

REVIEW

Systematic review of fertility preservation patient decision aids for cancer patients

Yifan Wang¹  | Antoinette Anazodo^{1,2,3}  | Shanna Logan^{1,2,3,4} 

¹School of Women and Children's Health, Faculty of Medicine, UNSW Sydney, Sydney, Australia

²Kids Cancer Centre, Sydney Children's Hospital, Sydney, Australia

³Nelune Comprehensive Cancer Centre, Prince of Wales Hospital, Sydney, Australia

⁴Fertility & Research Centre, Royal Hospital for Women, Sydney, Australia

Correspondence

Dr Shanna Logan, School of Women and Children's Health, Faculty of Medicine, UNSW Sydney, Kensington, NSW, Australia.
Email: shanna.logan@unsw.edu.au

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Abstract

Objective: Despite recommendations internationally for the timely provision of fertility information, cancer patients report unmet information needs, with poor provision and inadequate written information to assist in fertility preservation decision-making. Patient decision aids (PtDAs) may be a useful resource in this setting to inform patients and guide decision-making. A systematic review of the literature on decision aids for fertility preservation in cancer patients would determine the effectiveness of these tools in supporting decision-making about fertility preservation and indicate their current use in clinical care.

Methods: A systematic review was conducted in March 2018, within electronic search databases Medline, EMBASE, PSYCH Info, PubMed, and Web of Science. An initial search identified 718 potentially relevant articles from databases and screening of relevant reference lists.

Results: A total of 12 papers, detailing 11 studies with a total of 772 participants, evaluating nine decision aids, were included within the review. PtDAs were shown to significantly increase fertility preservation knowledge and decrease decisional conflict. Overall satisfaction with decision aids was high. Currently, only two reviewed decision aids are available for cancer patients. Another tool has been integrated into a web page, and one implementation study has been completed.

Conclusions: PtDAs can serve as effective complements to current fertility counselling practices by increasing information satisfaction and decision-making outcomes. More research is needed into the appropriateness of these resources for patients across the reproductive age range. Future implementation studies may assist in aiding dissemination of these tools into clinical practice.

KEYWORDS

cancer, decision aid, decisional support tool, fertility, fertility preservation, oncofertility, oncology

1 | BACKGROUND

In recent years, advancements in the detection and treatment of cancer have led to improvements in rates of survival for cancer patients of reproductive age. Treatment approaches must then consider life after cancer and management of long-term treatment effects, such as infertility and interrupted family planning. Oncological treatment, such as

radiation to the pelvis and brain, and chemotherapy regimens containing alkylating agents can potentially cause high levels of damage to germ cells and affect reproductive hormone production.¹ This gonadal damage may lead to higher rates of premature ovarian failure and azoospermia compared with the general population,² resulting in early menopause or sterility. As such, family planning is often interrupted, with lower rates of pregnancy reported in female cancer survivors,

for example, compared with sibling cohorts.³ Actual or threatened infertility in cancer patients of reproductive age is consequently a source of significant distress and may severely impact quality of life into survivorship.^{4,5} It is therefore important that cancer patients are adequately supported in ways to manage their reproductive health throughout cancer treatment.

There are a number of fertility preservation treatment approaches recommended for cancer patients, which differ in their level of recommendation.⁶⁻¹² Methods of fertility preservation for female cancer patients include oocyte and embryo cryopreservation, ovarian transplantation, conservative gynaecological surgery, ovarian suppression, or cryopreservation of ovarian tissue.¹³ With the increasing success of ovarian cryopreservation and transplantation techniques, this option is more recently being considered as standard practice, especially in prepubertal patients.^{14,15} Cryopreservation of spermatozoa is the only established method of fertility preservation for male patients, with cryopreservation of testicular tissue recommended only when as part of a clinical trial or experimental protocol.¹⁰ Patient and treatment factors may influence which preservation options, if any, are most appropriate, taking into account such factors as access to services, likely prognosis, cancer type, oncological treatment protocol, and time to commence oncological treatment.⁵ The decision to undertake fertility preservation is further complicated by the concurrent distressing nature of a new cancer diagnosis, the stresses of oncological treatment planning and preparation, and possible fertility treatment financial barriers, which may vary internationally depending on the model of care utilised.^{16,17} Given the complexity of the multistep decision-making process, it is important that patients are adequately supported to determine which options are best suited to their individual situation.

Despite the need for appropriate support regarding fertility preservation, provision of patient information is often not adequate. International guidelines recommend that risks to fertility and options for preservation are discussed with patients as early as possible to allow them adequate time to make fertility treatment decisions.⁶⁻¹² However, research indicates that although the majority of patients recall a fertility discussion with their health provider,⁴ up to half of patients report inadequate provision of information¹⁸ and unmet information needs.¹⁹ Moreover, written materials are often not age appropriate for younger reproductive age cancer patients.²⁰ The majority of patients (up to 73%) are concerned about fertility,²¹ and as such, irrespective of whether they ultimately choose to undergo fertility preservation, patients appreciate the opportunity to discuss fertility issues and deem fertility information to be important.^{22,23} Furthermore, lack of knowledge about fertility issues is correlated with greater levels of decisional conflict and regret, which can lead to long-term psychological impacts in survivorship.²² Therefore, it is imperative to improve the ways in which patients are informed about their fertility and the written decisional support that is provided for fertility preservation.

Patient decision aids (PtDA) can be useful complements in an oncofertility setting, to help inform patients about fertility treatment options and guide decision-making processes.²⁴ These tools are designed to provide patients with written information about available treatment options and likely treatment outcomes, in order to assist patients in selecting the best treatment option suited to their individual situation and personal values.²⁵ Studies have shown that PtDAs

are effective at reducing decisional conflict and allowing patients to take an active role in their treatment planning, and lead to greater satisfaction with care and improved psychosocial outcomes.¹⁷ The efficacy of PtDAs in female cancer patients of reproductive age, for example, within a breast cancer population in Australia, has been shown to significantly reduce decisional regret.²⁶

Research had yet to review the effectiveness of PtDAs in assisting fertility preservation decision-making for both male and female patients across all cancer types. Although an environmental scan had been undertaken in previous literature to assess the efficacy of fertility preservation PtDAs,²⁷ research had yet to systemically assess the peer-reviewed literature on effectiveness of these PtDAs, in view of guiding further implementation research. Fertility preservation PtDAs may be a valuable resource to implement into standard clinical practice.²⁶ Despite this benefit, research indicated that these tools may not be readily available to support fertility preservation decision-making,²⁸ suggesting a low level of use in clinical care. In order to determine the overall benefit of such tools within this context, current level of access to fertility preservation PtDAs use in clinical care also needed assessment.

Therefore, the current manuscript aimed to systematically review the literature on fertility preservation PtDAs to assess the research question: In cancer patients of reproductive age, what is the effectiveness of current fertility preservation PtDAs tools in facilitating patient decision-making, compared with standard care. This systematic review assessed the peer-reviewed literature reporting on the efficacy and effectiveness of these tools, in informing and supporting patients in their fertility treatment decision-making. Secondly, this review also determined the current availability of these evidence-based resources to cancer patients for utilisation in clinical care. With these two objectives, this systematic review assists in guiding further research in implementation and dissemination of fertility preservation PtDAs into clinical practice.

2 | METHODS

2.1 | Inclusion criteria and search strategy

Studies were considered eligible for the review if they reported on a fertility preservation PtDA. PtDAs may be stand-alone tools or incorporated within larger support resources. They may be implemented at any point during oncology treatment and all modes of patient delivery considered, eg, online web-based or paper-based tools. Studies published in English and peer reviewed, containing quantitative or qualitative data, were included, with no restrictions on patient gender, cancer diagnosis, language of PtDAs, or date of publication. Multiple papers from the same study were included if they reported different sets of results. If multiple papers reported on the same results, only the most recent publication was included to remove duplicity. Published conference abstracts (classified as grey literature) captured in the original search were included if they contained sufficient and original data not yet published elsewhere and a published paper was not available for review. Developmental studies were included if they reported sufficient data to indicate acceptability of a tool and to reflect possible future utilisation of PtDAs in clinical care. Studies were excluded if they

did not contain data, eg, protocols for PtDAs currently under evaluation (see Figure 1 for inclusion exclusion flowchart).

The literature search was conducted in March 2018 utilising five electronic databases: Medline, EMBASE, PSYCH Info, PubMed, and Web of Science. Search terms were altered for each database to map to specific subheadings (see Table 1 for a summary of all search terms). An initial search identified 716 potentially relevant studies after excluding duplicates, with two further studies identified following screening of relevant reference lists. The titles and abstracts were screened by a single reviewer (Y.W.), identifying 37 potentially relevant studies. The full texts were then reviewed by two reviewers (Y.W. and S.L.) and disagreements were resolved through discussion and third-party input (A. A.). A final 12 papers, detailing 11 studies, met eligibility for inclusion.

2.2 | Quality assessments

The quality and risk of bias of the remaining studies were assessed using the Mixed Methods Appraisal Tool (MMAT).²⁹ The MMAT

assesses quality of either qualitative or quantitative research on the domains of sampling, measurements, completion of data, and bias. Scores on the MMAT vary from 25% (one criterion met) to 100% (all criteria met). The majority of studies assessed reported sound quality (n = 4 scored 100%^{26,30-32}; n = 3 scored 75%^{31,33,34}; n = 2 scored 50%).^{24,35} One study's quality score was poor (25%)³⁶; however, this was likely due to the review nature of the study being inadequately appraised by the MMAT, and as such, it was retained for final analysis. Two studies were considered "grey literature" in the form of conference abstracts and could not be assessed on quality.^{37,38}

3 | RESULTS

A total of 12 papers, from 11 studies, evaluating nine PtDAs were reviewed (see Table S1 for full study details and extracted data). The studies were published between 2009 and 2018 and originated from six countries. One study utilised mixed-methods design (questionnaires and interviews)²⁴ while all others were quantitative, utilising

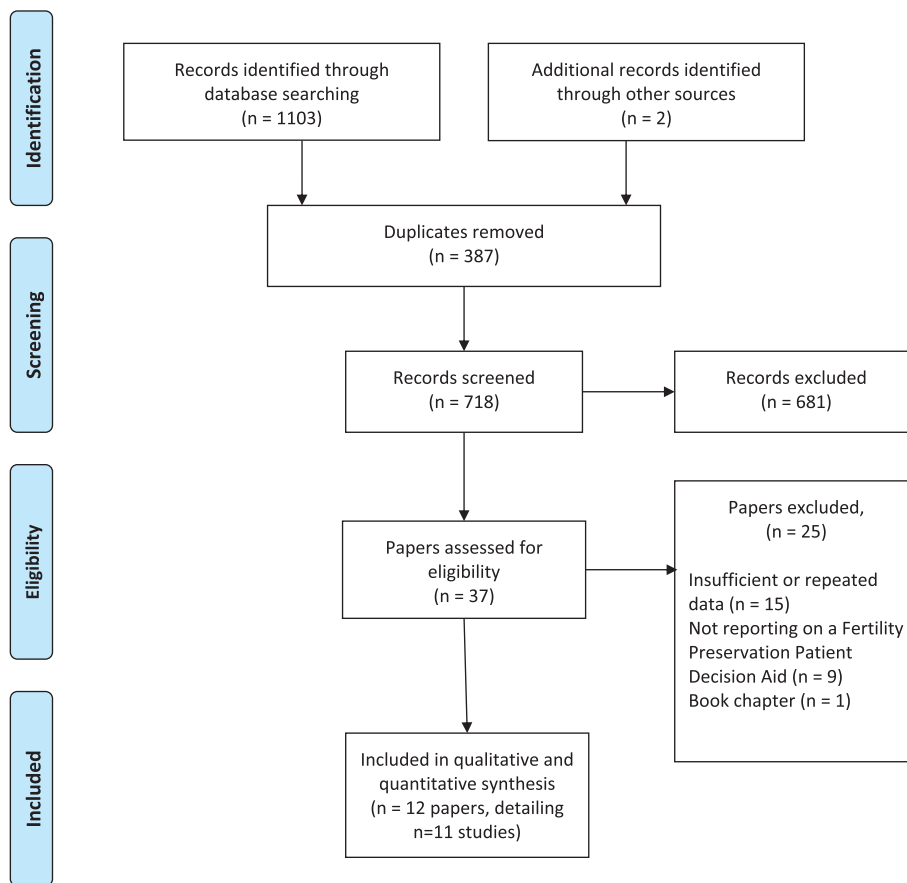
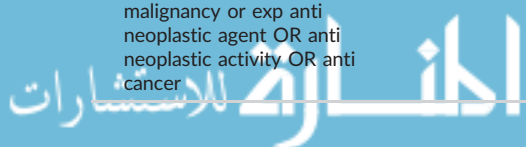


FIGURE 1 A PRISMA flowchart for inclusion and exclusion of papers reporting on a fertility preservation patient decision aid tool for cancer patients

TABLE 1 Summary of search terms used across all electronic databases

Cancer	Fertility Preservation	Decision Aids
Cancer or exp neoplasm or malignancy or exp anti neoplastic agent OR anti neoplastic activity OR anti cancer	Exp Fertility preservation or exp assisted reproductive techniques or exp infertility or exp infertility therapy or reproductive technology	Decision aid* or exp decision support techniques or decision support systems or exp decision making



online or paper-based questionnaires.^{24,26,30-32,35-37,39,40} Study type was categorised according to an efficacy and effectiveness rating tool.⁴¹ One study was developmental,³⁶ five contained both stages of development and efficacy,^{24,30,32,34,39} five were efficacy or effectiveness studies,^{26,31,35,37,40} and one was an implementation study.³³

3.1 | Characteristics of participants in included studies

Sample sizes ranged from nine to 337 (mean sample size = 64.3) with a total of 772 participants across all studies. In the studies with control arms, there were no significant differences between control and intervention groups on demographic variables such as age and education level.

Ten studies recruited cancer patients,^{24,26,30-37} one study recruited survivors,³⁶ and one recruited parents of cancer patients.⁴⁰ A variety of health care professionals involved in the care of cancer patients (including oncologists, gynaecologists, and nurses) were recruited by four studies largely to evaluate acceptability and usability of the PtDAs.^{24,32,35,36} One study recruited healthy women within the community,^{24,39} and specifically healthy women with lower education,²⁴ who were asked to make a hypothetical decision about fertility preservation if they were diagnosed with cancer.

Age of cancer patients and survivors ranged from 18 to 43 years. Patient populations differed on stage of treatment. Four studies specifically recruited newly diagnosed patients, or patients who had yet to commence any adjuvant therapies.^{26,30,31,33} One study recruited patients who had undergone no more than 1 week of treatment.³⁵ Two studies did not specify length of treatment, rather recruited patients based on time since diagnosis (within 5 y),^{32,34} time since fertility preservation decision (at least 1 y ago),²⁴ or did not specify any patient criteria.³⁷ Another, detailing a development study, recruited a combination of patients and survivors who were analysed together as the same group and did not specify a time frame since diagnosis.³⁶

3.2 | Patient decision aids

The format of PtDAs differed between online ($n = 5$)^{24,30,32,37,39,40} and paper-based booklets ($n = 2$).^{26,34,36} One PtDA was integrated within a computerised educational tool.³⁵ Another PtDAs from an implementation study came in the format of a decision tree.³³

Five of the tools were in English,^{26,32,34,35,37,40} and there was one each in Portuguese,³⁶ Dutch,^{24,31,39} German,³⁰ and Japanese.³³ The PtDAs typically consisted of informative sections and interactive sections with values clarification exercises,^{24,26,30-32,34,39} quizzes to assess patient knowledge,³⁵ and space for notes or questions.^{26,30,34} Video testimonials from female cancer survivors who had made decisions about fertility preservation in the past were also included.³²

All the PtDAs were primarily targeted at health care consumers (patients and their families). One PtDA had separate sections developed for patients and clinicians.³⁵ The majority of PtDAs were solely targeted at female cancer patients ($n = 6$),^{24,26,30-34,39} Two tools were designed for male patients,^{35,36} one of which from a study that developed a separate PtDA for both male and female patients.³⁶ One study analysed a PtDA created for parents of paediatric cancer patients

of any gender.⁴⁰ Six PtDAs were not specific to any cancer type,^{30,33,35-37,40} one was able to be tailored specifically to several types of cancer,³² while two specifically targeted breast cancer.^{24,26,31,34,39}

The majority of PtDAs were designed to be implemented during treatment planning or prior to chemotherapy or radiation therapy exposure, as this is the most effective period to pursue fertility preservation. Only one tool specifically stated that it was also suitable to be used by cancer survivors following completion of treatment.³²

The International Patient Decision Aid Standards (IPDAS) Collaboration are quality criteria for assessing the development of PtDAs.²⁵ Three PtDAs were reported to have been developed utilising IPDAS criteria, with full IPDAS scores reported in two studies.^{24,30,32} The first PtDA met seven out of seven criteria to be defined as a decision aid, eight out of eight criteria to lower the risk of making a biased decision, and 10 out of 10 criteria for quality development.³² Eight other criteria were not applicable. The second PtDA was reported to have met 43 out of 48 criteria for development and content.²⁴ The authors were able to assess an additional PtDA that was locally available using the IPDAS criteria. The PtDA met seven out of seven criteria to be defined as a decision aid, six out of nine criteria to lower the risk of making a biased decision, and 11 out of 12 criteria for quality development (five other criteria not applicable).^{26,34} The remaining studies did not report on IPDAS score, nor was an IPDAS score able to be calculated, without access to the PtDA tool. However, a final PtDA³⁷ reported that it was developed according to the Ottawa hospital Research institute PtDA development toolkit, which includes IPDAS and Standards for Universal reporting of PtDA Evaluation studies (SUNDAE) guidelines.⁴²

3.3 | Objective 1: assessing the effectiveness of fertility preservation PtDAs

Outcome measures on decision-making effectiveness were guided by the key measures utilised by the studies reviewed, with reporting modelled on key measures previously utilised in the Cochrane review of PtDAs,⁴³ including knowledge, decisional conflict, satisfaction and acceptability, and decisional regret. Outcome measures utilised by the Cochrane review of PtDAs that were not able to be reported within the review due to lack of data include accurate risk perceptions, congruence between chosen option and values, patient-clinician communication, and participation in decision-making.⁴³

3.4 | Primary outcomes

3.4.1 | Knowledge

A decision is considered informed and therefore high quality if knowledge about fertility preservation is high and their final decision is in concordance with their attitude towards fertility preservation (as reported by the Multidimensional Measure for Informed Choice; MMIC).⁴⁴ Knowledge about fertility preservation was utilised across 10 studies, with one study utilising the MMIC²⁶ and others using short knowledge quizzes assessing the patient's understanding of content

included in the PtDA. Statistically significant improvements in fertility preservation knowledge pre and post viewing a PtDA in populations of cancer patients were noted in three studies ($P = 0.002-0.04$).^{26,31,37} In one sample this knowledge was retained at 6 months.³⁷ Significant improvements in knowledge were also reported by parents of paediatric cancer patients ($P = 0.04$)⁴⁰ and healthy women ($P = <0.001-0.024$).²⁴ Another study found that viewing a PtDA resulted in moderate level fertility preservation knowledge; however, this study did not evaluate knowledge prior to use.³² Two studies with newly diagnosed female cancer patients reported that a PtDA combined with standard care (a brochure or fertility counselling) group, compared with standard care alone group, reported commensurate increases in fertility knowledge³¹ and no significant group differences.^{30,31} However, those who accessed fertility counselling and a PtDA did report significantly greater knowledge confidence ($P = 0.047$).³⁰ Recently diagnosed male cancer patients reported no significant group difference for knowledge between those who accessed a PtDA and those who did not. However, health professionals who viewed the same PtDA performed significantly better on a knowledge test ($P = 0.006$) compared with health professionals who did not. One study utilising the MMIC reported no differences in the proportions of patients who made an informed choice versus an uninformed choice between the PtDA group and the control (standard care).²⁶

3.4.2 | Decisional conflict

The decisional conflict scale was utilised across six studies to assess levels of decisional conflict experienced by patients in relation to their fertility preservation. This scale assesses the uncertainty surrounding a decision and the individual's self-perceived effective decision-making. Scores range from 0 to 100 with scores above 37.5 indicating high decisional conflict.⁴⁵ Two studies indicated a statistically significant ($P = 0.02$) reduction in decisional conflict in newly diagnosed female cancer patients after PtDA use when measured³⁷ at 6 and 12 months (breast cancer patients only).²⁶ Similarly, lower decisional conflict was reported in men who viewed a PtDA compared with those who did not ($P = 0.0065$).³⁵ There were no significant differences in decisional conflict between a brochure only or counselling only intervention, compared with a PtDA,^{30,31} or between PtDAs with or without a values clarification exercise.³⁹ Therefore, the merit of PtDAs, or use of values clarification exercises, in significantly reducing decisional conflict compared with other supportive interventions is not reported.

3.4.3 | Satisfaction and acceptability

There was extensive evaluation of satisfaction and acceptability of the utilisation of PtDAs. Several studies reported that patients, clinicians, and parents viewed these tools positively.^{26,32,34,36,40} For example, in one sample, more than 85% of women "agreed" or "strongly" agreed it was useful, attractive, clear, and easy to use; 75% of women felt empowered after using it, and 85% reported they felt ready to discuss fertility with their health care provider.³² Similarly, a second sample reported 94% of participants rated the PtDA as "very" or "quite" relevant, and 88% would recommend it to others.³⁴ A third

developmental study reported both patients and clinicians felt the PtDA was easy to read, well organised, and contained relevant information.³⁶

Two studies reported that the PtDA elicited some negative feelings, with half (53%) of breast cancer survivors reporting use of the PtDA made them "a little" sad, and a third (29%) felt it made them "quite a bit sad or upset." Some women also reported that using the PtDA made them "somewhat" (19%), "a little" (38%), or "quite a bit" (13%) "worried or concerned." The participants reported that these feelings were related to both their understanding of their impacted fertility, and due to remembering a distressing period in their lives.³⁴ Similarly, a subsample of five women in a second study felt upset or nervous while using the PtDA.³²

3.5 | Secondary outcomes

3.5.1 | Regret

Two studies utilised the decisional regret scale to measure regret associated with fertility preservation treatment decisions in newly diagnosed female breast cancer patients, comparing a PtDA to a brochure or consumer guide.^{26,31} This five-item scale assesses aspects associated with decisional regret, such as whether the patient felt that it was the right decision and whether the decision did the patient harm.⁴⁶ Both studies reported a trend towards higher decisional regret over time in the intervention and control groups.^{26,31} No significant differences in anticipated regret between groups were reported at baseline, or regret at 6 months³¹; however, significantly lower decisional regret was shown at 12 months ($P = 0.031$) in the intervention group, compared to a group with standard care.²⁶

Three studies evaluated the impact of PtDA use on fertility preservation preferences and decision-making values.^{26,31,32} No significant differences were reported in patient's decision-making values in one survivor sample,³² or in fertility preservation decisions between the PtDA groups and control groups at the time of diagnosis.^{26,31}

3.6 | Objective 2: current use of fertility preservation PtDAs in clinical care

The authors of the PtDAs were contacted to confirm the availability of the tools for use in clinical care. At the time of search, three PtDAs were available for clinical use, one each in Australia (English),^{26,34} Portugal (Portuguese),³⁶ and the Netherlands (Dutch).^{24,31,39} Upon review, one PtDA was no longer available.^{24,31,39} Three PtDAs are awaiting further evaluation before they are made publicly available.^{30,32,40} The materials of another one PtDA had been largely incorporated into a new web-based self-help program for men.³⁵ A further PtDA was ultimately not implemented into clinical practice as researchers deemed it inappropriate for their health care system given the limitations placed on options for fertility preservation and alternative family planning.³³ It is unclear what stage of development the final PtDA is in.³⁷

One paper describing an implementation study with a decision tree evaluated fertility preservation outcomes for women. The study

reported that 48.6% of patients chose to undergo embryo cryopreservation with a mean of 5.29 embryos cryopreserved per patient and a calculated expected live birth rate of 0.66. An additional 11.4% of patients opted for oocyte cryopreservation but were referred elsewhere and as such follow-up data was not available.³³

4 | DISCUSSION

This systematic review of 12 papers, detailing 11 studies, relating to nine fertility preservation PtDAs for cancer patients, indicates that currently one tool is in development; seven are undergoing efficacy/effectiveness evaluation, and one is undergoing implementation efforts. The primary object of this review was to assess the effectiveness of fertility preservation PtDAs in cancer patients. A second objective was to assess current availability of these evidence-based PtDAs for use in clinical care.

PtDAs were found to improve female patients' and clinicians' knowledge about the impacts of cancer on fertility and the options for fertility preservation. PtDA use was shown to lower decisional conflict in both female and male patients, consistent with results from the Cochrane review of PtDAs.⁴³ Overall, the PtDAs were found to be both acceptable and helpful, contained relevant information, and patients reported a high level of satisfaction with their use. Results also indicate that decisional regret is significantly reduced in female patients at 12 months post intervention with PtDA use, although significance was not shown at earlier time points. Although data are limited, these results highlight the potential long-term benefits of PtDA use in female cancer patients in supporting decision-making processes throughout treatment.

Overall, these results are consistent with those reported in the Cochrane review of decision aids, in that PtDAs assist patients to feel more comfortable with their health treatment choices and compared with usual care, improve individual's perception of involvement in decision-making via increased knowledge, and lower decisional conflict and decisional regret.⁴³ Similarly, when IPDAS criteria was available, fertility preservation PtDA tools reported within this review were reported to be of suitable quality.²⁵

It is important to consider that a normative part of the decision-making process for newly diagnosed cancer patients may include heightened negative emotion that should not be interpreted as a negative impact of utilising a PtDA tool. Although lower decisional conflict has been associated with less fretting, nervousness, and decreased tendency to postpone decision-making,⁴⁶ higher decisional conflict in newly diagnosed cancer patients may indicate that patients are actively engaged with difficult treatment decision-making. Conversely, heightened decisional conflict in cancer survivors may be more reflective of uncertainty surrounding the effective decision-making in the past. Thus, both the level of decisional conflict and patient status are important factors for clinicians to consider in best supporting cancer patients and survivors with their fertility. Similarly, negative feelings associated with PtDA use may be a result of increased awareness while decision-making needs are being met and is not necessarily a deterrent from utilising these tools. Indeed, research indicates that heightened anxiety is common for patients adjusting to the news of

infertility and making difficult decisions surrounding fertility preservation.⁴⁷

At the time of this review, the current availability of these PtDA tools for clinical use is limited. Currently, only two of the tools reported within this review are likely available for clinical use, and a further tool's content has since been integrated into a web page. Additionally, one implementation study was available, which reported on the fertility preservation outcomes after utilisation of the PtDA. This low uptake may be due to the stage of development of most tools, with the majority of studies published within the last 5 years, and thus, most PtDAs are likely still in development or undergoing evaluation. However, it does highlight the potential benefit of future research in implementing and disseminating these peer-reviewed, evidence-based PtDAs to assist future clinical use. This is a growing area of interest, with literature indicating that six other tools may be made available upon completion of development and evaluation in the future, three of which are reported within these results,^{29,31,39} and the remaining outlined in protocols.^{26,37,49} Therefore, there may be a greater body of evidence to support the implementation of these tools into clinical practice in the near future.

4.1 | Study limitations

The findings from this review may be limited in its generalisability to a wider population of cancer patients due to the small sample sizes utilised by the studies to assess effectiveness of the tool. There are inherent difficulties in utilising a sample that is compiled of cancer survivors or healthy women, as the decision-making processes are retrospective or hypothetical, influencing the ability to generalise to newly diagnosed cancer patients in making the same decisions. As a result, the data may not have sufficient external validity to make strong conclusions about our target population. Further implementation studies assessing how these tools are utilised in a newly diagnosed cancer patient population, and feasibility of integrating such tools into standard clinical care, will assist in highlighting the effects of fertility preservation PtDA utilisation compared with standard care within this population.

This review is also limited by the few tools available for review and subsequent limited data on any particular output domain. For example, decisional regret was only evaluated by two studies and only one study assessed decision quality as a key outcome. This review was also unable to capture data on other primary measures of PtDA effectiveness including preparation for decision-making, decision self-efficacy, and role preferences. There is therefore difficulty at the current time in drawing strong conclusions on patient and context factors that may be most impactful in utilisation of PtDA tools. Given that the research to date has been mostly quantitative, qualitative research exploring newly diagnosed cancer patients' experiences using a PtDA may assist in better understanding how these tools influence treatment decision-making processes and patient treatment experiences, alongside how patients interact with these resources.

The studies included within this review included results beyond the research question, assessed different genders and cancer types, or did not specify time of PtDA implementation within the cancer

journey. This has likely increased the heterogeneity of our results and makes it more difficult to draw strong conclusions about how each outcome measure may influence PtDA effectiveness and clinical use compared with standard care. With future implementation studies, we will be better able to determine how fertility preservation PtDAs influence decision-making measures and best support cancer patients and survivors in this process.

4.2 | Clinical implications

To the best of our knowledge, this is the first systematic review that investigates the effectiveness of fertility preservation PtDAs targeted at cancer patients. Given that limited written information regarding fertility is a prominent barrier for cancer patients of reproductive age, the implementation of fertility preservation PtDAs may act as a complement to current fertility care, by assisting patients in becoming more informed and able to make fertility preservation decisions appropriate to their personal situation. However, it is important to note that irrespective of the effectiveness of such tools, their use cannot replace verbal communication with health care professionals. Therefore, it is imperative that clinicians, including reproductive, oncology, and haematology specialists, are aware of current treatment options available and best practice models of care. PtDAs with clinician-targeted sections may also be beneficial in assisting oncology clinicians to discuss fertility preservation options with patients in a timely manner and refer on to specialist care.

With reasonable effectiveness and low levels of current use in clinical care, future research needs to consider the implementation of these resources into standard care. The vast majority of tools reviewed in this study are targeted at female cancer patients. This is likely because there are currently a number of fertility preservation options available for women while sperm banking remains the sole established method for males. Moreover, the procedures involved for women are generally more invasive, expensive, and, historically, may have required cancer treatment to be delayed.⁴⁷ However, results from the studies reviewed suggest that male patients may benefit similarly from access to PtDAs and they are therefore a useful complement to clinical practice regardless of patient gender, or complexity of decisional process in assisting patient satisfaction with fertility care.

Resources to support fertility decision-making in survivorship are currently limited with only one tool suitable to be implemented at this time point.³² Given the current challenges with timely information provision and referrals to fertility preservation, some survivors may not have had the opportunity to discuss fertility prior to treatment or, for a number of reasons, may have declined fertility preservation at the time. Moreover, cancer survivors report ongoing concerns regarding the uncertainty of their fertility status following treatment.⁴⁸ It is important that survivors receive adequate support postoncological treatment to assess their fertility and options for family building. The provision of PtDAs for assessing fertility and alternative family planning options in survivorship can provide an opportunity to meet these ongoing needs and should be an area of focus for future research. Longitudinal research comparing patient perceptions of decision-making at the time of diagnosis with these same views in

survivorship, in the context of fertility and ovarian reserve (females) and testicular function (males), may be particularly beneficial in understanding the long-term decision-making outcomes and offering insight into long-term models of support.

Another area of consideration is the age appropriateness of PtDAs for patients across the reproductive age range. Adolescent and young adults are at a key stage in their development and present with unique psychosocial concerns and support needs. They may have differing health literacy⁴⁹ and decision-making processes⁵⁰ to their adult counterparts. While many patients in this age group are not at the point of active family planning, fertility is still a key concern for most patients.⁵⁰ Because of the distinctive needs of paediatric patients, it is difficult to extrapolate the results from the adult studies in this review into this population without further evaluation by younger participants. Currently, only one PtDA targeting paediatric cancer patients exists,⁴⁰ designed to be administered to parents. Given paediatric and adolescents' potential differing cognitive development and health literacy understanding, age appropriate adaptations will be required for paediatric and AYA patients, which include changes in language, length of PtDA, and the integration of psychosocial support. The lack of paediatric resources may be attributed to minimal fertility preservation options available to prepubertal paediatric cancer patients and other barriers to paediatric fertility preservation including ethical issues surrounding proxy decision-making.⁵¹ However, with increasing clinical recommendations for management of fertility preservation in prepubertal patients, this is an area worthy of further consideration.

In considering future dissemination of current PtDAs, it is important to consider equity of access. The tools included in this review came in five languages (English, Dutch, German, Portuguese, and Japanese), and with the exception of English, only one tool was available for each language. In order to be inclusive, the tools need to be available in a larger variety of languages to meet the needs of ethnically diverse patients within the health settings in which the tools have been developed. Translation of existing tools that have undergone prior evaluation in a culturally sensitive manner will assist migrant patients to better access and utilise local health services alongside cultural majority patients. Similar consideration needs to be given to patients with lower health literacy, and given that this factor is associated with lower knowledge about health care options, higher uncertainty, and regret surrounding decision making,⁵² how current tools can be adapted to suit literacy level is worthy of consideration.

5 | CONCLUSION

In conclusion, 12 papers, detailing 11 studies and evaluating nine fertility preservation PtDAs, report that these tools are positively viewed by patients and clinicians, improve knowledge about fertility preservation, and may lower decisional conflict and regret. Given the recency in current literature there are limited PtDAs currently available for clinical use and limited implementation studies. As such, further research should look into implementation with female and male adult and paediatric patients at both the time of diagnosis and survivorship. Optimising information delivery and tailoring for subgroups of cancer

patients, including lower health literacy and other spoken languages, is also worthy of consideration. Overall PtDAs may serve as a valuable complement to current fertility care practices, in ensuring needs for high-quality information and support that are met alongside clinical consultations.

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CONFLICT OF INTEREST

The authors declare no competing financial interests exist.

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ORCID

Yifan Wang  <https://orcid.org/0000-0003-0664-1426>

Antoinette Anazodo  <https://orcid.org/0000-0002-5495-6062>

Shanna Logan  <https://orcid.org/0000-0003-2745-4531>

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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