connectedness between centres. Ten working groups were formed within ANZCO to develop the guidelines through consensus and focus groups (Supplementary Table A1) to produce the final framework (Table 5). Multidisciplinary discussion during the Delphi process facilitated agreement for inclusion on subjects that were deemed important by experts in the field. Four themes for implementation were identified through the Delphi process: i) the importance of leveraging pre-existing high-quality guidelines; ii) the need for guidelines that are relevant and easy to implement in clinical practice; iii) consideration of geographic barriers and cultural inclusivity and iv) acknowledgement of some benefit of inclusion of emerging technologies to improve awareness in end-users, even if not for clinical action. A disadvantage of Delphi methodology is that it can solidify preconceived ideas, therefore

Table 5
The ANZCHOG Oncofertility Guidelines Framework formed with Delphi consensus and working group (WG) iterations.

WG1: What are the potential impacts of routine cancer treatment on female reproductive health (pubertal development, sexual health, fertility and pregnancy)?

1. What are potential impacts of different chemotherapy agents on female reproductive health (pubertal development, sexual health, fertility and pregnancy)?
2. What are the potential impacts of external beam including TBI on female reproductive health (pubertal development, sexual health, fertility and pregnancy)?
3. What are the potential impacts of brachytherapy on female reproductive health (pubertal development, sexual health, fertility and pregnancy)?
4. What are the potential impacts of *unilateral* salpingo-oophorectomy on female reproductive health (pubertal development, sexual health, fertility and pregnancy)?

WG2: What are the risks, benefits and potential impacts of new gonadotoxic and epigenomic therapies on reproductive health (pubertal development, sexual health, fertility & pregnancy)?

5. What are the risks, benefits and potential impacts of craniospinal radiation on reproductive health (pubertal development, sexual health, fertility & pregnancy)?
6. What are the risks, benefits and potential impacts of CAR-T cell therapy on reproductive health (pubertal development, sexual health, fertility & pregnancy)?
7. What are the risks, benefits and potential impacts of epigenomic therapies on reproductive health (pubertal development, sexual health, fertility & pregnancy)?
8. What are the risks, benefits and potential impacts of other novel therapies on reproductive health (pubertal development, sexual health, fertility & pregnancy)?
9. What are the risks, benefits and potential impacts of proton therapy on reproductive health (pubertal development, sexual health, fertility & pregnancy)?

WG3: What is the evidence of the following FP techniques to be considered in male CAYA undergoing gonadotoxic treatment?

10. What is the natural history of testicular endocrine and exocrine dysfunction during and after gonadotoxic treatment (chemotherapy, external beam radiotherapy and total body irradiation, and orchidectomy)
11. Can electroejaculation be considered for FP in males undergoing gonadotoxic treatment?
12. What is the evidence of sperm collection to be considered in male CAYA before, during and after gonadotoxic treatment?
13. What is the safety and efficacy evidence of sperm dissection from testicular biopsies to be considered in male CAYA undergoing gonadotoxic treatment?
14. What is the safety and efficacy evidence of testicular sperm extraction to be considered in male CAYA undergoing gonadotoxic treatment?
15. What is the safety and efficacy evidence of testicular tissue preservation to be considered in male CAYA undergoing gonadotoxic treatment?
16. Are the offspring born from FP measures healthy?

WG4: What are the recommended standard FP techniques to be considered in female CAYA undergoing gonadotoxic treatment?

17. What are the risks, benefits and potential impacts of stimulation and oocyte collection in biological female CAYA undergoing gonadotoxic treatment?
18. What are the risks, benefits and potential impacts of ovarian tissue collection in birth assigned CAYA undergoing gonadotoxic treatment?
19. What is the evidence of ovarian transposition to be considered in female CAYA undergoing gonadotoxic treatment?

WG5: What is the evidence of the novel FP techniques to be considered in female CAYA undergoing gonadotoxic treatment?

20. What is the evidence of novel fertility protective agents to be considered in female CAYA undergoing gonadotoxic treatment?
21. What is the evidence of GnRH therapy to be considered in female CAYA undergoing gonadotoxic treatment?
22. What is the evidence of in-vitro maturation (IVM) to be considered in female CAYA undergoing gonadotoxic treatment?
23. What are the future considerations for cancer survivor's suitability utilizing uterine transplant in the future?
24. What is the evidence of uterine transposition to be considered in female CAYA undergoing gonadotoxic treatment?

WG6: What are the best models of clinical care for oncofertility before, during and after cancer treatment?

25. When should FP discussion occur in the cancer treatment trajectory?
26. What should be discussed during oncofertility consultation before, during and after cancer treatment?
27. What is the evidence for including oncofertility coordinators in oncofertility care?
28. What is the evidence for psychosocial support be included in oncofertility care?
29. What are the supportive care issues for CAYA having FP?
30. What evidence-based information resources are available to support clinicians and families?
31. What is the evidence for multidisciplinary meetings in oncofertility?
32. a) What is the evidence for concordance between parents/guardians/partners and CAYA for FP experience?
    b) What is the impact of shared/surrogate decision making between parents/guardians and CAYA?

WG7: What are the best models of surgical care for oncofertility before, during and after cancer treatment?

33. What are the advantages and disadvantages of centralised tissue transport and storage to centres of excellence versus decentralized service?
34. Should oophorectomy versus cortical biopsy be considered in CAYA undergoing ovarian tissue cryopreservation?
35. What is best practice surgical care in oncofertility (pre, intra and post op)?

WG8: Governance and regulations in CAYA oncofertility

36. What are the skills and the experience recommended/preferred for medical practitioners and nurses involved in CAYA oncofertility?
37. What is the level of the accreditation required for reproductive laboratories involved in CAYA oncofertility?
38. What is the level of the accreditation required for institutions involved in CAYA oncofertility?
39. What are the general guidelines for transport of tissue?
40. What is the role of clinical ethics and institutional governance frameworks in CAYA oncofertility? (Include utility of oncofertility steering committees)
41. Mature minor principle as it relates to FP and ownership of the tissue?
42. a) What access to tissue do family members of deceased patients have for use of tissue or burial?
    b) How do we implement access to tissue for families?
43. What are the legal and ethical considerations for using reproductive tissue for research?
44. What are the regulations of materials and medical devices used for CAYA?

WG9: What are the considerations for fertility preservation in special populations?

45. What are the considerations for fertility preservation for CNS tumour patients?
46. What are the considerations for fertility preservation for genetic predispositions patients?
47. What are the considerations for fertility preservation for leukaemia patients?

WG10: What are the recommendations that address applicability, implementation, resources and monitoring?

48. How should the Australian and New Zealand context be considered?
49. What is the evidence for population monitoring of impact through oncofertility registries?
50. What implementation strategies should be used to influence uptake and practice of guidelines?
51. How should we monitor the health economic benefits of oncofertility?

the questions will form the basis of systematic reviews of the literature and policy to minimise this bias. Further details on the ANZCO Delphi process can be found in Supplementary File A.

4. Discussion

Oncofertility is a rapidly evolving field. Collectively, current international guidelines have been developed for postpubertal female and transgender males (ESHRE, 2020) [13], male and female CAYA ≤25 years (PanCareLIFE 2021, JSCO 2017) [15–17,19,20]; adults and children with cancer (ASCO 2018, COSA 2021) [14,18]; CAYA males and females undergoing gonadotoxic therapy or gonadectomy (ASRM 2019) [21]. Evidence on gonadotoxic risk assessment, fertility preservation procedures are included in all guidelines. Guidelines have also included systematic approaches and models of care, the importance of counselling by multidisciplinary teams rather than a discipline-specific approach, the critical need for clearly defined roles and responsibilities, and a known point of contact for all referrals [13–21]. Provision of written information, including decision aids, individualised counselling with attention to ethical, financial and legal aspects of fertility preservation and provision of psychological support particularly for younger patients and their families are suggested [13–21]. Informed consent, maintenance of fertility preservation documentation and monitoring of outcomes through registries is recommended [13,45]. Guidelines should consider special populations including brain tumour and leukaemia patients, not only because they are the two most common childhood cancers, but also because of the challenges these diagnoses pose for implementation of oncofertility care. Paediatric providers identify specific concerns for this group, including 'the impact of cranial surgery on cognitive function', the optimal timing for fertility preservation referral and malignant reseeding. Importance of post-fertility preservation care [13–21], and importance of preconception counselling and high-risk obstetric monitoring in pregnancy after gonadotoxic treatment have also been discussed [13].

Implementing guidelines into clinical practice is complicated, and coverage or documentation of oncofertility care for eligible patients is still variable [46,47]. Changes are required at individual and organisational levels for their success [44]. A number of measures have been identified to enhance guideline translation and adoption, including an understanding of readiness of end-users to change, and integrating implementation strategies within the guidelines. Leveraging recently published guidelines can save resources and time. Consistency of terminology, how populations are defined (for example according to Tanner staging or menarcheal status), and clearly accessible explanations and descriptors of evidence and recommendations can assist CAYA clinicians. Co-design with diverse end-users can facilitate cultural inclusivity and an understanding of the local context. And developing guidelines under the banner of professional bodies, including national paediatric oncology bodies, can promote support and unity in oncofertility care across paediatric oncology and adult reproductive sectors.

Several countries have established comprehensive fertility preservation networks and localised guidelines to support CAYA patients and their families access care with excellent results [34,35]. The Nordic Network for Gonadal Preservation after Cancer Treatment in CAYA have shown increased fertility preservation protocols in their centres from 25 % to 75 % over 12 years [48]. The Oxford hub and spoke model has demonstrated a network of 36 centres undertaking ovarian tissue cryopreservation and 16 undertaking testicular tissue cryopreservation, with a significant increase in fertility preservation procedures seen in prepubertal patients in spoke centres [49]. Countries such as Spain and Portugal have established national policies for fertility preservation to enable patients and their families access relevant fertility care [37]. A Swiss multi-centre network demonstrated high acceptance rates of testicular tissue cryopreservation (87.5 %, 35/40) highlighting the willingness of patients and their families to consider fertility preservation [50].

Mechanisms need to be in place to update guidelines regularly and to translate the updates into clinical practice. Clinical guidelines can be readily outpaced by rapid medical advancements. This, combined with the lack of guarantees about future fertility, the urgency of cancer treatment, potential ethical and legal barriers, and underdeveloped clinical pathways, can leave paediatric clinicians practising in a landscape of uncertainty [51]. Responsive and adaptive guidance on assessing infertility risk, medical co-morbidity; monitoring of safety and efficacy; clinical ethics guidance; laboratory and surgical quality assurance; information support and psychosocial counselling for families, as well as survivorship care are necessary for paediatric providers.

Guidelines can play a role in raising awareness of emerging technologies, even if they are not accessible, in order to enhance oncology clinician knowledge and respond to consumer awareness. For example, the Food and Drug Administration has approved a number of new therapies and long-term infertility impact is unknown [41,48]. Uterine transplantation is emerging as a viable option that can provide women without a uterus an opportunity to attain both genetic and gestational motherhood [52]. The first live birth after transplant was reported in September 2014 [52] Uterine transplantation has progressed significantly in recent years, over 15 centres having initiated clinical trials, including Australia where the first birth was reported in 2024 [53–55]. It is important that paediatric providers have educational awareness of these new fertility impacting technologies, however implications for CAYA oncology practice are unclear.

Delphi methodology can support development of consensus in the absence of evidence. There are several advantages of employing the Delphi technique, including anonymous participation, encouraging honest feedback and enabling participants to express their views without the influence of others. The iterative approach of Delphi allows participants to re-evaluate their responses in comparison to others to achieve a consensus view [36]. However, success relies much on the quality and experience of the expert panel, and reliability of outcomes can be impaired by bias. The role of nursing staff present a great opportunity in this space. A study at the RCH Melbourne demonstrated that 29/41 (70.7 %) of nursing staff desired more training and participation in oncofertility care, yet only 43 % had some involvement in care [56]. As CAYA oncofertility nursing networks grow, new iterations of guidelines need to be developed according to nursing as well as consumer priorities.

The questions highlighted by the ANZCO Delphi are undergoing systematic review as well as review of policy by a multidisciplinary

guidelines group before making evidence-based or consensus-based recommendations for the guidelines. The importance of additional layers of governance at the institutional levels (research, clinical ethics or novel technologies governance) for implementation of experimental care can fill an important gap that guidelines cannot fill [17,57]. Implementation studies to assess utility, scalability, address the issue of accessibility (for health care professionals and patients) of how to best present evidence summaries at the point of care are being planned through the ANZCO clinical trials network. They will aim to assess the impact of the guidelines on key performance indicators and the core competencies of clinicians.

5. Conclusions

This review presents an overview of high impact oncofertility guidelines in CAYA and a consensus-based paediatric-specific guideline development process. Commonalities in international guidelines exist, such as sperm, oocyte, embryo and ovarian tissue cryopreservation considered standard practice in most guidelines [13–21]. Utility of reproductive tissue and livebirth data are limited so monitoring of long-term outcomes are recommended [13–21]. Differences in guideline development, grading of evidence and recommendation strengths were seen. Varying recommendations for different populations utilizing the same technology, and sociocultural factors highlight the highly nuanced and individualised nature of fertility counselling. This can make implementation at the point of care difficult for providers. Delphi consensus processes can provide multidisciplinary clinicians and researchers the opportunity for iterative intellectual exchange, to inform consensus priorities for oncofertility care and guidance in youth with the cautionary note that they must adapt as evidence comes to light. An implementation focus can evaluate if the impact of the guidelines on oncofertility care in paediatric oncology centres is aligned with their original aims.

CRediT authorship contribution statement

Harjot Kaur: Writing – review & editing, Validation, Project administration, Investigation, Data curation, Writing – original draft, Supervision, Methodology, Formal analysis. **Michael Assis:** Validation, Resources, Methodology, Formal analysis, Writing – review & editing, Supervision, Project administration, Investigation, Data curation. **Apoorva Bhargava:** Validation, Project administration, Writing – review & editing, Resources. **Zobaida Edib:** Project administration, Writing – review & editing. **Diana Navarro-Perez:** Writing – review & editing, Project administration, Conceptualization, Supervision, Investigation. **Devini Ameratunga:** Supervision, Writing – review & editing, Conceptualization. **Antoinette Anazodo:** Writing – review & editing, Conceptualization, Supervision. **David Handelsman:** Supervision, Writing – review & editing, Conceptualization. **Shital Julania:** Writing – review & editing, Conceptualization, Supervision. **Maria McCarthy:** Supervision, Writing – review & editing, Conceptualization. **Michelle Peate:** Validation, Conceptualization, Writing – review & editing, Supervision. **Laura Raiti:** Writing – review & editing, Conceptualization, Supervision. **Genia Rozen:** Supervision, Writing – review & editing, Conceptualization. **Patrick Western:** Writing – review & editing, Conceptualization, Supervision. **Yasmin Jayasinghe:** Visualization, Resources, Methodology, Funding acquisition, Writing – review & editing, Supervision, Project administration, Investigation, Conceptualization.

Research agenda

- The value of oncofertility guidelines (with clear recommendations and levels of evidence) to facilitate best oncofertility practices globally.
- The utility of Delphi frameworks to achieve consensus amongst multidisciplinary professionals.
- Evaluation of guidelines *via* implementation frameworks for utility, scalability, accessibility, effectiveness.

Practice points

- International guidelines recommend discussing the impact of cancer treatment on fertility in all patients with curative intent.
- New guidelines and ethical frameworks for CAYA are available to help guide clinicians in this complex area of care.

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Conflicts of interest

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The following named authors are also team leaders for the upcoming ANZCHOG guidelines under development: Devini Ameratunga, David Handelsman, Shital Julania, Maria McCarthy, Laura Raiti, Genia Rozen, Patrick Western, Yasmin Jayasinghe and Chairs including Michelle Peate and Antoinette Anazodo.

The following Guidelines group members have contributed and/or reviewed and consented to the manuscript: Gulfam Ahmad (The Royal Children's Hospital Melbourne, Parkville VIC, Australia; The University of Melbourne, Parkville VIC, Australia), Paola Kabalan Baeza (John Hunter Children's Hospital, New Lambton Heights NSW, Australia; Calvary Mater Newcastle, Waratah NSW, Australia; Hunter & Northern NSW Youth Cancer Service, Calvary Mater Newcastle, Waratah NSW, Australia), Sarah Catford (Alfred Health, Melbourne VIC, Australia; The Royal Women's Hospital Melbourne, Parkville VIC, Australia; Dept Obstetrics and Gynaecology, Monash University, Clayton VIC, Australia; Hudson Institute of Medical Research, Clayton VIC, Australia), Sarat Chander (Division of Radiation Oncology, Peter MacCallum Cancer Centre, Parkville VIC, Australia; Sir Peter MacCallum Department of Oncology, University of Melbourne, Parkville VIC, Australia), Jennifer Chard (Department of Radiation Oncology, Peter MacCallum Cancer Centre, Parkville VIC, Australia), Noemi Fuentes-Bolanos (Sydney Children's Hospital, Randwick NSW, Australia), Robert B. Gilchrist (Fertility & Research Centre, Discipline of Women's Health, School of Clinical Medicine, University of New South Wales Sydney, Sydney NSW, Australia), Sarah Hunter (Starship Children's Hospital, Auckland, New Zealand), Karla Hutt (Monash Biomedicine Discovery Institute, Department of Anatomy and Developmental Biology, Monash University, Clayton VIC, Australia), Helen Irving (Children's Health Queensland Hospital and Health Services, South Brisbane QLD, Australia; University of Queensland, St Lucia QLD, Australia), Madhura Jayasingam (University of Melbourne, Parkville VIC, Australia; Royal Women's Hospital Melbourne, Parkville VIC, Australia; Royal Children's Hospital Melbourne, Parkville VIC, Australia), Darren Katz (Men's Health Melbourne, Melbourne VIC, Australia; Department of Surgery, University of Melbourne, Parkville VIC, Australia; Department of Urology, Western Health, Footscray, VIC, Australia), Violet Kieu (Melbourne IVF, East Melbourne VIC, Australia; The Royal Women's Hospital Melbourne, Parkville VIC, Australia), Daniel Lantsberg (Public fertility Care, The Royal Women's Hospital Department of Obstetrics and Gynaecology; University of Melbourne, Melbourne, Parkville, VIC, Australia), Lyndal Moore (Hunter & Northern NSW Youth Cancer Service, Calvary Mater Newcastle, Waratah NSW, Australia), Dehlia Moussaoui (Department of Paediatric and Adolescent Gynaecology, The Royal Children's Hospital Melbourne, Parkville VIC, Australia), Adam Nelson (Kids Cancer Centre, Sydney Children's Hospital, Sydney, NSW Australia; School of Medicine, University of New South Wales, Sydney, NSW Australia), Tristan Pettit (Children's Haematology Oncology Centre, Waipapa Hospital, Christchurch, NZ), Annie Ryan (Department of Oncology & Haematology, Perth Children's Hospital, Perth WA, Australia; The Kids Research Institute, University of Western Australia, Nedlands WA, Australia), Erin Sharwood (Children's Health Queensland Hospital and Health Services, South Brisbane QLD, Australia; University of Queensland, Brisbane, QLD, Australia), Kate Stern (Melbourne IVF, East Melbourne VIC, Australia; The Royal Women's Hospital Melbourne, Parkville VIC, Australia), Leanne Super (The Royal Children's Hospital Melbourne, Parkville VIC, Australia; Monash Children's Hospital, Clayton VIC, Australia; Monash University, Clayton VIC, Australia; Murdoch Children's Research Institute, Parkville VIC, Australia), Tom Walywn (Royal Hobart Hospital, Hobart TAS, Australia; University of Western Australia, Crawley WA, Australia), Greg Wheeler (Peter MacCallum Cancer Centre, Parkville VIC, Australia), Kate White (University of Sydney, Camperdown NSW, Australia), Anusch Yazdani (University of Queensland, Brisbane, QLD, Australia; Monash IVF Queensland, QLD, Australia), Margaret Zacharin (Department of Obstetrics, Gynaecology and Newborn Health, University of Melbourne, Parkville, VIC Australia; The Royal Children's Hospital, Parkville, VIC Australia; Murdoch Children's Research Institute, Parkville, VIC, Australia).

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Appendix A. Supplementary data

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References

[1] International Agency for Research on Cancer. Globocan cancer observatory. Available from: https://gco.iarc.fr/en.
[2] Wu Y, Deng Y, Wei B, et al. Global, regional, and national childhood cancer burden, 1990-2019: an analysis based on the Global Burden of Disease Study 2019. J Adv Res 2022;40:233–47.
[3] Australian Institute of Health and Welfare. Cancer in Australia 2021. Cancer series no. 133. Cat. no. CAN 144. Canberra: AIHW; 2021.
[4] Australian Institute of Health and Welfare. Australia's children. Cat. no. CWS 69. Canberra: AIHW; 2020. Available from: https://www.aihw.gov.au/reports/childrenyouth/australiaschildren/contents/health/cancerincidence-survival.
[5] Korte E, Schilling R, Balcerek M, Campbell H, Dirsken U, Herrman G, et al. Fertility education for adolescent cancer patients: gaps in current clinical practice in Europe. Eur J Cancer Care 2020;29(5):e13279.
[6] Chow EJ, Stratton KL, Leisenring WM, Oeffinger KC, Sklar CA, Donaldson SS, et al. Pregnancy after chemotherapy in male and female survivors of childhood cancer treated between 1970 and 1999: a report from the Childhood Cancer Survivor Study cohort. Lancet Oncol 2016;17(5):567–76. https://doi.org/10.1016/S1470-2045(16)00086-3.
[7] Barton SE, Najita JS, Ginsburg ES, Leisenring WM, Stovall M, Weathers RE, et al. Infertility, infertility treatment, and achievement of pregnancy in female survivors of childhood cancer: a report from the Childhood Cancer Survivor Study cohort. Lancet Oncol 2013 Aug;14(9):873–81. https://doi.org/10.1016/S1470-2045(13)70251-1. Epub 2013 Jul 13. PMID: 23856401; PMCID: PMC3845882.
[8] Angarita AM, Johnson CA, Fader AN, Christianson MS. Fertility preservation: a key survivorship issue for young women with cancer. Front Oncol 2016;6:102. https://doi.org/10.3389/fonc.2016.00102.
[9] Dizon DS. Quality of life after breast cancer: survivorship and sexuality. Breast J 2009;15(5):500–4.
[10] Logan S, Perz J, Ussher J, Peate M, Anazodo A. Systematic review of fertility-related psychological distress in cancer patients: informing an improved model of care. Psychooncology 2019;28:22–30.

[11] Benedict C, Thom B, Friedman DN, Diotallevi D, Pottenger EN, Raghunathan NJ, et al. Young adult female cancer survivors' unmet information needs and reproductive concerns contribute to decisional conflict regarding posttreatment fertility preservation: decisions about future fertility preservation. Cancer 2016; 122:2101–9.
[12] Logan S, Anazodo A. The psychological importance of fertility preservation counseling and support for cancer patients. Acta Obstet Gynecol Scand 2019;98(5): 583–97. https://doi.org/10.1111/aogs.13562.
[13] * ESHRE Guideline Group on Female Fertility Preservation, Anderson RA, Amant F, Braat D, D'Angelo A, Chuva de Sousa Lopes SM, Demeestere I. ESHRE guideline: female fertility preservation. Hum Reprod Open 2020;2020(4):hoaa052. https://doi.org/10.1093/hropen/hoaa052. Published 2020 Nov 14.
[14] * Oktay K, Harvey BE, Partridge AH, Quinn GP, Reinecke J, Taylor HS, et al. Fertility preservation in patients with cancer: ASCO clinical practice guideline update. J Clin Oncol 2018;36:1994–2001. https://doi.org/10.1200/JCO.2018.78.1914.
[15] * Mulder RL, Font-Gonzalez A, Hudson MM, Van Santen HM, Loeffen EAH, Burns KC, et al. Fertility preservation for female patients with childhood, adolescent, and young adult cancer: recommendations from the PanCareLIFE consortium and the international late effects of childhood cancer guideline harmonization group. Lancet Oncol 2021;22(2):e45–56.
[16] * Mulder RL, Font-Gonzalez A, Green DM, Loeffen EAH, Hudson MM, Loonen J, et al. Fertility preservation for male patients with childhood, adolescent, and young adult cancer: recommendations from the PanCareLIFE consortium and the international late effects of childhood cancer guideline harmonization group. Lancet Oncol 2021;22(2):e57–67.
[17] Mulder RL, Font-Gonzalez A, van Dulmen-den Broeder E, Quinn GP, Ginsberg JP, Loeffen EAH, et al. Communication and ethical considerations for fertility preservation for patients with childhood, adolescent, and young adult cancer: recommendations from the PanCareLIFE Consortium and the International Late Effects of Childhood Cancer Guideline Harmonization Group. Lancet Oncol 2021;22(2):e68–80.
[18] * COSA Fertility Preservation Guidelines Group. COSA guidelines for fertility preservation for people with cancer. Clinical Oncology Society of Australia 2022. Available from: https://www.cancer.org.au/clinical-guidelines/cancer-fertility-preservation [Accessed on: 20 December 2024].
[19] * Harada M, Kimura F, Takai Y, Nakajima T, Ushijima K, Kobayashi H, et al. Japan Society of Clinical Oncology Clinical Practice Guidelines 2017 for fertility preservation in childhood, adolescent, and young adult cancer patients: part 1. Int J Clin Oncol 2022;27:265–80. https://doi.org/10.1007/s10147-021-02081-w.
[20] * Tozawa A, Kimura F, Takai Y, Nakajima T, Ushijima K, Kobayashi H, et al. Japan Society of Clinical Oncology Clinical Practice Guidelines 2017 for fertility preservation in childhood, adolescent, and young adult cancer patients: part 2. Int J Clin Oncol 2022;27:281–300. https://doi.org/10.1007/s10147-021-02076-7.
[21] * Practice Committee of the American Society for Reproductive Medicine. Fertility preservation in patients undergoing gonadotoxic therapy or gonadectomy: a committee opinion. Fertil Steril 2019 Dec 1;112(6):1022–33.
[22] Goossens E, Jahnukainen K, Mitchell RT, van Pelt A, Pennings G, Rives N, et al. Fertility preservation in boys: recent developments and new insights. Hum Reprod Open 2020;2020(3):hoaa016.
[23] Meirow D, Levron J, Eldar-Geva T, Hardan I, Fridman E, Zalel Y, et al. Pregnancy after transplantation of cryopreserved ovarian tissue in a patient with ovarian failure after chemotherapy. N Engl J Med 2005;353:318–21.
[24] Jayasuriya S, Peate M, Allingham C, Li N, Gillam L, Zacharin M, et al. Satisfaction, disappointment, and regret surrounding fertility preservation decisions in the pediatric and adolescent cancer population. J Assist Reprod Genet 2019 Sep;36(9):1805–22. https://doi.org/10.1007/s10815-019-01536-4. Epub 2019 Aug 9. PMID: 31399917; PMCID: PMC6730729.
[25] Marino JL, Peate M, McNeil R, Orme LM, McCarthy MC, Glackin A, et al. Experiences of family and partner support in fertility decision-making among adolescents and young adults with cancer: a national Australian study. J Adolesc Young Adult Oncol 2024;13(1):180–8.
[26] McDougall RJ, Gillam L, Delany C, Jayasinghe Y. Ethics of fertility preservation for prepubertal children: should clinicians offer procedures where efficacy is largely unproven? J Med Ethics 2018;44(1):27–31.
[27] Anazodo A, Laws P, Logan S, Saunders C, Travaglia J, Gerstl B, et al. How can we improve oncofertility care for patients? A systematic scoping review of current international practice and models of care. Hum Reprod Update 2019 Mar 1;25(2):159–79. https://doi.org/10.1093/humupd/dmy038. PMID: 30462263; PMCID: PMC6390168.
[28] Martinet-Kosinski F, Lamy S, Bauvin E, Dalenc F, Vaysse C, Grosclaude P. Access to information and oncofertility consultation for young women with breast cancer: a population-based study. Sci Rep 2023 Feb 27;13(1):3313. https://doi.org/10.1038/s41598-023-30423-3.
[29] Arecco L, Perachino M, Damassi A, Latocca MM, Soldato D, Vallome G, et al. Burning questions in the oncofertility counseling of young breast cancer patients. Breast Cancer 2020;14:1178223420954179. https://doi.org/10.1177/1178223420954179.
[30] Zhao H, Jin L, Li Y, Zhang C, Wang R, Li Y, et al. Oncofertility: what can we do from bench to bedside? Cancer Lett 2019;442:148–60. https://doi.org/10.1016/j.canlet.2018.10.023.
[31] National Health and Medical Research Council. NHMRC levels of evidence and grades for recommendations for developers of guidelines. Canberra: NHMRC; 2009. Available from: https://www.mja.com.au/sites/default/files/NHMRC.levels.of.evidence.2008-09.pdf.
[32] * Anazodo A, Laws P, Logan S, Saunders C, Travaglia J, Gerstl B, et al. The development of an international oncofertility competency framework: a model to increase oncofertility implementation. Oncologist 2019 Dec 1;24(12):e1450–9.
[33] Hoekman EJ, Louwe LA, Rooijers M, van der Westerlaken LAJ, Klijn NF, Pilgram GSK, et al. Ovarian tissue cryopreservation: low usage rates and high live-birth rate after transplantation. Acta Obstet Gynecol Scand 2020 Feb;99(2):213–21. https://doi.org/10.1111/aogs.13735. Epub 2019 Oct 8. PMID: 31538662; PMCID: PMC7003842.
[34] Recommendations N. Recommendations on fertility preservation for boys and young men with childhood cancer. Available from: https://pho.barnlakarforeningen.se/wp-content/uploads/sites/20/2019/11/PM-SALUB-Fertility-preservation-for-boys-and-young-men-1.2.pdf; 2012 2015.
[35] British fertility society recommendations, Yasmin E, Balachandren N, Davies MC, Jones GL, Lane S, Mathur R. British Fertility Society. Fertility preservation for medical reasons in girls and women: British fertility society policy and practice guideline. Hum Fertil 2018 Apr;21(1):3–26. https://doi.org/10.1080/14647273.2017.1422297. Epub 2018 Jan 3. PMID: 29298394.
[36] Abril-Sánchez S, Freitas-de-Melo A, Giriboni J, Santiago-Moreno J, Ungerfeld R. Sperm collection by electroejaculation in small ruminants: a review on welfare problems and alternative techniques. Anim Reprod Sci 2019 Jun 1;205:1–9.
[37] Pasten González A, Salvador Alarcón C, Mora J, Martin Gimenez PM, Carrasco Torrents R, Krauel L. Current status of fertility preservation in pediatric oncology patients. Children 2024 Apr 30;11(5):537.
[38] Barrett D, Heale R. What are Delphi studies? Evid Base Nurs 2020;23:68–9. Available from: https://ebn.bmj.com/content/23/3/68.
[39] Marti C, Deluche E, Jochum F, Bendifallah S, Azais H, Deidier J, et al. Management of endometrial cancer: French Society of Onco-Gynecology's evaluation through a Delphi survey. J Clin Med 2022 Nov 15;11(22):6765.
[40] Courbiere B, Le Roux E, Mathieu d'Argent E, Torre A, Patrat C, Poncelet C, et al. Oocyte vitrification for fertility preservation in women with benign gynecologic disease: French clinical practice guidelines developed by a modified Delphi consensus process. J Clin Med 2021 Aug 25;10(17):3810.
[41] Torres-Castaño A, Perestelo-Pérez L, Duarte-Díaz A, Toledo-Chávarri A, Ramos-García V, Álvarez-Pérez Y, et al. Information needs and research priorities for fertility preservation in women with breast cancer: patients and experts' perspectives. Eur J Cancer Care 2021 Jan;30(1):e13359.
[42] Boeri L, Capogrosso P, Ortensi I, Miacola C, Cai T, Verze P, et al. Diagnostic and therapeutic workup of male infertility: results from a Delphi consensus panel. Int J Impot Res 2023;35:1–13. https://doi.org/10.1038/s41443-021-00511-x.
[43] Skaczkowski G, White V, Thompson K, Bibby H, Coory M, Pinkerton R, et al. Factors influencing the documentation of fertility-related discussions for adolescents and young adult cancer patients in Australia. Eur J Oncol Nurs 2018;34:42–8.
[44] * Lau LS, Allingham C, Anazodo A, Sullivan M, Peate M, Hunter S, et al. The Australian New Zealand consortium in children, adolescents, and young adults oncofertility action plan. Pediatr Blood Cancer 2024 Jul:e31041.
[45] Allingham C, Gillam L, McCarthy M, Zacharin M, Jayasuriya S, Heloury Y, et al. Fertility preservation in children and adolescents with cancer: pilot of a decision aid for parents of children and adolescents with cancer. JMIR Pediatr Parent 2018;1(2):e10463. https://doi.org/10.2196/10463. Published 2018 Nov 28.

[46] Asadi-Azarbaijani B, Oskam IC, Jahnukainen K. A 12-year overview of fertility preservation practice in Nordic pediatric oncology centers. J Cancer Surviv 2024 Jun;14:1–8.
[47] Mallela J, Pereira L, Simon E, Makkapati S, Forty S, Bruno S, et al. Communicating adolescent and young adult oncology treatment guidelines in practice: the importance of documentation for ensuring positive impacts on oncology care. J Adolesc Young Adult Oncol 2024 Dec;13(6):852–8. https://doi.org/10.1089/jayao.2023.0188. Epub 2024 Jul 3. PMID: 38959174.
[48] Stacchiotti S, Schoffski P, Jones R, Agulnik M, Villalobos VM, Jahan TM, et al. Safety and efficacy of tazemetostat, a first-in-class EZH2 inhibitor, in patients with epithelioid sarcoma (NCT02601950). J Clin Oncol 2019;37(15_suppl):11003.
[49] Ghattaura H, Davies J, Becker CM, Lane S, Lakhoo K. Fertility preservation service for children and young adults at high risk of infertility: the hub and spoke model. Pediatr Surg Int 2024 Jul 19;40(1):201. https://doi.org/10.1007/s00383-024-05770-5. PMID: 39030371; PMCID: PMC11271373.
[50] Moussaoui D, Surbone A, Adam C, Diesch-Furlanetto T, Girardin C, Bénard J, et al. Testicular tissue cryopreservation for fertility preservation in prepubertal and adolescent boys: a 6-year experience from a Swiss multi-center network. Front Pediatr 2022;6:909000.
[51] McQuillan S. Audit of current fertility preservation strategies used by individual pediatric oncologists throughout Australia and New Zealand. J Paediatr Oncol 2013;1:112–8.
[52] South Eastern Sydney Local Health District. Meet Henry: Australia's first uterus transplant baby [Internet]. Sydney: South Eastern Sydney Local Health District, https://www.seslhd.health.nsw.gov.au/news/meet-henry-australia%E2%80%99s-first-uterus-transplantbaby#:~:text=Baby%20Henry%20Bryant%20doesn't,hospital's%20Maternal%20Fetal%20Medicine%20department; 2024.
[53] Georgevsky D, Li Y, Pather S, Tejada-Berges T, Robinson D, Laurence J, et al. Uterus transplantation and pregnancy induction: approved protocol at the royal prince alfred hospital. Aust N Z J Obstet Gynaecol 2021 Aug;61(4):621–4.
[54] Kemertzis MA, Ranjithakumaran H, Hand M, Peate M, Gillam L, McCarth M, et al. Fertility Preservation Toolkit: a clinician resource to assist clinical discussion and decision-making in pediatric and adolescent oncology. J Paediatr HematolOncol 2018;40(3):e133–9.
[55] Keim-Malpass J, Fitzhugh HS, Smith LP, Smith RP, Erickson J, Douvas MG, et al. What is the role of the oncology nurse in fertility preservation counseling and education for young patients? J Cancer Educ 2018;33:1301–5. https://doi.org/10.1007/s13187-017-1247-y.
[56] Recommendations N. Recommendations on fertility preservation for boys and young men with childhood cancer. Available from: https://pho.barnlakarforeningen.se/wp-content/uploads/sites/20/2019/11/PM-SALUB-Fertility-preservation-for-boys-and-young-men-1.2.pdf; 2012 2015.
[57] Moravek MB, Appiah LC, Anazodo A, Burns KC, Gomez-Lobo V, Hoefgen HR, et al. Development of a pediatric fertility preservation program: a report from the pediatric initiative network of the oncofertility consortium. J Adolesc Health 2019 May 1;64(5):563–73.