



SINGAPORE LYMPHOMA SCIENTIFIC SYMPOSIUM 2025
Lymphoma Education Preceptorship- CAR-T and Bispecific Antibodies Module

CAR-T Nursing 101



Singapore
General Hospital
SingHealth

Jordan Hwang

ADVANCED PRACTICE NURSE / ASSISTANT DIRECTOR, NURSING
SPECIALITY NURSING / DEPARTMENT OF HAEMATOLOGY, SINGAPORE GENERAL HOSPITAL
NURSING EDUCATION CO-LEAD, SINGHEALTH DUKE-NUS CELL THERAPY CELL, SINGAPORE

31ST AUGUST 2025



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Centre Singapore



National Heart
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National
Neuroscience Institute



Singapore National
Eye Centre



SingHealth
Community Hospitals



Polyclinics
SingHealth

Disclosure

I have no conflict of interest to declare.

Developing a Cellular Therapy Ready Nursing Team

- Issues to address:
 1. Lead team
 2. Knowledge
 3. Skills
 4. Application
 5. Translation
 6. Quality Assurance

1. Lead Team

- Responsible for the curation & upkeep of the cellular therapy nursing team.
- SOPs, training, practice standards, accreditation.
- Ensuring credibility of lead team members:
 - Observer / apprenticeship
 - Continuous education
 - Collaborate



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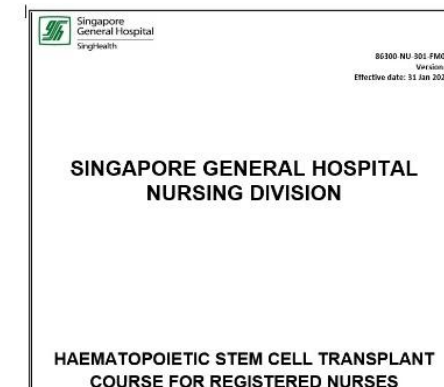
Singapore General Hospital
Nursing Operational Guidelines

Title: Training and Development for New Apheresis Staff	Document No: 86300-CL-001	Page 1 of 8
Issuing Department: Haematology Date Revised: 29 July 2022 Version Number: 5	Approved By: Aloysius Ho Yew Leng, Program Director, HCTTP	

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Singapore General Hospital
Policy & Procedure

Title: Administering CAR-T Immune Effector Cells	Document No: 86300-CN-501	Page 1 of 10
Issuing Department: Haematology Date Revised: 31 Jul 2023 Version Number: 3	Approved By: Aloysius Ho Yew Leng, Program Director, HCTTP	



2. Building Knowledge 1

Patient's CAR-T Journey

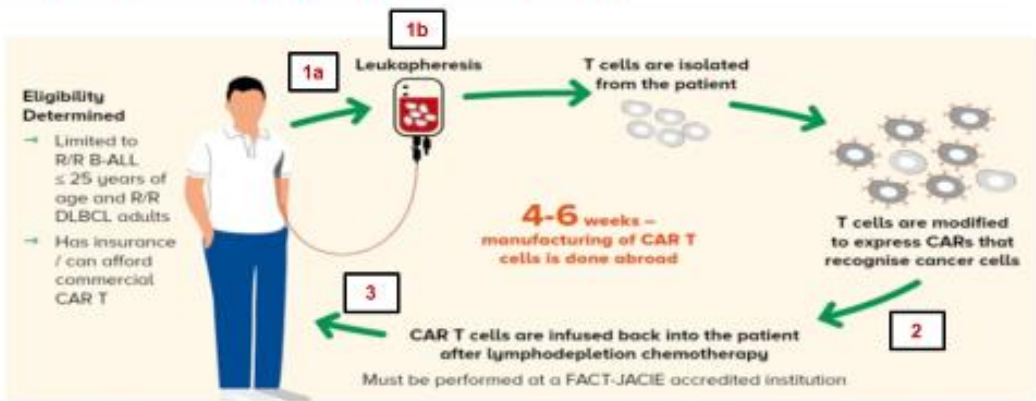
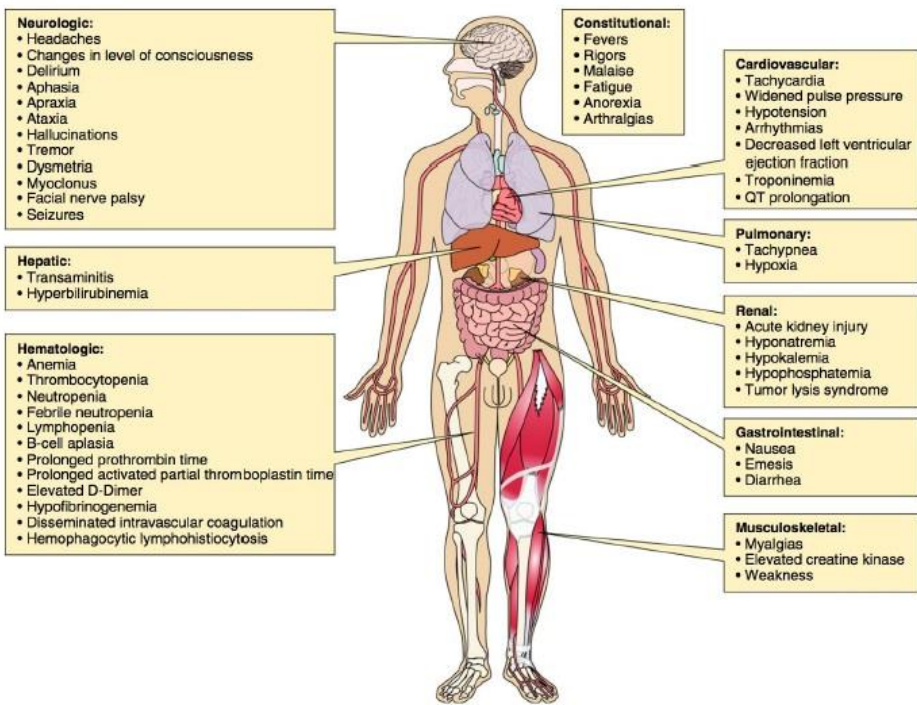


Figure 1 The CAR T workflow at the Singapore General Hospital Department of Haematology



Potential CAR-T Therapy Effects/ Complications



Lee, Blood, 2014

2. Building Knowledge 2

A. CRS & ICANS Risk & Occurrence of Products

Table 5
CAR-T Toxicity Profiles by Grading Scale Used

Cell Product	Malignancy	CRS Grading Scale	CRS, %	Neurotoxicity, %
Tisagenlecleucel	Pediatric ALL (n = 75) [7]	Penn	All: 77% Grade ≥ 3: 46%	All: 40% Grade ≥ 3: 13%
	Pediatric ALL (n = 255) [25]	ASTCT	All: 55% Grade ≥ 3: 16%	All: 27% Grade ≥ 3: 9%
	DLBCL (n = 111) [8]	Penn	All: 58% Grade ≥ 3: 22%	All: 21% Grade ≥ 3: 12%
	NHL (n = 155) [25]	ASTCT	All: 45% Grade ≥ 3: 5%	All: 18% Grade ≥ 3: 5%
	NHL (n = 28) [44]	Penn	All: 57% Grade ≥ 3: 18%	All: 39% Grade ≥ 3: 11%
Axicabtagene ciloleucel	Aggressive NHL (n = 101) [9]	Lee	All: 93% Grade ≥ 3: 13%	All: 64% Grade ≥ 3: 28%
	Aggressive NHL (n = 298) [26]	ASTCT	All: 91% Grade ≥ 3: 7%	All: 69% Grade ≥ 3: 31%
Lisocabtagene maraleucel	Aggressive NHL (n = 91) [12]	Lee	All: 42% Grade ≥ 3: 2%	All: 30% Grade ≥ 3: 10%
Brexucabtagene autoleucel	MCL (n = 68) [11]	Lee	Any: 91% Grade ≥ 3: 15%	All: 63% Grade ≥ 3: 31%
Idecabtagene vicleucel	MM (n = 128) [13]	Lee	Any: 84% Grade ≥ 3: 5%	All: 18% Grade ≥ 3: 3%

NHL indicates non-Hodgkin lymphoma.

M. Alexander et al. / Transplantation and Cellular Therapy 27 (2021) 558–570

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B. Grading of Cytokine Release Syndrome

Grading System	Grade 1	Grade 2	Grade 3	Grade 4
ASTCT criteria [14]	Temperature >38 °C not attributable to any other cause with no hypotension or hypoxia	Temperature >38 °C not attributable to any other cause with either hypotension not requiring vasopressors and/or hypoxia requiring low-flow nasal canula <6 L/min	Temperature >38 °C not attributable to any other cause with either hypotension requiring one vasopressor with or without vasopressin and/or hypoxia requiring high-flow nasal canula >6 L/min, facemask, nonrebreather mask, or Venturi mask	Temperature >38 °C not attributable to any other cause with either hypotension requiring multiple vasopressors (excluding vasopressin) and/or hypoxia requiring positive pressure (CPAP, BiPAP, intubation, or mechanical ventilation)

M. Alexander et al. / Transplantation and Cellular Therapy 27 (2021) 558–570

C. Scoring of ICE & Grading of ICANS

Table 7
Comparison of CARTOX-10 and ICE Scoring Tools

Tool	CARTOX-10 [47]	ICE [14]
Orientation	Orientation to year, month, city, hospital, president/prime minister of country of resident: 5 points	Orientation to year, month, city, hospital: 4 points
Following Commands	—	Ability to follow simple commands (“Show me 2 fingers” or “Close your eyes and stick out your tongue”): 1 point
Naming	Ability to name 3 objects (eg, point to clock, pen, button): 3 points	
Writing	Writing: ability to write a standard sentence (eg, “Our national bird is the bald eagle”): 1 point	
Attention	Ability to count backwards from 100 by 10: 1 point	

Neurotoxicity Domain	Grade 1	Grade 2	Grade 3	Grade 4
ASTCT [14]				
ICE score	7–9	3–6	0–2	0 (patient is unarousable and unable to perform ICE)
Depressed LOC	Awakens spontaneously	Awakens to voice	Awakens only to tactile stimulus	Patient is unarousable or requires vigorous or repetitive tactile stimuli to arouse; stupor or coma
Seizure	N/A	N/A	Any clinical seizure focal or generalized that resolves rapidly or nonconvulsive seizures on EEG that resolve with intervention	Life-threatening prolonged seizure (>5 min); or repetitive clinical or electrical seizures without return to baseline in between
Motor findings	N/A	N/A	N/A	Deep focal motor weakness such as hemiparesis or paraparesis
Elevated ICP/cerebral edema	N/A	N/A	Focal/focal edema on neuroimaging	Diffuse cerebral edema on neuroimaging; decerebrate or decorticate posturing; or cranial nerve VI palsy; or papilledema; or Cushing’s triad

M. Alexander et al. / Transplantation and Cellular Therapy 27 (2021) 558–570

D. Availability of anti-IL6, steroid orders



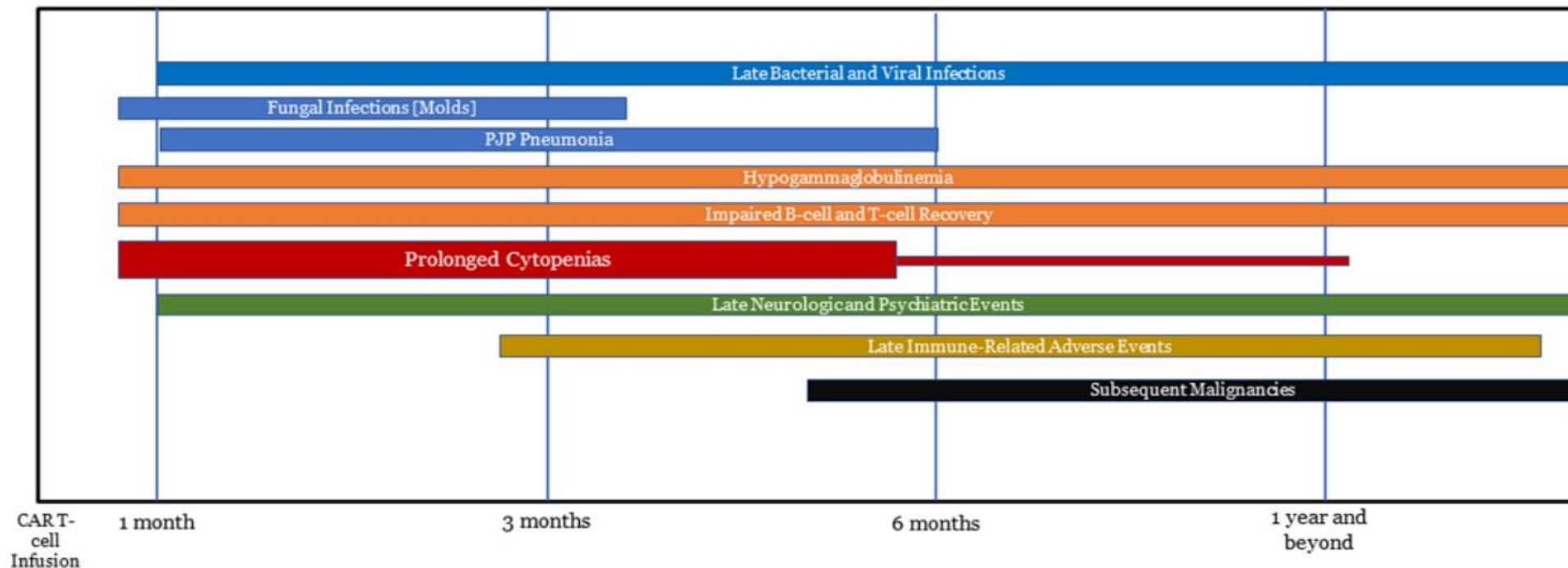
2. Building Knowledge 3

Managing patients

1. Post discharge care advise – patient / caregiver
 - Educate on potential delayed toxicities and home precautions
 - Responding to adverse events
2. Normalcy of living
3. Psycho-emotional challenges
4. Financial challenges
5. Social media
6. Life-long partnership

2. Building Knowledge 4

- Persistence & durability of remission after CAR T cell therapy.
- Potential late effects post CAR-T therapy:



Transplant Cell Ther. 2021 March ; 27(3): 222–229.

Figure 1.
Time-line of Late Toxicities with CAR T-cell Therapy.

2. Building Knowledge: How we can help.

- Create easy reference 'CHEAT' sheets.
- Examples:

Managing CRS

9.5 Initial Management

CRS Grade	Treatment
1	Septic work up and empirical treatment for febrile neutropenia, Paracetamol 1g QDS, monitor fluid status
2	Hypotension: fluid bolus 500mls x 2 if refractory escalate to grade 3 treatment within 2 hours, low flow nasal cannula, consider Tocilizumab for elderly patient and/or significant comorbidities
3	Managed in ICU, fluid resuscitation, Noradrenaline, Tocilizumab 8mg/kg +/- corticosteroids Methylprednisolone 1-2mg/kg BD or Dexamethasone 10mg Q6H, repeat dose Tocilizumab 8 hours later if no improvement
4	Managed in ICU, multiple vasopressors, ventilation, Tocilizumab 8mg/kg, Methylprednisolone 1-2mg/kg BD or Dexamethasone 10mg Q6H, repeat dose of Tocilizumab 8 hours later if no improvement

Attending to ICANS

Recommendations for management of CAR-T-cell-related encephalopathy syndrome (CRES)

Grade 1	Vigilant supportive care; aspiration precautions; intravenous (IV) hydration Withhold oral intake of food, medicines, and fluids, and assess swallowing. Convert all oral medications and/or nutrition to IV if swallowing is impaired Avoid medications that cause central nervous system depression: Low doses of lorazepam (0.25–0.5 mg IV every 8 h) or Haloperidol (0.5 mg IV every 6 h) can be used, with careful monitoring, for agitated patients Neurology consultation Fundoscopic exam to assess for papilloedema MRI of the brain with and without contrast; diagnostic lumbar puncture with measurement of opening pressure; MRI spine if the patient has focal peripheral neurological deficits; CT scan of the brain can be performed if MRI of the brain is not feasible Daily 30 min electroencephalogram (EEG) until toxicity symptoms resolve; If no seizures are detected on EEG, continue Levetiracetam 750 mg every 12 h, If EEG shows non-convulsive status epilepticus, treat as per algorithm in Table 4 Consider anti IL6 therapy with Tocilizumab 8mg/kg*IV or Siltuximab 11mg/kg IV, if CRES is associated with concurrent cytokine-release syndrome (CRS)
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The EU CAR-T Handbook

START



Editors:

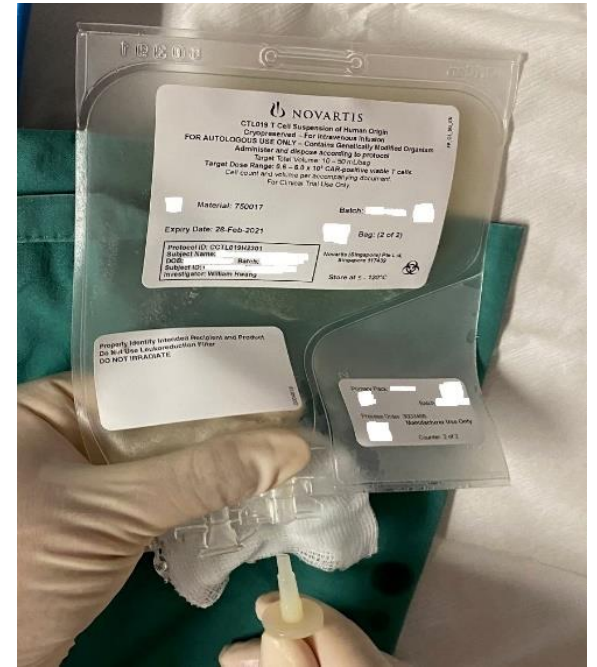
Mahmoud Aljurf, Chiara Bonini, Christian Chabannon (editor-in-chief), Julio Delgado, Martin Dreyling, Jurgen Kuball, Annalisa Ruggeri, Marion Subklewe and Anna Sureda

Project Lead:

Isabel Sánchez-Ortega

3. Skill Competence

- Chemotherapy administration & handling competency
- Central venous line access competency
- Cellular product administration competency
- Anti-IL6 / anti-IL1 administration competency



CD19 CAR-T



BCMA CAR-T

3. Skill Competence

Title: Administering CAR-T Immune Effector Cells	Document No: 86300-CN-501	Page 7 of 8
Issuing Department: Haematology Date Revised: 5 April 2021 Version Number: 1	Approved By: Aloysius Ho Yew Leng, Program Director, HSCTP	

Table 1: Vital Signs / Mentation Monitoring Schedule:

Legend: T: Temperature, PR: Pulse Rate, RR: Respiratory Rate, Pulse oximetry: SPO2.

Note: More frequent vital signs monitoring may be required if patient becomes febrile, unwell, haemodynamically unstable, or altered mental state.

	CAR T cells	CIK cells / DLI / MSC
Pre-infusion	1. T, PR, RR, BP, SPO2 2. ICE score & ICANS grading	T, PR, RR, BP, SPO2
During infusion	1. T, PR, RR, BP, SPO2: - Every 5 mins x 6 readings, - Every 15 mins till completion of infusion 2. Observe for changes to mental states / seizures	1. T: At 15 mins, 30 mins, & 60 mins 2. PR, RR, BP, SPO2: - Every 5 mins x 6 readings, - Every 15 mins x 2 readings
Post infusion	1. T, PR, RR, BP, SPO2: - Hourly x 6 readings, - 4 hourly if well 2. ICE score & ICANS grading: every 8 hourly till patient discharge. 3. Observe for changes to mental states / seizures	1. T, PR, RR, BP, SPO2: - Inpatient: Hourly x 4 readings, then 4 hourly if well. - Outpatient: Hourly x 2 readings then home if well.

3. Skill Competence : How we can help.

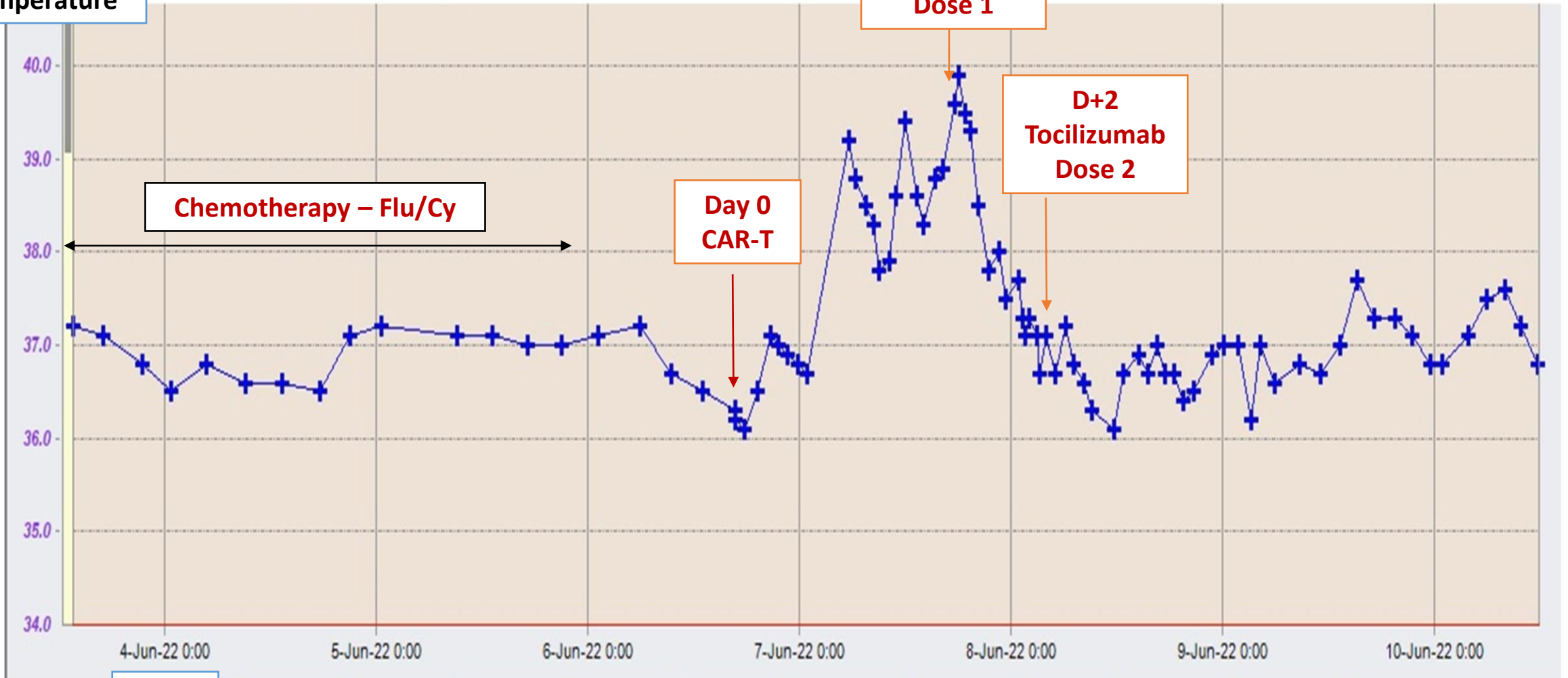
- Create easy reference 'CHEAT' sheets & escalation pathways.
- Examples:

Appendix A: Potential Adverse Reactions and Management Strategies:

Adverse Reactions	Management Strategies
Allergic reaction, Anaphylaxis	Stop infusion. Inform Doctor promptly. Administer antihistamines or aggressive life support as ordered.
Bradycardia	Close vital sign monitoring and slow infusion. Inform Doctor promptly. Administer treatment as ordered.
Chest tightness	Close vital sign monitoring and slow infusion. Administer oxygen if saturation decreased. Run ECG. Inform Doctor promptly. Administer treatment as ordered.
Chills/ Rigors	Close vital sign monitoring and slow infusion. Inform Doctor promptly. Administer treatment as ordered. Septic work up.
Dyspnea	Close vital sign monitoring and slow infusion. Administer oxygen. Inform Doctor promptly. Administer treatment as ordered.
Erythema, Rash	Close vital sign monitoring and slow infusion. Inform Doctor promptly
Fever	Close vital sign monitoring and slow infusion. Inform Doctor promptly Serve antipyretics if not administered prior to infusion. Septic work up.

4. Application to Practice 1

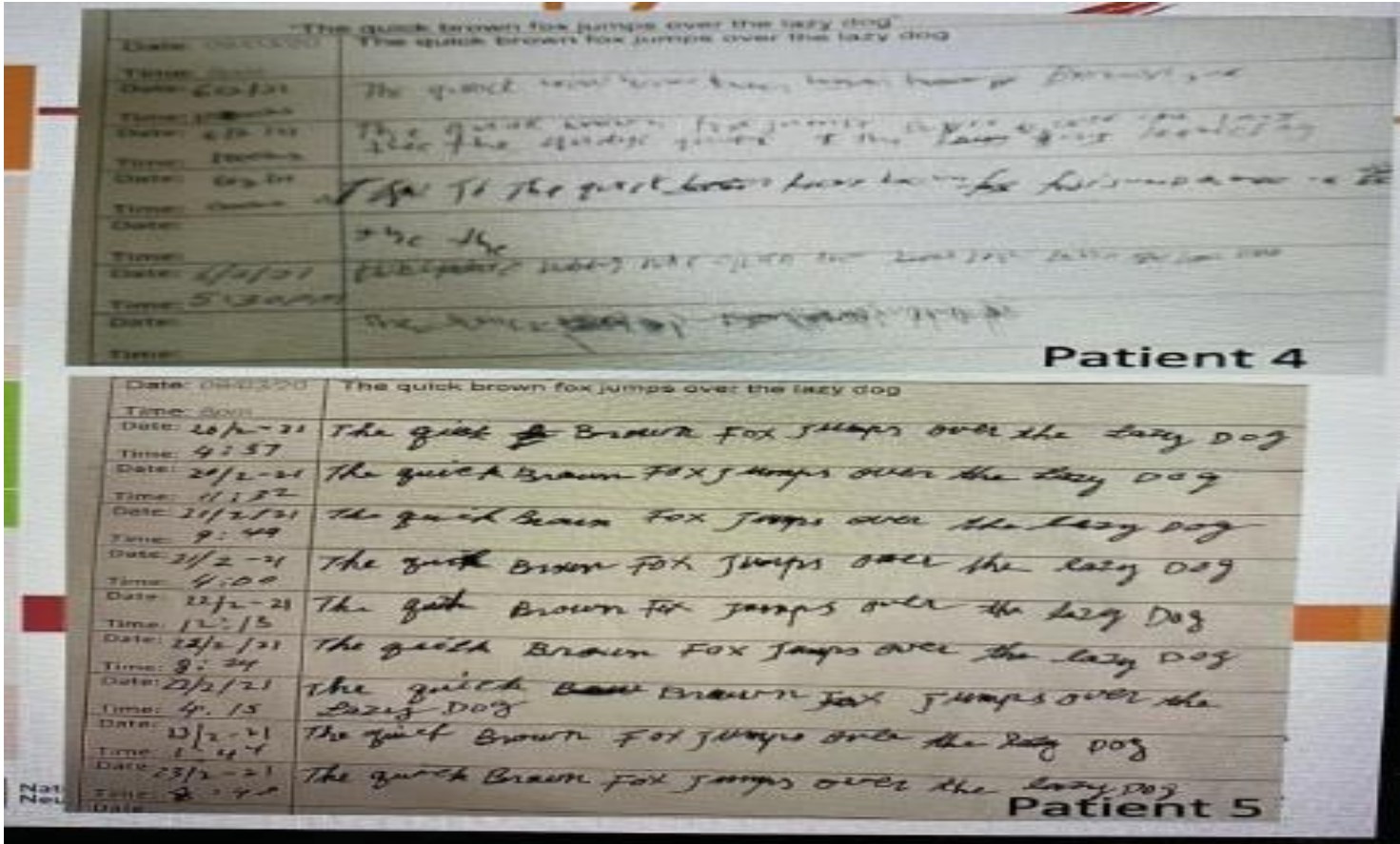
Temperature



Date

4. Application to Practice 2

Changes in Handwriting



Pictures from Dr Francesca Lim

5. Translation of Practice

1. Innovative care delivery
2. Role expansion & extension
3. Centre of Excellence



4. Publications



Seminars in Oncology Nursing
Volume 40, Issue 3, June 2024, 151628



Advanced Practice Nursing and CAR-T Cell Therapy: Opportunities, Challenges and Future Directions

Daniel Kisielewski ^a, Matthias Naegele ^b

[Clin Hematol Int.](#) 2022 Sep; 4(3): 75–88.

Published online 2022 Jul 8. doi: [10.1007/s44228-022-00004-8](https://doi.org/10.1007/s44228-022-00004-8)

PMCID: PMC9263804

PMID: [36131128](https://pubmed.ncbi.nlm.nih.gov/36131128/)

The EBMT Immune Effector Cell Nursing Guidelines on CAR-T Therapy: A Framework for Patient Care and Managing Common Toxicities

[Rose Ellard](#),¹ [Michelle Kenyon](#),² [Daphna Hutt](#),³ [Erik Aerts](#),⁴ [Maaïke de Ruijter](#),⁵ [Christian Chabannon](#),⁶ [Mohamad Mohty](#),⁷ [Silvia Montoto](#),⁸ [Elisabeth Wallhult](#),⁹ and [John Murray](#)¹⁰

[J Adv Pract Oncol.](#) 2020 Sep-Oct; 11(7): 757–763.

Published online 2020 Sep 1. doi: [10.6004/jadpro.2020.11.7.8](https://doi.org/10.6004/jadpro.2020.11.7.8)

PMCID: PMC7646631

PMID: [33575070](https://pubmed.ncbi.nlm.nih.gov/33575070/)

The Role of Advanced Practice Providers and Telemedicine in Reinventing Care: The Transition of a CAR T-Cell Transplantation Program to the Outpatient Setting

[Kiersten LeBar](#), DNP, MMHC, APRN, CPNP-AC,¹ [Sarah Murawski](#), MPAS, PA-C,² [Sherlyn Umayam](#), MSN, AGACNP-BC, AOCNP®,² and [Virginia Quinn](#), MSN, AGACNP-BC²

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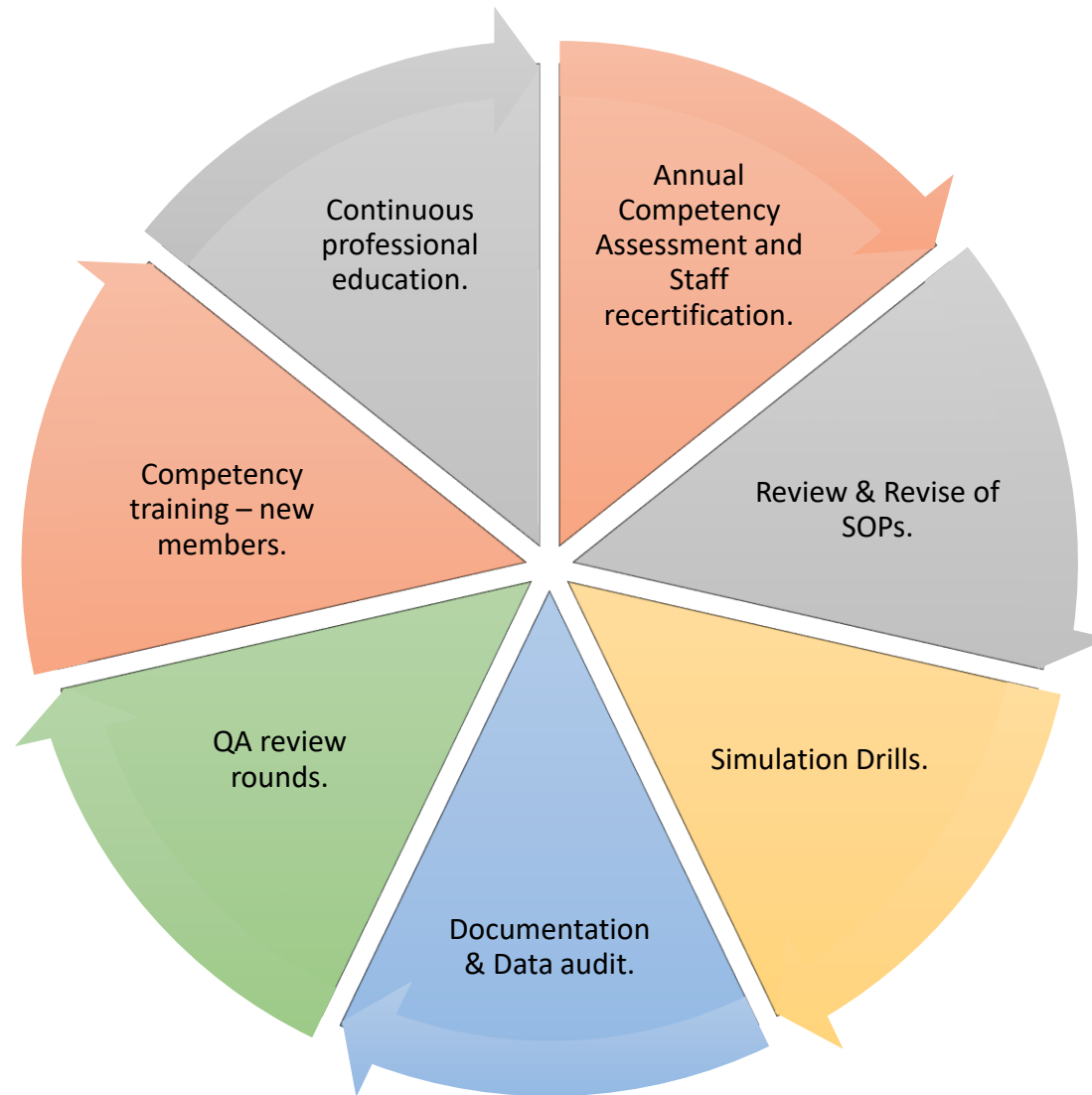
The Lancet Hamatology

Nursing impact on the CAR-T cell landscape

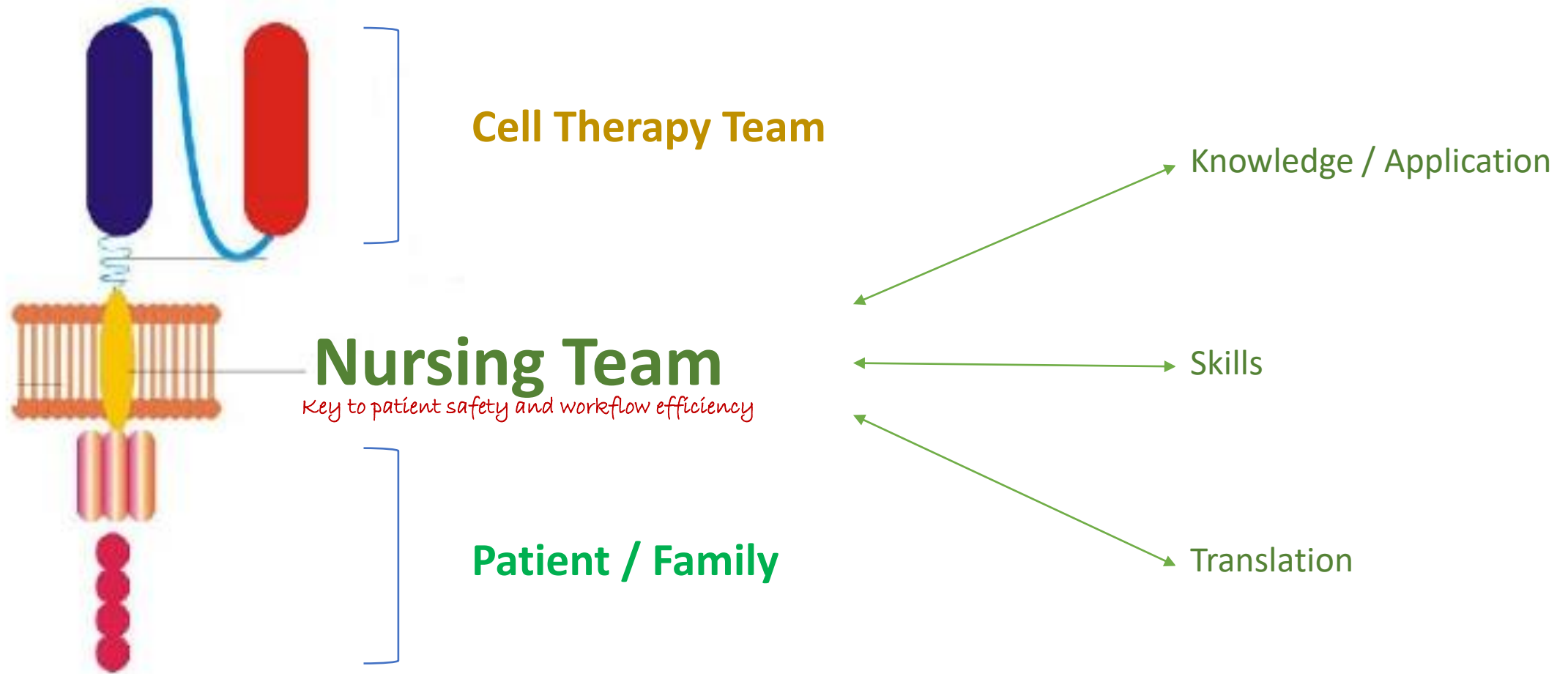
[Kathleen McDermott](#) • [Lauren Spendley](#)

Published: March, 2020 • DOI: [https://doi.org/10.1016/S2352-3026\(20\)30033-8](https://doi.org/10.1016/S2352-3026(20)30033-8) •

6. Quality Assurance



Cellular Therapy Service



[Remodeled CAR T-Cell Therapy Causes Fewer Side Effects - NCI \(cancer.gov\)](#)

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Thank You

Email: Jordan.hwang.c.c@sgh.com.sg



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