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Review

Nursing care for chimeric antigen receptor T cell therapy survivors: A literature review

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ABSTRACT

Chimeric antigen receptor T cell (CAR-T) therapy is an immunotherapy that involves genetically modifying the patient's own T cells to express a chimeric antigen receptor, enabling them to recognize and destroy cancer cells. This treatment has revolutionized the prognosis and management of hematological malignancies, leading to a significant increase in long-term survivors. However, there is limited evidence regarding late sequelae and post-treatment care due to the recent emergence of this therapy. The rapid advancement of CAR-T therapies has created opportunities for advanced practice nurses to play a crucial role in coordinating care, providing education, and ensuring the ongoing well-being of survivors. This article provides an overview of the physical, psychosocial, and financial challenges faced by long-term survivors of CAR-T therapy and proposes a comprehensive nursing care plan to address these issues.

Introduction

Chimeric antigen receptor T cell (CAR-T) therapy is a cutting-edge form of personalized immunotherapy. Its acronym stands for chimeric antigen receptor T cell and consists of the genetic modification of the patient's T cells and the subsequent expansion of autologous T cells externally to express a chimeric antigen. Once reinfused, the modified T cells can identify and destroy cancer cells.[1]

In 2019, the European Medicines Agency approved two commercial CAR-T therapies: tisagenlecleucel (Kymriah®), indicated for second-line treatment of acute lymphoblastic B-cell leukemia (ALL) in patients with $\leq$ 25 years of age and in adults with diffuse large B-cell lymphoma (DLBCL) after two lines of treatment; and axicabtagene ciloleucel (Yescarta®), indicated in second-line treatment for DLBCL and primary mediastinal B-cell lymphoma.[2] In February 2021, the CAR-T cell product ARI-0001, developed at the Hospital Clínic in Barcelona, Spain, received authorization from the Spanish Agency of Medicines and Medical Devices for the treatment of patients aged $\geq$ 25 years with relapsed/refractory (R/R) ALL.[3] Recently, the results of the first European academic CAR-T therapy for multiple myeloma in R/R patients after two or more lines of therapy, ARI0002h, have been presented.[4] Other CAR-T constructs are currently being developed for chronic lymphocytic leukemia, mantle-cell lymphoma, follicular lymphoma, and Hodgkin lymphoma.[5]

In Spain, 24 centers are accredited to administer CAR-T therapy.[6] Given the complexity of the process, its widespread use has been limited. As a result, eight Spanish regions lack accredited centers, forcing patients and caregivers to travel to another community for a period of 6–8 weeks. CAR-T centers in Spain receive patients who travel from their referral center for screening, lymphopheresis, lymphodepletion, infusion, and early follow-up (+42 days). The Advanced Practice Nurse in CAR-T therapy (APNCAR-T) is responsible for patients' first contact with the infusion center. She is responsible, together with the medical team, for the therapeutic education of the procedure and its organization, for the detection of the potential side-effects and is responsible for guiding the patient's navigation between the different centers, ensuring compliance with established care plans, guaranteeing continuity of care, managing persistent or late toxicities and monitoring disease recurrence.[1] For the safe management of patients, close communication and collaboration between referring centers and CAR-T centers are essential. The APNCAR-T monitors, educates and ensures that the patient/caregiver follows the correct development of the process. After the infusion and management of early toxicities, it is time for the patient/caregiver to return to the referring center. Coordinating follow-up between both centers is advisable to facilitate the return to their family nucleus.

Early toxicities include cytokine release syndrome (CRS), immune effector cell–associated neurotoxicity syndrome,

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hypogammaglobulinemia, B-cell aplasia, cytopenia, and infections. Several clinical guidelines and consensus documents exist for managing early toxicities,[1,2,7–11] which have helped unify criteria and promote early detection and intervention. The number of survivors who have received CAR-T therapy has increased in recent years. Most recommendations for managing the sequelae of survivors are based on clinical experience, particularly from centers with long-term clinical trial populations.[11–13] Studies examine the physiological and psychosocial needs of survivors and evaluating evidence-based interventions are limited.[13–16] This paper aims to describe CAR-T therapy survivors' physical, psychosocial, and financial sequelae and establish a comprehensive survivorship nursing care plan.

Late effects

Evidence on the late effects of CAR-T therapy is limited. It is essential to keep in mind that recipients may have multiple comorbidities (hypertension, diabetes, among others.) and relapsed/refractory disease after multiple lines of therapy, which may include hematopoietic stem-cell transplantation (HSCT), making it difficult to identify effects that can be directly attributed to CAR-T therapy.[17] In addition to the risk of relapse of their hematologic disease, recipients of CAR-T therapy are at risk of developing new complications in the weeks following infusion, including physical, psychosocial, and economic toxicities.[7,8]

CAR-T centers should establish follow-up guidelines with referral centers, providing care protocols and guidelines for maintaining shared care arrangements. APNCAR-T ensures the implementation of shared survivor management protocols and guidelines in a face-to-face or telematics manner to ensure safe patient management and continuity of care.[2,7–10] A recommended follow-up schedule and tests are described in Table 1.

Physical toxicities

The main late physical toxicities identified to date include:

Table 1
Recommended minimum frequency of attendance at the CAR-T center for survivor patients.[1,2,7,8,17]

Period	Visit frequency	Outcomes to be monitored
Day +100 to 1 year	Monthly	General physical examination (weight and height)
1–2 years	Six-monthly	Vital signs
2–15 years	Annually	Adherence to prophylaxis treatment Neurological status (ECI, mini mental) Psychological status and quality of life. Social, financial and labor status Cytopenias status (hemogram) Immunological status: immune cell markers, immunoglobulins, CAR-T persistence. Cardiovascular disease (cardiac enzymes). Respiratory function (breathing rate, pulse oximeter …) Gastrointestinal and liver health (nutrient profile) Evaluate disease: remission, minimal residual disease status, relapse, death. Subsequent treatments including allo-HCT and other IEC/ATMP therapies. New cancers/secondary myeloid diseases Autoimmunity and new autoimmune diseases Endocrine, reproductive and bone health including growth and development. Vaccine program

ATMP, advanced therapy medicinal products; CAR-T, chimeric antigen receptor T cell; HCT, hematopoietic cell transplantation; IEC, immune effector cells.

B-cell aplasia and hypogammaglobulinemia: These conditions occur because CAR-T cells, after infusion, become activated, proliferate and destroy both malignant cells and healthy B cells, compromising the immune system and increasing the risk of infections. Healthy B cells are responsible for the production of immunoglobulins.[10] Hypogammaglobulinemia is the most frequent late toxicity after CAR-T CD19 therapy. We should also consider that approximately 35% of patients have baseline hypogammaglobulinemia, probably secondary to underlying disease and previous treatments, and therefore we should monitor levels more closely in these patients.[17] APNCAR-T monitors immunoglobulin levels and identifies those patients who require treatment. In adult patients with low immunoglobulin levels, the guidelines recommend administering *intravenous or subcutaneous immunoglobulin G (IgG)* in patients with IgG $<$ 400 mg/dl and/or recurrent infections. They also recommend hygiene and safety standards to avoid preventable infections. Hygiene and safety rules for patients, caregivers, and health professionals include frequent handwashing, food hygiene (washing, storage and cooking), and correct use of personal protective equipment, avoiding crowded places, and contact with persons with infectious symptoms and promoting vaccination.[7,8,13–15]

Late cytopenias: It manifests as anemia, thrombocytopenia, neutropenia, leukopenia, and lymphopenia. The exact mechanism is unknown, but it is thought to be due to myelosuppression caused by CAR-T cells.[15] Some patients, due to previous treatments, may have prolonged cytopenias. APNCAR-T monitors complete blood count levels and identifies, initiates, and ensures patient adherence to drug treatment. Treatment includes supportive measures such as transfusion of blood products, prophylactic antibiotics, and growth-factor support.[10] APNCAR-T must ensure compliance with hygiene and safety standards to avoid preventable infections and bleeding.

Late infections: CAR-T cell therapy is an immunotherapy that involves genetically modifying the patient's own T cells to express a chimeric antigen receptor, enabling them to recognize and destroy cancer cells. This treatment has revolutionized the prognosis and management of hematological malignancies, leading to a significant increase in long-term survivors. However, there is limited evidence regarding late sequelae and post-treatment care due to the recent emergence of this therapy. The rapid advancement of CAR-T therapies has created opportunities for Advanced Practice Nurses to play a crucial role in coordinating care, providing education, and ensuring the ongoing well-being of survivors. This article provides an overview of the physical, psychosocial, and financial challenges faced by long-term survivors of CAR-T therapy and proposes a comprehensive nursing care plan to address these issues.

Fatigue: This is most frequent and difficult symptom to manage.[17] The combination of the patient's baseline status and the disease itself, the side effects of lymphosuppressive therapy, early toxicities, and treatment cause it. APNCAR-T should monitor for the presence of fatigue from the early stages of its onset, normalize this symptom, and develop and introduce measures for its prevention and management, such as physical exercise programs, meditation, yoga or massages, etc. Scientific evidence shows that corticosteroid treatment reduces fatigue, but it is contraindicated due to its T-cell-suppressive effect.[1,12,13,17]

Late neurotoxicity: Late neurotoxicity involves cognitive impairments that can affect memory, attention, and concentration.[16] These impairments are similar to those experienced by patients after intensive chemotherapy and HSCT. Considering that survivors have previously undergone treatments that can cause these difficulties, it is difficult to attribute this late toxicity solely to CAR-T therapy. More longitudinal studies are needed to provide answers. APNCAR-T promotes cognitive stimulation activities and brain-training programs that include activities that exercise memory (reading and writing) and attention (memory games, crossword puzzles, sudoku, card games, video games …),

monitoring neurological impairment and adherence to these interventions through the interview.

Secondary malignant neoplasm's: These are rare events with potentially long latency. Genetically altered CAR-T cells pose an improbable risk of insertional mutagenesis possibly leading to secondary malignant diseases. More extended follow-up and epidemiological data are needed to estimate the incidence of secondary neoplasms accurately. Until more information is available, the APNCAR-T ensures that survivors adhere to cancer detection recommendations similar to those for HSCT and follows close monitoring in accordance with the guidelines of the Spanish National Health System (SNS).[1,12–14,17]

Fertility: To date, no study has evaluated the effects of CAR-T therapy on fertility. Recommendations suggest consulting a fertility preservation specialist before starting the first line of treatment and continuing long-term follow-up.[1,12,17] The APNCAR-T implements safe sexuality education strategies that include infection prevention measures, emphasizing hygiene, and condom use.[18] They address the lack of sexual desire, whether due to weakness, fatigue, anxiety, stress, hormonal changes, medication, or concerns related to body image. APNCAR-T facilitates communication between partners and refers to specialized teams when necessary.

Other possible late effects: Late toxicities may include cardiac and renal toxicities. Cardiac toxicities present as elevated troponin levels, reduced left ventricular ejection fraction, decompensated congestive heart failure, and/or new-onset arrhythmias. Early administration of tocilizumab at the onset of CRS is being investigated as a protective measure.[17,18] APNCAR-T closely monitors patients, especially those of advanced age or exposed to previous treatments that may produce cardiac toxicity (anthracyclines, carfilzomib) for early detection and treatment. Acute kidney injury is evident as early toxicities, but it is unknown whether patients receiving CAR-T therapy are at risk of developing long-term chronic kidney disease. Thus, APNCAR-T closely monitors patients who have received previous HSCT, experienced grade 3–4 CRS or required intensive care unit admission, who are elderly or were exposed to previous treatments that may produce renal toxicity (cisplatin, methotrexate, melphalan, cyclophosphamide) for early detection and treatment.[17]

Psychological toxicities

CAR-T therapy is a therapeutic option for patients who have exhausted other treatment options. Because it is indicated as a second- or third-line treatment, patients may experience a decreased quality of life due to side effects of previous treatments and tumor burden.[1,17] Recent studies not only have shown an improvement in the quality of life of survivors throughout the process but have also highlighted that anxiety, stress, depression, insomnia, and fear or uncertainty of relapse persist throughout the process.[12–14,19] Survivor's overall mental health can be affected by fear of recurrence and anxiety and stress related to managing side-effects and complications, which challenges their ability to adapt.[18,20] APNCAR-T focuses on early detection and provides supportive interventions to enhance patients' ability to manage anxiety, improve coping skills, and promote positive adaptation.[17,21] In direct patient care, APNCAR-T encourages communication to create an environment of trust that allows for open discussion, normalization, and coping with the fear of recurrence, as well as referral to psychological specialists if necessary for the patient himself/herself or his caregiver.

Social toxicities

Patients receiving CAR-T therapy should remain less than 1 hour from the infusion center, or 30 minutes in case of ambulatory administration.[22] This separation from their home causes patients and caregivers to be distanced from their families and workplaces. The requirement of a caregiver 24 hours a day for the first 6–8 weeks creates a close bond between them but can also cause caregiver burnout. Caregivers gradually delegate tasks to the patient as they recover. APNCAR-T provides guidance and reinforces when the patient can regain autonomy and must advise on reintegration into the workforce and increased personal interactions.

Financial toxicities

Financial toxicity is the out-of-pocket costs associated with the treatment plan.[17] It is not just a financial concern but can contribute to exacerbating psychological toxicities (anxiety and stress) related to the treatment.[23,24] In Spain, the commercial cost of CAR-T therapy is approximately €300,000–400,000. Both the cost of the therapy and the associated hospital costs are covered by the SNS.[6] However, there are associated costs, such as prophylactic drugs and other auxiliary expenses not specifically unrelated to treatment. These auxiliary expenses can include transportation costs, accommodation, daily living expenses, and a loss income due to interruption of the patient's and/or caregiver's work.[10] These expenses accumulate throughout the process and require ongoing monitoring.[24,25] Few subsidy or financial assistance programs are available to help defray these additional costs, and the availability of such programs varies depending on the patient's region of origin. In addition, patients come to CAR-T therapy with pre-existing financial toxicity due to previous therapies and disease progression. APNCAR-T discusses with the patient/caregiver how the disease and treatment affect their finances to seek solutions and financial support if available. Transparent conversations can support improved care and prevention of financial toxicity. Patients should be referred to social work teams at referral and infusion centers for advice on community resources and/or to entities and associations that offer support to patients and caregivers.

Nursing care plan

The nursing care plan (NCP) is the organization and provision of nursing care aimed at promoting, maintaining, and restoring health and preventing diseases and complications. It is a systematic and organized method for providing individualized care, guided by the understanding that each person responds differently to actual or potential health alterations. It enables the care provision in a rational, logical, and systematic manner.[26] Various studies have shown the effectiveness and positive health results of the implementation of NCP in cancer survivors. In them, they exalt the figure of the APN as the professional who can integrate the design, provision, monitoring, and coordination of care plans for cancer survivorship.[28–31]

In the following, we present an NCP for CAR-T-therapy survivors that is standardized but open to individualization, including accurate or potential nursing diagnoses, outcomes, and nursing interventions.

Comprehensive assessment

The process of nursing care begins with gathering information to assess the needs on which nursing interventions will be developed. Assessment is a planned, systematic, ongoing, and deliberate process of collecting and interpreting patient health status.[26] Various methods are used to obtain data and convert it into information:

- Interview and physical examination.
- Interpretation of laboratory tests and patient reports.
- Exchange of information with other healthcare professionals.

The most commonly used data collection structures are Marjory Gordon's functional health patterns or Virginia Henderson's basic needs, which often serve as a template for the initial exploratory phase of the interview. In this work, we have chosen Gordon's functional patterns[27] (Table 2), following the current care guidelines.[10,17]

Using specific tools focused on a particular aspect can enhance and improve the assessment. A recent systematic review described that the

Table 2
Gordon's functional health patterns.[10,26,27]

Pattern 1: health perception—health management Client's perceived pattern of health and well-being and how health is managed. Involves lifestyles, health promotion, and risk prevention practices and medical and nursing prescriptions.	**Pattern 2: Nutritional–metabolic** It aims to know the consumption of food and liquids of the person in relation to their metabolic needs. Involves individual pattern of food and fluid intake (eating habits), anthropometric measurements, psychological aspects of feeding, infant feeding pattern, skin lesions and condition of the skin, mucous membranes and teeth.	**Pattern 3: Elimination** It aims to know the excretory function patterns of the person. Involves intestinal elimination pattern, bladder elimination pattern and elimination pattern through the skin.
Pattern 4: Activity—exercise Describes patterns of activity, exercise, leisure, and entertainment. Involves activities of daily living, amount and type of exercise and sport, recreational activities, and factors that interfere with the performance of desired activities.	**Pattern 5: Cognitive–perceptual** Describes the sensory, perceptual, and cognitive patterns of the person. Involves status of vision, hearing, taste, touch, smell, pain perception and management; cognitive functions such as language, memory, and decision making.	**Pattern 6: Sleep–rest** Describes patterns of sleep, rest, and relaxation. Involves perception of quality and quantity of sleep and energy, sleep aids, routines client uses
Pattern 7: Self-perception/self-concept Describes patterns of self-concept and perceptions of self . Involves person's attitude toward self and self-worth, body image, and emotional pattern, nonverbal communication pattern (body posture and movement, eye contact) and verbal communication pattern (voice and speech pattern).	**Pattern 8: Role-relationship** Describes patterns of role engagement and relationships. Involves perception of their role responsibilities, satisfaction with family, work and social relationships.	**Pattern 9: Sexuality—reproductive** Describes the sexual and reproductive patterns of the person. Involves satisfaction and dissatisfaction with sexuality, sexuality disorders, problems in the reproductive stage of women and problems in menopause.
Pattern 10: Coping/stress tolerance Describes the person's pattern of adaptation and coping to life processes, and its effectiveness, manifested in terms of stress tolerance. Involves: The person's resilience to attacks of integrity, stress management, support and help systems, and perceived ability to handle stressful situations.	**Pattern 11: Value—belief** Describes the pattern of values and spiritual and/or religious beliefs that influence decision-making. Involves: things perceived as important in life, perception of quality of life, conflict with important values or beliefs, and health-related expectations.	

most commonly used validated scales for assessing CAR-T therapy recipients are as follows:[20]

The Patient-Reported Outcomes Measurement Information System scale v1.2—Global Health is a ten-item patient-reported measure of physical, mental, and social health. Items query general health, quality of life, physical health, mental health, satisfaction with discretionary social activities, carrying out every day physical activities, pain, fatigue, satisfaction with social roles, and emotional problems.[32]

European Quality of Life-5 Dimensions questionnaire (EQ-5D) is a generic health-related quality-of-life measurement instrument that can be used both in relatively healthy individuals (general population) and in groups of patients with different pathologies. The individual assesses his or her own health status, first in levels of severity by dimensions (descriptive system) and then on a more general visual analog scale. A third element of the EQ-5D is the index of social values obtained for each health state generated by the instrument.[33]

Visual analog scales are psychometric measuring instruments designed to document the characteristics of disease-related symptom severity in individual patients and use this to achieve a rapid (statistically measurable and reproducible) classification of symptom severity and disease control.[34]

The European Organization for Research and Treatment of Cancer core quality of life questionnaire (EORTC QLQ-C30) is designed to measure cancer patients' physical, psychological, and social functions. The questionnaire is composed of multiitem scales and single items.[35]

Table 3 presents the recommended scales for conducting a comprehensive assessment of CAR-T therapy survivors.

Table 3
Comprehensive assessment for CAR-T cell therapy survivors.[1,10,14,26]

Pattern 1: Health perception—health management **Quality of life** - EORTC QLQ-C30 - SF36 - ECOG/ karnosky **Therapeutic compliance** - Morisky Green Test	**Pattern 2: Nutritional–metabolic** **Nutrition** - Mininutritional assessment - Nausea/vomiting - Appetite **Risk of pressure ulcers** - Braden Scale	**Pattern 3: Elimination** **Temperature** **Constipation/diarrhea** **Diuresis**
Pattern 4: Activity–exercise **Autonomy** - Barthel - Norton/Brody **Risk of falls** - Multiple fall risk scale **Asthenia** - Scale perform	**Pattern 5: Cognitive–perceptual** **Neurological status** - ICE **Pain** - VAS	**Pattern 6: Sleep–rest** **Rest** - Oviedo sleep questionnaire **Anxiety** - HADS
Pattern 7: Self-perception/self-concept **Quality of life** - EORTC QLQ-C30 - SF36 - ECOG/ karnosky **Anxiety / Depression** - HADS	**Pattern 8: Role—relationship** **Caregiver** - Zarit overload questionnaire **Social risk** - Gijon scale.	**Pattern 9: Sexuality—reproductive** **Reproduction** **Sexuality**
Pattern 10: Coping/stress tolerance **Coping**	**Pattern 11: Value—belief** **Crisis of values** **EORTC QLQ - INFO25 d.**	

CAR-T, chimeric antigen receptor T cell; IEC, immune effector cells; EORTC QLQ-C30, European Organization for Research and Treatment of Cancer core quality of life questionnaire; ECOG, Eastern Cooperative Oncology Group; VAS, Visual analog scales; HADS, Hospital Anxiety and Depression Scale.

Table 4
Most frequent nursing diagnoses in survivors of CAR-T cell therapy.[1,10,14,26]

Pattern 1: Health perception—health management	**Pattern 2: Nutritional–metabolic**	**Pattern 3: Elimination**
Deficient knowledge (00126) Ineffective protection (00043).	Imbalanced nutrition (00002).	Risk for infection (00004) Constipation (00011) Hyperthermia (00007).
Pattern 4: Activity—exercise	**Pattern 5: Cognitive–perceptual**	**Pattern 6: Sleep–rest**
Risk for impaired skin integrity (00047) Fatigue (0003) Impaired physical mobility (00085)	Impaired memory (00131) Chronic pain(00133)	Disturbed sleep pattern (00198) Insomnia (00095)
Pattern 7: Self-perception/self-concept	**Pattern 8: Role—relationship**	**Pattern 9: Sexuality—reproductive**
Fear (00148). Ineffective coping (00069) Disturbed body image(00118)	Risk for caregiver role strain (00062) Alterations in family caregiver's lifestyle (2203) Risk for loneliness (00054) Decreased diversional activity engagement (00097) Interrupted family processes (00060)	Ineffective sexuality pattern (00065)
Pattern 10: Coping/stress tolerance	**Pattern 11: Value—belief**	
Anxiety (00146) Social isolation (00053) Labile emotional control (00251) Risk for relocation stress syndrome(00149)	Decisional conflict (00083) Deficient knowledge (00126)	

CAR-T, chimeric antigen receptor T cell.

Nursing diagnoses

APNCAR-T uses critical thinking skills to interpret assessment data and identify and prioritize the affected needs of patients. Using a classification system to support nursing practice provides clinically useful terminology and standardized language.[26] NANDA-I taxonomy provides a model for classifying and categorizing areas of nursing responsibility. Table 4 lists the most common actual or potential nursing diagnoses in survivors.

Nursing interventions

Nursing interventions encompass any treatment based on clinical judgment and knowledge that a nurse performs to improve patient outcomes. APNCAR-T must choose the most appropriate interventions for the patient's situation, keeping in mind that they represent specific actions (activities) that fall within each intervention. The Nursing Interventions Classification (NIC) is an organized list of nursing interventions or care.[36] The choice of the most relevant NICs must be

Table 5
Most frequent nursing interventions in survivors of CAR-T cell therapy.[10,26,28]

Pattern 1: Health perception—health management	**Pattern 2: Nutritional–metabolic**	**Pattern 3: Elimination**
Education: Procedure/treatment (5618) Health education (5510) Education: Individual (5606) Chemotherapy management (2240) Teaching: Prescription drugs (5616) Discharge planning (7370) Infection control (6540) Infection protection (6550)	Nutrition management (1100) Nutritional counseling (5246) Nausea management (1450)	Infection protection (6550) Maintenance of venous access devices (2440) Infection control (6540) Bowel management (0430) Constipation/impaction management (0450) Temperature regulation (0180) Vital signs monitoring (6680) Environmental management (6480)
Pattern 4: Activity—exercise	**Pattern 5: Cognitive–perceptual**	**Pattern 6:Sleep–rest**
Energy management (0180) Administration of blood products (4030) Pressure ulcer prevention (3540) Skin surveillance (3590) Exercise promotion (0200) Exercise therapy (0226)	Memory training (4760) Reality orientation (4820) Neurological monitoring (2620) Pain management (1400) Pain control (1605) Analgesic administration (2210)	Encouraging sleep (1850) Relaxation technique (5880) Enhancing coping (5230) Environmental control: Comfort (6482) Medication administration (2300)
Pattern 7: Self-perception/self-concept	**Pattern 8: Role—relationship**	**Pattern 9: Sexuality—reproductive**
Self-esteem empowerment (5400) Emotional support (5270) Enhancing coping (5230) Body image enhancement (5220) Decision-making support (5250)	Promotion of family involvement (7110) Primary caregiver support (7040) Socialization enhancement (5100) Participation in leisure activities (1604) Entertainment therapy (5360) Activity therapy (4310 Maintenance of family processes (7130) Promotion of family normalization (7200)	Sexual counseling (5248) Emotional support (5270) Education: Safe sex (5622) Family planning: Contraception (6784) Self-esteem enhancement (5400)
Pattern 10: Coping/stress tolerance	**Pattern 11: Value—belief**	
Enhancing socialization (5100) Increase support systems (5440) Facilitate visitation (7560) Decrease anxiety (7560) Enhancing safety (5380) Emotional support (5270) Decrease anxiety (5820)	Facilitating learning (5520) Support in decision-making (5250) Family support during treatment (2609) Immunization behavior (1900) Teaching treatment, prescribed medications, diet and prescribed activity (5612, 5614, 5616) Facilitating self-responsibility (4480)	

CAR-T, chimeric antigen receptor T cell.

linked to the actual or potential problems of the survivors and must address and fulfill the set objectives (Table 5).

Educational program for CAR-T survivors

APNCAR-T leads individualized therapeutic education for patients and caregivers, adapting it to each situation and providing time for clarifying doubts. A formalized educational program (EP) is structured and documented with written and digital materials.[1] The EP should educate patients/caregivers about the increased risk of infection due to prolonged cytopenia and B-cell aplasia (if applicable, hematopoietic products, growth factors, and immunoglobulins). It should emphasize hygiene and infection prevention strategies (vaccination, prophylaxis, etc.).

Furthermore, patients and caregivers should be vigilant for any signs of relapse, such as fever, night sweats, and palpable lymph nodes.[37] The EP enables patients and caregivers to acquire the necessary essential competencies for proper monitoring and detection of warning signs or symptoms and enhances their autonomy and self-care in accordance by established NCP.

In the future, APNCAR-T should study the implementation of this care plan and educational program to demonstrate the effects of late toxicities of CAR-T therapy and develop communication and collaboration strategies with other disciplines in the care of these patients (social work, psychology, cardiology, immunology, etc.) to provide holistic care.

Conclusions

CAR-T therapy is an emerging and novel treatment, and as research in this field grows and more patients undergo the procedure, the number of survivors increases. The late toxicities of CAR-T therapy affect patients physically, psychologically, socially, and economically. APNCAR-T is essential for monitoring and surveillance of these late effects for early detection, and to ensure efficient coordination, communication and continuity of care for survivors. Implementing NCPs and evaluating them in every patient/caregiver encounter is essential to address their actual or potential needs. The NCP includes a therapeutic education program regarding preventive measures and late effects of CAR-T therapy, focused on empowering patients and caregivers with knowledge and skills to recognize and manage these effects while maintaining the highest level of functionality, autonomy, and comfort. APNCAR-T contributes to the overall well-being of survivors during follow-up, reinforces health promotion, and provides skills to enhance self-care.

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CRediT authorship contribution statement

Mercedes Montoro-Lorite: Conceptualization, Methodology, Investigation, Writing – Original Draft, Writing – Review and Editing, Visualization, Supervision, Project administration. **Cristina Moreno**: Writing – Original Draft, Writing – Review and Editing. Carla Ramos: Writing – Review and Editing. **María Teresa Solano**: Writing – Review and Editing. **Silvia Lahoz**: Writing – Review and Editing. **Carolina Bonilla-Serrano**: Writing – Review and Editing. **Ariadna Domènech**: Writing – Review and Editing. **Pilar Ayora**: Investigation, Writing – Original Draft, Writing – Review and Editing, Visualization, Supervision. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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