

PERSPECTIVE

PERSPECTIVES AND INNOVATION IN PEDIATRIC PSYCHO-ONCOLOGY: RESEARCH, ADVANCED THERAPIES, TECHNOLOGIES, AND NEW FRONTIERS

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ABSTRACT: This perspective describes recent innovation in the pediatric psycho-oncology field from a clinical and scientific point of view. These new insights are crucial for improving the overall quality of life and long-term outcomes for patients and their families and for driving future research in pediatric psycho-oncology. In particular, it emphasizes the implementation of neuropsychological screening tools to monitor and prevent cognitive decline in patients affected by central nervous system malignancies or those receiving neurotoxic treatments. Early detection through screening facilitates timely interventions, thereby reducing the risk of long-term cognitive deficits. Then perspectives about the integration of evidence-based practices such as Eye Movement Desensitisation and Reprocessing (EMDR) and mindfulness, for addressing the emotional and psychological challenges faced by children with cancer (e.g., trauma-related symptoms; stress management) will be discussed. Additionally, the use of digital technologies has expanded access to psychological support, therefore meriting further investigation. Specific psychological issues will be discussed suggesting further insights and considerations from the clinical and scientific community.

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Impact statement: This article highlights recent innovations in pediatric psycho-oncology, offering critical insights into current topics to improve care for psycho-oncology patients. In particular, the need to standardize psychological and neuropsychological assessment methodologies and tools for early diagnosis and management of possible cognitive decline is emphasized. On psycho-oncological care, the manuscript also emphasizes the need for evidence-based therapies and the role of psycho-social interventions using digital technologies, an aspect that opens new frontiers for accessible and sustainable interventions. The manuscript gathers observations not only to improve knowledge of current clinical practices, but more importantly to lay the foundation for future research, guiding toward increasingly advanced, standardized, and personalized pediatric psycho-oncology.

Key words: *pediatric cancer; psycho-oncology; psycho-social interventions; innovation; digital tools.*

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INTRODUCTION

Cancer in children and adolescents is probably one of the most psychologically challenging diseases, whose treatment path causes an emotional burden on the patient and the whole family.

Pediatric cancer patients may have pain, anxiety, depression, and neuropsychological difficulties due to the medical treatment (1). A cancer diagnosis in childhood brings intense distress in young patients, whose psychosocial needs differ from those of adults. In addition, compliance difficulties may often impact the patients' and families' quality of life (QoL) (2). Scientific literature and clinical experiences have proven that it is possible to provide early intervention to individualize and prevent potential psychopathological/psycho-social risk situations (3, 4).

For this reason, pediatric psycho-oncology care is a fundamental aspect of care in pediatric oncology, during medical treatment. In recent years, research results have increasingly highlighted the efficacy of psychological treatments and the need to create standardized psychological care from diagnosis to survivorship or the palliative phases (5-7).

New insights are emerging from innovative psychological care methods, which have been

spreading to respond to the unique challenges in pediatric psycho-oncology.

These methods concern new psychotherapies relying on evidence-based approaches, on the use of new technologies and increasingly advanced and standardized psycho-social and neuropsychological assessment and monitoring. Some of these therapies, experiences and methods are already being tested in Europe and in the Italian pediatric oncology AIEOP centers (Italian Association of Pediatric Onco-hematology) (8). Nonetheless, greater commitment is required to successfully implement these methods across pediatric cancer centers in order to make them standard practice. These methods would also highlight the need to use objective measurements for psychological variables thus contributing to the ever-increasing recognition of psycho-oncology as a science (**Figure 1**).

Many psychosocial interventions described in the literature have effectively managed these critical issues in pediatric cancer care. However, few digital and technological approaches have yet been studied. (9)

The following sections describe some of the experiences mentioned in the three macro themes of innovation in psycho-oncology: neuro-psycho-social assessment/monitoring, innovative therapies and use of technology.

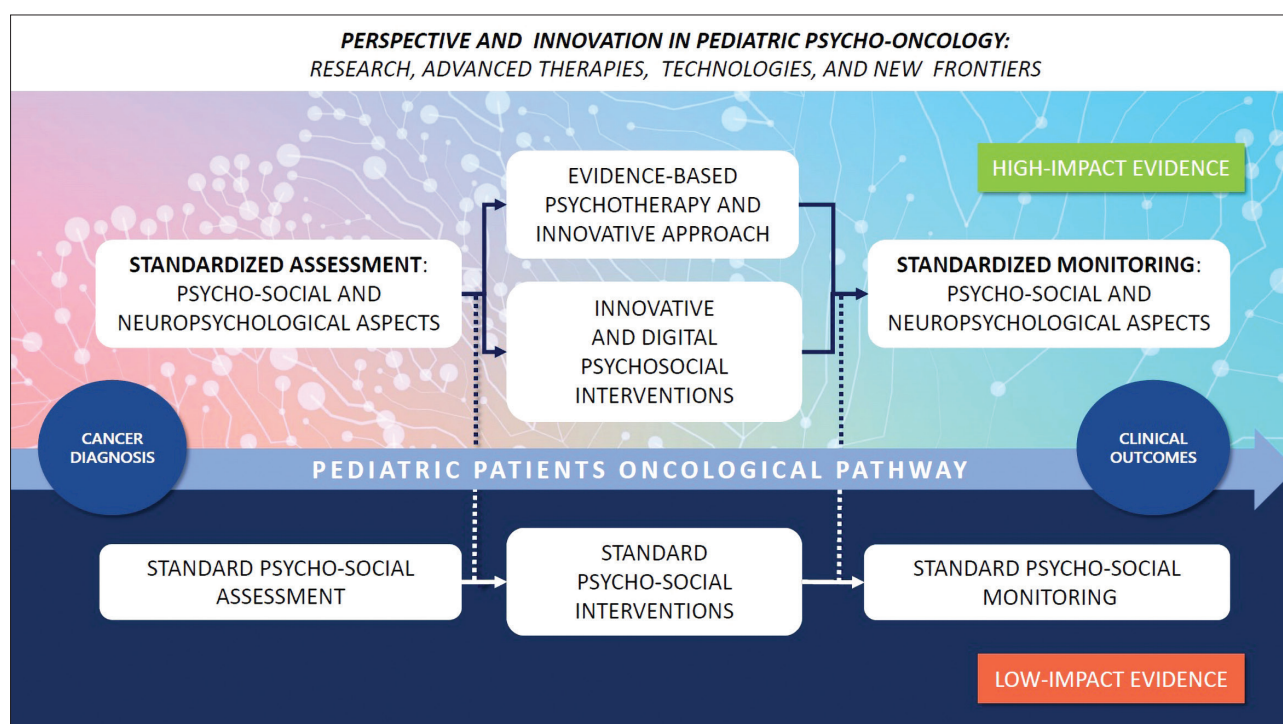


Figure 1. Flowchart on perspectives and evidence implementation in pediatric psycho-oncology.

ASSESSMENT AND MONITORING: NEURO-PSYCHO-SOCIAL ASPECTS

Children and adolescents affected by specific oncological and hematological diseases such as brain tumors, are at particular risk for neuropsychological sequelae, due to intensive and combined therapy (neurosurgical intervention, radiotherapy, chemotherapy). Among children and adolescents with brain tumors, neuropsychological sequelae may involve several functional domains (*i.e.*, attention and working memory) which may impact the neurodevelopmental trajectory (10).

Also, patients with sickle cell diseases, due to various stroke phenomena or other complications related to Moyamoya disease, show a significantly weaker school performance than the normative population by presenting deficits, for example, in verbal intelligence and executive function (11).

Therefore, it is fundamental that these patients are guaranteed neuropsychological screening to permit adequate rehabilitation programs (12).

In the last few decades, research showed that neurocognitive sequelae in this population have increased (13, 14).

Moreover, few studies to date have described neuropsychological outcomes, for example before surgical resection in the early postoperative phase preceding adjuvant therapies among children with brain tumors (15).

Ideally, neuro-cognitive assessment in pediatric brain tumors and in other patients with onco-hematological diseases should be carried out at baseline, before the beginning of treatment, and again following treatment completion and follow-up, for appropriate monitoring over time, in order to propose adequate rehabilitation programs over time. Specifically, the Italian brain tumor neuropsychological protocol includes the enrolment of pediatric patients aged 3-17 with a diagnosis of a brain tumor. These patients will be assessed through the use of several Italian standardized neuropsychological tests, which have good psychometric properties and are age appropriate. Administration takes place at three different time points of the clinical course: at diagnosis and before surgery, after surgical removal and before the start of potential adjuvant therapies, and at 1-year follow-up after potential adjuvant therapies (13).

For patients with hematological diseases the neuropsychological protocol includes the enrolment

of pediatric patients with chronic hematologic disease aged 6-18 years. Protocols include the screening of neuropsychological aspects at the beginning of treatment and after one year, with the aim of monitoring neuropsychological trends over time.

The results will allow to promote tailored and adequate rehabilitation programs and moments of networking with schoolteachers for a positive reintegration at school and to propose personalized strategies that can support their learning abilities and academic skills.

Overall, the Italian neuropsychological protocol has the potential to become a guideline for the management of all oncological and hematological pathologies that risk to compromise the cognitive development of children and young people.

EVIDENCE-BASED PSYCHOTHERAPY AND INNOVATIVE APPROACH: EMDR AND MINDFULNESS-BASED INTERVENTIONS

Over the years, in the field of advanced psycho-oncology, it has become increasingly important to disseminate evidence-based standards of care and intervention to promote the global well-being of patients, especially among fragile patients such as children and adolescents.

As oncological diseases are considered to be a highly traumatic event for both the patient and the entire family unit, interest has grown in Italian pediatric oncology hospitals regarding the proposal of specific protocols for the screening and treatment of traumatic experiences related to cancer.

Among the psychotherapeutic methods designed to help cope with traumatic experiences, Eye Movement Desensitisation and Reprocessing (EMDR) is recognized as an evidence-based method for the treatment of trauma, approved by the American Psychological Association (1998-2002), the American Psychiatric Association (2004), by the International Society for Traumatic Stress Studies (2010) and by the Italian Ministry of Health in 2003. In August 2013, the World Health Organization recognized EMDR as an effective treatment for trauma and related disorders.

Oncological diagnosis represents a traumatic event, it evokes a sense of vulnerability, helplessness, threat, or a loss of control. A growing body of research indicates that posttraumatic stress disorder

der (PTSD) and symptoms (PTSS) are some of the most important psychological consequences for those affected by cancer (16).

Faretta et al, in 2016 outlined a specific protocol for the psycho-oncology setting that has achieved many positive results in reducing disease-related stress in the adult oncology setting.

EMDR is a proven and fast therapy, particularly effective for reducing stress symptoms like intrusive thoughts in adult cancer patients (14-16). In pediatric oncology, however, EMDR is a newer approach to cancer-related trauma. Italian pediatric psycho-oncologists first introduced EMDR as part of routine care for pediatric cancer patients, their siblings, and families, using a standardized protocol that includes screening for distress and PTSD risk at diagnosis. Research has shown that EMDR reduces intrusive symptoms and PTSD risk in children and adolescents with cancer (17, 18). Additionally, it promotes positive psychological changes, such as post-traumatic growth, following challenging life events (18-20) EMDR should start with the cancer diagnosis and continue through the patient's entire treatment, addressing key phases of care, including communication and therapy initiation. Its integration into standard practice can strengthen pediatric oncology care.

Among advanced therapy there are innovative therapies such as mindfulness, which helps to mitigate the negative consequences of traumatic stress experiences such as cancer diagnosis in childhood by strengthening resilience (*i.e.*, successful management and coping with ongoing experiences of stress and adversity) and by influencing the related physiological effects of stress. (21, 22)

Mindfulness includes bringing attention to one's bodily sensations, thoughts, feelings, and moment-to-moment awareness in a non-judgmental way (23). In fact, when mindfulness is offered with an awareness of trauma, it helps reduce the risk of exacerbating symptoms of stress related to acute and chronic illness (24).

Children with cancer often have significant social-emotional challenges resulting not only from the illness itself but from anxieties associated with diagnosis and prognosis, side effects of treatments, and hospital stays resulting in separations from familiar setting and social support.

Several studies have shown mindfulness to increase an individual's capacity to observe and experience strong emotions with greater objectivity and less reactivity (25).

The disease also affects both the body and the mind, for this reason approaches such as mindfulness can help regain the psychophysical balance that illness interrupts.

For these reasons, Italian researchers have proposed mindfulness sessions with adolescents and children who experience particularly anxious situations, with the aim of reducing symptoms (biopsy, catheter insertion, surgery). Clinicians who work with pediatric cancer patients should be qualified and supervised, with specific training in patient management to propose these advanced and innovative psychotherapeutic methods.

There is not a specific psycho-oncological mindfulness protocol for cancer patients, but the most utilized mindfulness-based clinical interventions in oncology are Mindfulness Based Stress Reduction (MBSR) protocol and mindfulness based cognitive therapy. Mindfulness-based activities, such as mindful movement, mindfulness of senses, mindfulness of breath, mindfulness of emotions, and the body scan, can be adapted well for different age groups (26).

EMDR and new approaches such as mindfulness, suitable for children and adolescents, should be a core part of the training in pediatric psycho-oncology.

DIGITAL PSYCHOSOCIAL INTERVENTIONS

The incorporation of digital technologies and media into pediatric psycho-oncology presents promising opportunities for the enhancement of psychosocial care (27, 28). These innovative tools are designed to address specific psychosocial functions, including the improvement of emotional resilience (29-31), the promotion of treatment adherence (32), and the alleviation of stress for both patients and their families (33). By utilizing digital platforms for the early assessment of screening needs and the delivery of customized interventions, healthcare providers can offer more effective support throughout the treatment continuum, encompassing both follow-up and palliative care phases (34). Furthermore, these digital interventions promote patient-centered care by enhancing engagement, personalizing clinical pathways, and contributing to psychological well-being (35, 36). Smartphones, tablets, and other digital tools could increase patient engagement during hospitalization (**Figure 2**). These tools can provide patients with information, education, entertainment and collecting

personal health data (30). The use of digital support can also help healthcare providers to develop decision-making or monitoring tools. Nevertheless, evidence supporting the efficacy of these approaches in cancer care and pediatric psycho-oncology is still emerging, highlighting the necessity for comprehensive and rigorous studies (37). Digital interventions to promote the psychological well-being of patients and caregivers during cancer treatment can also be assessed through the healthcare satisfaction of psychosocial interventions and services (38).



Figure 2. Pediatric patient in the psycho-oncologist's room at 'Gemelli ART', the Radiation Oncology Unit of the Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy.

Digital innovation is currently rapidly evolving, but it is still underrepresented in pediatric cancer literature, despite being supported by numerous activities of influential scientific and institutional societies. The following paragraphs will therefore present some examples of technology-mediated interventions and evidence in pediatric and oncology health care settings. Digital storytelling possesses significant potential for enhancing communication and facilitating emotional processing in cancer (39). Storytelling is also beneficial for pediatric cancer patients facing various stressful situations, as it provides a means for them to explore and articulate their emotional challenges (40). In the context of pediatric oncology there are some studies

on this type of intervention (41) but it remains insufficiently supported by empirical evidence (42). Among the potential tools already in use in pediatric settings, social robots are showing promising results in pediatric oncology settings (43). Social robots, particularly those designed with humanoid features, demonstrate significant potential in pediatric oncology environments by enhancing communication and engagement (44). These robots offer educational support to children regarding their medical conditions, (45) impart coping strategies, (46) and foster cooperation during medical procedures (47). Their adaptability and user-friendly interfaces render them effective instruments for cultivating trust and facilitating psychosocial support (48).

Particular attention should be paid to educational video games, representing a new and interesting psycho-educational tool in pediatric cancer care.

They could contribute significantly to the construction of the patient-healthcare provider relationship, and help providers better understand the patient's cognitive, emotional, and social functioning (49). In pediatric cancer care, video games have become valuable tools for encouraging children to manage their health or promote self-management (50, 51). Additionally, these interactive experiences can provide distraction, reducing anxiety and stress related to medical procedures, which can lower the need for sedation (52, 53). Cancer treatment requires great commitment, compliance, and cooperation every day and after the end of treatment (54, 55). Video games also foster resilience, giving children a sense of agency and control over their treatment journeys (56). Chatbots and artificial intelligence (AI) tools driven by healthcare providers, patients, and families could improve clinical and psychosocial outcomes and promote health equity in pediatric cancer treatment (57). AI can provide personalized resources and effective stress management techniques, improving the quality of care and support for young patients (58). The use of technology in pediatric psycho-oncology needs further investigation to evaluate its effectiveness for young patients and their caregivers. Future innovations and scientific research may lead to better and more accurate treatment recommendations (59).

DISCUSSIONS

The Italian centers adhering to the AIEOP network are working to ensure that they all provide a sim-

ilar standard of care from a psychological point of view. This article discusses the main insights of pediatric psycho-oncology, emerging from an increased attention to the discipline by the scientific world, both psychological and medical. In recent years, treatments have improved children and adolescent survival rates from 20% to 85%, so it is mandatory to focus on the short- and long- term quality of life of the patients and their families as a whole. As described, the perspective that we want to highlight is the use of a psychotherapy tailored to the single patient and caregiver (such as EMDR or mindfulness) in order to treat possible post-traumatic stress symptoms that could emerge immediately after diagnosis or during survivorship phase. Also, the need for an assessment and rehabilitation standardized program is crucial to prevent the appearance of deficits and their chronicity over time. Finally, these methods could be delivered also through digital tools that represent in recent years powerful tools with which psychologists work in pediatric cancer care. They can be used during all phases of the treatment, from the beginning to follow-up, to support patients and their families and track the development of therapy.

FUTURE DIRECTIONS

Although research is making great strides in the field of psycho-oncology, there are still too few shared clinical and scientific standards, especially on certain issues. In our opinion, the psychiatric management should be standardized, especially for some cases, such as the presence of psychiatric symptoms (e.g., hallucinations, disorientation, sleep disturbance) that occur following the intake of heavy doses of cortisone. Being able to recognize difficulties in advance before an explosion of symptoms, and knowing which drugs to use, could undoubtedly benefit the standard clinical practice of oncologists and the quality of patients' psychosocial condition. Another important issue to explore further regards when and how to suggest information about fertility preservation to patients. Educational materials, dedicated psychologists and clinician experts in fertility should be made available before treatment begins in order to prevent anxiety and confusion (60, 61). Finally, one of the key aspects to consider is the adolescent's decision-making process;

this is particularly important not only concerning treatments but also regarding genetic tests to evaluate a predisposition to cancer syndrome, for example. Patients, especially adolescents, who are about to do genetic tests must have access to a standard surveillance program and development-appropriate psychosocial care (62-64). Further studies are recommended and necessary to deepen this argument in order to elaborate formal recommendations regarding prevention, monitoring, and rehabilitation.

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Authors' contributions

GZ, SC, EM, and DS were involved in paper's conception and design; GZ, SC, EM, VM, ADS and DPRC participated in the rationale and structuring of the methodology. GZ, SC, EM, and VM were involved in material and literature collection and organization. GZ, SC, EM, ADS and VM were involved in manuscript writing and original draft preparation; DPRC, AM, DS, and FF were involved in manuscript review; GZ, SC, EM and AM were involved in the last revision and supervision.

Availability of data and materials

Data will be made available on reasonable request due to restrictions, e.g., privacy or ethical.

Ethical approval

Human studies and subjects

N/A.

Publication ethics

Plagiarism

Authors declare no potentially overlapping publications with the content of this manuscript and all original studies are cited as appropriate.

Data falsification and fabrication

All the data corresponds to the real.

REFERENCES

- Lewandowska A, Zych B, Papp K, Zrubcová D, Kadučáková H, Šupínová M, et al. Problems, Stressors and Needs of Children and Adolescents with Cancer. *Children*. 2021;8(12):1173. doi: 10.3390/children8121173.
- Desjardins L, Barrera M, Schulte F, Chung J, Cataudella D, Janzen L, et al. Predicting social withdrawal, anxiety and depression symptoms in pediatric brain tumor survivors. *J Psychosoc Oncol*. 2019;37(1):22-36. doi: 10.1080/07347332.2018.1535531.
- Brand S, Wolfe J, Samsel C. The Impact of Cancer and its Treatment on the Growth and Development of the Pediatric Patient. *Curr Pediatr Rev*. 2017;13(1):24-33. doi: 10.2174/1573396313666161116094916.
- Armstrong FD, Reaman GH. Psychological research in childhood cancer: The Children's Oncology Group perspective. *J Pediatr Psychol*. 2005;30:89-97. doi: 10.1093/jpepsy/jsi020.
- Datta SS, Cardona L, Mahanta P, Younus S, Lax-Pericall MT. Pediatric psycho-oncology: Supporting children with cancer. In Rey JM, Martin A (eds), *JM Rey's IACAPAP e-Textbook of Child and Adolescent Mental Health*. Geneva: International Association for Child and Adolescent Psychiatry and Allied Professions, 2019. Available from: https://iacapap.org/_Resources/Persistent/bd5ed920e764a942a252495e744072214f773c69/I.6-PSYCHOONCOLOGY-2019.01.pdf. Accessed: Dec 12, 2024.
- Wiener L, Kazak AE, Noll RB, Patenaude AF, Kupst MJ. Standards for the Psychosocial Care of Children With Cancer and Their Families: An Introduction to the Special Issue. *Pediatr Blood Cancer*. 2015;62 (Suppl 5):S419-24. doi: 10.1002/pbc.25675.
- Weaver MS, Heinze KE, Kelly KP, Wiener L, Casey RL, Bell CJ, et al. Palliative Care as a Standard of Care in Pediatric Oncology. *Pediatr Blood Cancer*. 2015;62(Suppl 5):S829-33. doi: 10.1002/pbc.25695.
- Bell H, Ownsworth T, Lloyd O, Sheeran N, Chambers S. A systematic review of factors related to children's quality of life and mental health after brain tumor. *Psycho-oncol*. 2018;27(10):2317-26. doi: 10.1002/pon.4850.
- Erickson SJ, Steiner H. Trauma and personality correlates in long-term pediatric cancer survivors. *Child psychiatry and human development*. 2001;31(3):195-213. doi: 10.1023/a:1026477321319.
- Pancaldi A, Iughetti L. Neuropsychological Outcomes of Children Treated for Brain Tumors. *Children*. 2023;10(3):472. doi: 10.3390/children10030472.
- Annett R, Patel S, Phipps S. Monitoring and assessment of neuropsychological outcomes as a standard of care in pediatric oncology. *Ped Blood Cancer*. 2015;62(Suppl 5):S460-S513. doi: 10.1002/pbc.25749.
- Nathan PC, Patel SK, Dilley K, Goldsby R, Harvey J, Jacobsen C, et al.; Children's Oncology Group Long-term Follow-up Guidelines Task Force on Neurocognitive/Behavioral Complications After Childhood Cancer. Guidelines for identification of, advocacy for, and intervention in neurocognitive problems in survivors of childhood cancer: a report from the Children's Oncology Group. *Arch Pediatr Adolesc Med*. 2007;161(8):798-806. doi: 10.1001/archpedi.161.8.798.
- Gragert MN, Ris MD. Neuropsychological late effects and rehabilitation following pediatric brain tumor. *J Pediatr Rehabil Med*. 2011;4(1):47-58. doi: 10.3233/PRM-2011-0153.
- Robinson KE, Kuttesch JF, Champion JE, Andreotti CF, Hipp DW, Bettis A, et al. A quantitative meta-analysis of neurocognitive sequelae in survivors of pediatric brain tumors. *Pediatr Blood Cancer*. 2010;55(3):525-31. doi: 10.1002/pbc.22568.
- Mulhern RK, Merchant TE, Gajjar A, Reddick WE, Kun LE. Late neurocognitive sequelae in survivors of brain tumours in childhood. *Lancet Oncol*. 2004;5(7):399-408. doi: 10.1016/S1470-2045(04)01507-4.
- Landolt MA, Vollrath M, Ribi K, Gnehm HE, Sennhauser FH. Incidence and associations of parental and child posttraumatic stress symptoms in pediatric patients. *J Child Psychol. Psy-*

- chiatry. 2003;44:1199-207. doi: 10.1111/1469-7610.00201.
17. Zucchetti G, Gamberini G, Ciappina S, Cagnazzo C, Ricci F, Vallero S, Quarello P, Peretta P, Fagioli F. Neurocognitive and Psychological Outcomes among Children and Adolescents with Brain Tumors: Development of an Observational and Longitudinal Prospective Study Protocol. *Behav Sci.* 2023;13(7):536. doi: 10.3390/bs13070536.
 18. Capezzani L, Ostacoli L, Cavallo M, Carletto S, Fernandez I, Solomon R, et al. EMDR and CBT for cancer patients: Comparative study of effects on PTSD, anxiety, and depression. *J EMDR Pract Res.* 2013;7(3):134-43. doi: 10.1891/1933-3196.7.3.134.
 19. Faretta E, Borsato T, Civilotti C, Fernandez I, Paganini M. EMDR and CBT: a comparative clinical study with oncological patients. *J. EMDR Pract. Res.* 2016;10(3):215-27. doi: 10.1891/1933-3196.10.3.215.
 20. Portigliatti Pomeri A, La Salvia A, Carletto S, Oliva F, Ostacoli L. EMDR in Cancer Patients: A Systematic Review. *Front Psychol.* 2021;11:590204. doi: 10.3389/fpsyg.2020.590204.
 21. Ciappina S, Rocca E, Concas D, Faretta E, Fernandez I, Quarello P, et al. EMDR in pediatric hospital setting: a case report of an adolescent with cancer. *Front Psychol.* 2024 Feb 22;15:1347822. doi: 10.3389/fpsyg.2024.1347822.
 22. Zucchetti G, Ciappina S, Rocca E, Concas D, Giordano M, Battaglini C, et al. EMDR and standard psychotherapy for paediatric cancer patients and their families: a pilot study. *Front Psychol.* 2024;15:1407985. doi: 10.3389/fpsyg.2024.1407985.
 23. Arpawong TE, Oland A, Milam JE, Ruccione K, Meeske KA. Post-traumatic growth among an ethnically diverse sample of adolescent and young adult cancer survivors. *Psycho-Oncol.* 2013;22(10):2235-44. doi: 10.1002/pon.3286.
 24. Yi J, Kim M A. Postcancer experiences of childhood cancer survivors: how is posttraumatic stress related to posttraumatic growth? *J Trauma Stress.* 2014;27(4):461-7. doi: 10.1002/jts.21941.
 25. Ortiz R, Sibinga EM. The Role of Mindfulness in Reducing the Adverse Effects of Childhood Stress and Trauma. *Children.* 2017;4(3):16. doi: 10.3390/children4030016.
 26. Pathrose S P, Wells J, Patterson P, McDonald F, Everett B, Ussher J, et al. Contextualising an online mindfulness-based intervention for young people with cancer: A qualitative study. *Collegian.* 2024;31(1):56-62. doi: 10.1016/j.collegian.2023.11.005.
 27. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clin Psy: Sci and Pract.* 2003;10(2):144-56. doi: 10.1093/clip-sy.bpg016.
 28. Mehta R, Sharma K, Potters L, Wernicke AG, Parashar B. Evidence for the Role of Mindfulness in Cancer: Benefits and Techniques. *Cureus.* 2019;11(5):e4629. doi: 10.7759/cureus.4629.
 29. Murphy S, Donma AJ, Kohut SA, Weisbaum E, Chan JH, Plenert E, et al. Mindfulness Practices for Children and Adolescents Receiving Cancer Therapies. *J Pediatr Hematol Oncol Nurs.* 2022 Jan-Feb;39(1):40-48. doi: 10.1177/27527530211056514.
 30. Cramer H, Lauche R, Haller H, Langhorst J, Dobos G. Mindfulness- and Acceptance-based Interventions for Psychosis: A Systematic Review and Meta-analysis. *Glob Adv Health Med.* 2016;5(1):30-43. doi: 10.7453/gahmj.2015.083.
 31. Steineck A, Lau N, Fladeboe KM, Walsh CA, Rosenberg AR, Yi-Frazier JP, et al. Seeking virtual support: Digital technology use in adolescent and young adults with advanced cancer. *Pediatr Blood Cancer.* 2022;69(11):e29938. doi: 10.1002/pbc.29938.
 32. Puthenpura V, Marks AM. Clinical Application of Digital Technologies in Adolescent and Young Adult Oncology Supportive Care. *J Adolesc Young Adult Oncol.* 2021;10(2):127-30. doi: 10.1089/jayao.2020.0153.
 33. Tagliaferri L, Dinapoli L, Casà C, Colloca GF, Marazzi F, Cornacchione P, et al. Art and digital technologies to support resilience during the oncological journey: The Art4ART project. *Tech Innov Patient Support Radiat Oncol.* 2022;24:101-106. doi: 10.1016/j.tipsro.2022.10.004.
 34. Casà C, Dinapoli L, Marconi E, Chiesa S, Cornacchione P, Beghella Bartoli F, et al. Integration of art and technology in personalized radiation oncology care: Experiences, evidence, and perspectives. *Front Public Health.* 2023;11:1056307. doi: 10.3389/fpubh.2023.1056307.
 35. Wright M, Reitegger F, Cela H, Papst A, Gasteiger-Klicpera B. Interventions with Digital Tools for Mental Health Promotion among 11-18 Year Olds: A Systematic Review and Meta-Analysis. *J Youth Adolesc.* 2023;52(4):754-79. doi: 10.1007/s10964-023-01735-4.
 36. du Plessis J, Jordaan J. The impact of virtual reality on the psychological well-being of hos-

- pitalised patients: A critical review. *Heliyon*. 2024;10(2):e24831. doi: 10.1016/j.heliyon.2024.e24831.
37. Cheng L, Duan M, Mao X, Ge Y, Wang Y, Huang H. The effect of digital health technologies on managing symptoms across pediatric cancer continuum: A systematic review. *Int J Nurs Sci*. 2020;8(1):22-9. doi: 10.1016/j.ijnss.2020.10.002.
 38. Koumakis L, Schera F, Parker H, Bonotis P, Chatzimina M, Argyropaidas P, et al. Fostering Palliative Care Through Digital Intervention: A Platform for Adult Patients With Hematologic Malignancies. *Front Digit Health*. 2021;3:730722. doi: 10.3389/fdgh.2021.730722.
 39. Barello S, Triberti S, Graffigna G, Libreri C, Serino S, Hibbard J, et al. eHealth for Patient Engagement: A Systematic Review. *Front Psychol*. 2016;6:2013. doi: 10.3389/fpsyg.2015.02013
 40. Johnson Oyeniyi. The role of AI and mobile apps in patient-centric healthcare delivery. *World J Adv Res Rev*. 2024;21(1):1897-907. doi: 10.30574/wjarr.2024.22.1.1331.
 40. Shaffer KM, Turner KL, Siwik C, Gonzalez BD, Upasani R, Glazer JV, et al. Digital health and telehealth in cancer care: a scoping review of reviews. *Lancet Digit Health*. 2023;5(5):e316-e327. doi: 10.1016/S2589-7500(23)00049-3.
 41. Marconi E, Beghella Bartoli F, Meldolesi E, Mariani S, Panza G, et al. The Italian version of the Pediatric Quality of Life Inventory™ (PEDSQL™) 3.0 healthcare satisfaction hematology/oncology module: reliability and validity in radiation oncology. *Health Qual Life Outcomes*. 2023;21(1):72. doi: 10.1186/s12955-023-02149-3.
 42. Cueva M, Kuhnley R, Lanier A, Dignan M, Revels L, Schoenberg NE, et al. Promoting Culturally Respectful Cancer Education Through Digital Storytelling. *Int J Indig Health*. 2016;11(1):34-49. doi: 10.18357/ijih111201616013.
 43. Akard TF, Dietrich MS, Friedman DL, Hinds PS, Given B, Wray S, et al. Digital storytelling: an innovative legacy-making intervention for children with cancer. *Pediatr Blood Cancer*. 2015;62(4):658-65. doi: 10.1002/pbc.25337.
 44. Whitlow ML, Gilmer MJ, Dietrich MS, Cho E, Akard TF. Digital Stories Created by Children With Advanced Cancer. *J Pediatr Hematol Oncol Nurs*. 2024;41(5):336-48. doi: 10.1177/27527530241267296.
 45. Laing CM, Moules NJ, Estefan A, Lang M. Stories That Heal: Understanding the Effects of Creating Digital Stories With Pediatric and Adolescent/Young Adult Oncology Patients. *J Pediatr Oncol Nurs*. Official Journal of the Association of Pediatric Oncology Nurses. 2017;34(4):272-82. doi: 10.1177/1043454216688639
 46. Colina-Matiz S, Hernández Leal J, Ariza-Vargas JC, Beltrán Higuera OR, Ovalle-Chaparro C, González Suárez NL, et al. Social robotics as an adjuvant during the hospitalization process in pediatric oncology patients. *J Psychosoc Oncol*. 2024;42(6):811-21. Doi: 10.1080/07347332.2024.2335170.
 47. van Bindsbergen Kelly L.A.a,b, van Gorp Marloesa, Thomassen Brigitte W.a, Merks Johannes H.M.a,b, Grootenhuis Martha A.a,b. Social robots in pediatric oncology: opinions of health care providers. *J Psychosoc Oncol Res Pract*. 2022;4(2):p e073. doi: 10.1097/OR9.0000000000000073
 48. Al Husni Al Kelani M, Delvenne V. Use of Video game in a child and adolescent psychiatric unit. *Psychiatr Danub*. 2020;32(Suppl 1):167-71. PMID: 32890384.
 49. Trost MJ, Ford AR, Kysh L, Gold JI, Matarić M. Socially Assistive Robots for Helping Pediatric Distress and Pain: A Review of Current Evidence and Recommendations for Future Research and Practice. *Clin J Pain*. 2019;35(5):451-8. doi: 10.1097/AJP.0000000000000688.
 50. Moerman CJ, van der Heide L, Heerink M. Social robots to support children's well-being under medical treatment: A systematic state-of-the-art review. *J Child Health Care*. 2019;23(4):596-612. doi:10.1177/1367493518803031.
 51. Weibel M, Kristensson Hallström I, Skoubo S, Brogaard Bertel L, Schmiegelow K, Bækgaard Larsen H. Telepresence robotic technology support for social connectedness during treatment of children with cancer. *Children Society*. 2023;37(5):1392-417. doi: 10.1111/chso.12776.
 52. Thai A, Lowenstein D, Ching D. Game changer: Investing in digital play to advance children's learning and health. The Joan Ganz Cooney Center. 2009. Available from: https://joanganzcooneycenter.org/wp-content/themes/jgcc/downloader.php?file=/wp-content/uploads/2010/03/game_changer_final_1_.pdf. Accessed: Dec 12, 2024.
 53. Kowaluk A, Malicka I, Kałwak K, Woźniowski M. The Impact of Interactive Video Games Training on the Quality of Life of Children Treated for Leukemia. *Cancers*. 2024;16(21):3599. doi: 10.3390/cancers16213599.
 54. Kauhanen L, Järvelä L, Lähteenmäki PM, Arola M, Heinonen OJ, Axelin A, et al. Active video games

- to promote physical activity in children with cancer: a randomized clinical trial with follow-up. *BMC Pediatr.* 2014;14:94. doi: 10.1186/1471-2431-14-94.
55. Yang DJ, Lu MY, Chen CW, Liu PC, Hou IC. Development of a Therapeutic Video Game With the MDA Framework to Decrease Anxiety in Preschool-Aged Children With Acute Lymphoblastic Leukemia: Mixed Methods Approach. *JMIR Serious Games.* 2022;10(3):e37079. doi: 10.2196/37079. Erratum in: *JMIR Serious Games.* 2022;10(4):e43211. doi: 10.2196/43211.
 56. Kobayashi M, Ohno T, Noguchi W, Matsuda A, Matsushima E, Kato S, et al. Psychological distress and quality of life in cervical cancer survivors after radiotherapy: do treatment modalities, disease stage, and self-esteem influence outcomes? *Int J Gynecol Cancer.* 2009;19(7):1264-8. doi: 10.1111/IGC.0b013e3181a3e124.
 57. O'Connor M, Halkett GK. Una revisione sistematica degli interventi per ridurre il disagio psicologico nei pazienti pediatrici sottoposti a radioterapia. *Consigli di educazione dei pazienti.* 2019;102(2):275-83.
 58. Khan S, Zaib Abbasi A, Farhana Kazmi S, Ding Hooi T, Rehman U, Hlavacs H, Safi Arslan F. Serious video games and psychological support: A depression intervention among young cancer patients, *Entert Comput.* 2022;41:100479. doi: 10.1016/j.entcom.2022.100479.
 59. Sharma A, Lin IW, Miner AS, Atkins DC, Althoff T. Human-AI collaboration enables more empathic conversations in text-based peer-to-peer mental health support. *Nat Mach Intell.* 2023;5:46-57. doi.org/10.1038/s42256-022-00593-2.
 60. Micah Skeens. Using AI chatbots to support families of children with cancer. Available from: <https://www.wcrf.org/researchwefund/using-ai-chatbots-to-support-families-of-children-with-cancer/>. Accessed: Nov 20, 2024.
 61. Castellano-Damaso S, Vazquez-Gomez F, Perez-Somarrriba M, Sanchez-Salazar M, Lassaletta A. Artificial intelligence chatbots: Are they a reliable source for patients and families in pediatric neuro-oncology? *Pediatr Blood Cancer.* 2024;71(9):e31184. doi: 10.1002/pbc.31184.
 62. Schover LR. Patient attitudes toward fertility preservation. *Pediatr Blood Cancer.* 2009;53(2):281-4. doi: 10.1002/pbc.22001.
 63. Dionisi-Vici M, Felicetti F, Zucchetti G, Biasin E, Castiglione A, Gatti F, et al. The impact of infertility and physical late effects on psycho-social well-being of long-term childhood cancer survivors: A cross-sectional study. *EJC Paed Oncol.* 2023;2:100025. doi: 10.1016/j.ejcped.2023.100025.
 64. Druker H, Zelle K, McGee RB, Scollon SR, Kohlmann WK, Schneider KA, et al. Genetic Counselor Recommendations for Cancer Predisposition Evaluation and Surveillance in the Pediatric Oncology Patient. *Clin Cancer Res.* 2017;23(13):e91-e97. doi: 10.1158/1078-0432.CCR-17-0834.
 65. Forbes Shepherd R, Werner-Lin A, Keogh LA, Delatycki MB, Forrest LE. "I need to know if I'm going to die young": Adolescent and young adult experiences of genetic testing for Li-Fraumeni syndrome. *J Psychosoc Oncol.* 2021;39(1):54-73. doi: 10.1080/07347332.2020.1768199.
 66. Chiesa S, Marconi E, Dinapoli N, Sanfilippo MZ, Ruggiero A, Mastronuzzi A, et al. The Multidimensional Assessment for Pediatric Patients in Radiotherapy (M.A.P.-RT) Tool for Customized Treatment Preparation: RADAR Project. *Front Oncol.* 2021; 11:718. doi: 10.3389/fonc.2021.621690.