

## GERIATRIC ONCOLOGY

### **BREAKTHROUGH**

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to Treat Moderate to  
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**SPARK by NCIS** is published by the National University Cancer Institute, Singapore (NCIS).

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MCI (P) 058/09/2021

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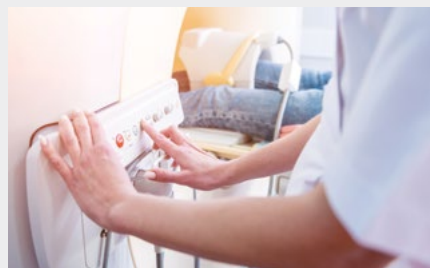
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### NCIS CANCER FUND

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Dear SPARK readers,

Welcome to the 9<sup>th</sup> issue of *SPARK by NCIS*, updated with a new and sharper look! In this issue, we showcase our Geriatric Oncology service. This multi-disciplinary team incorporates geriatric and oncology principles in their holistic care for this frail group of patients which is growing as our population ages. Using screening tools to comprehensively assess and guide treatment decisions and with extra support, older adults with cancer are able to receive their treatment tailored to their level of fitness.

In this busy year where hospital bed utilisation remains high, NCIS has ramped up its Urgent Care Clinic (UCC) services at NUH Medical Centre, Level 9 to see patients with acute illnesses or side effects related to treatment. This clinic led by our Advanced Practice Nurses (APNs) has provided another avenue for our patients to seek help when they are unwell and reduce Emergency Department attendance and hospital admissions. To use this service, our patients can call the NCIS CancerLine to make their appointments.

On the research front, we have discovered that not only chemotherapy treats cancer, our breakthrough section highlights research showing that chemotherapy may be repurposed to treat Covid-19 as well. In our CSI showcase section, we look into improving outcomes with new treatment combinations to overcome resistance in HER2 positive breast cancers. Breast cancer remains the top cancer amongst females in Singapore.

One of the goals of *SPARK by NCIS* newsletter since its first publication in 2016, is to highlight the various training programmes at NCIS. As an academic cancer centre, NCIS is the training ground of many cancer sub-specialities. In the education section of this issue, we take a look at the training of our radiation oncologists who are specialists in radiation therapy. Radiation therapy is a crucial component of cancer treatment and in Singapore, NCIS provides radiation therapy services at the National University Hospital, Ng Teng Fong General Hospital, Tan Tock Seng Hospital and Khoo Teck Puat Hospital.

As we are now living with Covid-19, we encourage all our eligible cancer patients to be vaccinated and for those vaccinated, to get their booster shots. If still in doubt, check out our special feature section on page 20 where we bust the myths of Covid-19 and cancer. Despite the pandemic, we have been very fortunate to provide uninterrupted cancer care to our patients at NCIS, and we continue to strive to do so with the new norms of life by working together with our patients and their caregivers. So let's protect ourselves, our loved ones and each other against Covid-19 by getting vaccinated!

With best wishes,

**Dr Chee Cheng Ean**

Senior Consultant  
Chief Medical Editor

**“ Despite the pandemic, we have been very fortunate to provide uninterrupted cancer care to our patients at NCIS, and we continue to strive to do so with the new norms of life by working together with our patients and their caregivers. ”**





# REPURPOSING CHEMOTHERAPY

## to Treat Moderate to Severe Covid-19 Patients

The Covid-19 pandemic has been raging globally for almost 2 years and as of 5<sup>th</sup> November 2021, the cumulative number of confirmed Covid-19 cases has almost reached 250 million, with deaths at a total of more than 5 million. While most people have a mild form of the illness, a sub-population of infected cases, typically the elderly and those with underlying conditions including cardiovascular disease and cancer, are susceptible to developing a severe form of Covid-19. This severe form is characterised by systemic hyperinflammation and respiratory distress, often resulting in multi-organ failure and death. Severe Covid-19 cases require intensive care and oxygen, placing a strain on the healthcare infrastructure in many places. While vaccines are effective in reducing the likelihood of severe Covid-19, they are not universally available and thus there remains a need to develop new medical treatment strategies to prevent the progression from mild to severe Covid-19.

There are several medical therapies that have been tested to reduce the morbidity and mortality in patients with moderate/severe Covid-19. These include anti-virals such as Remdesivir and Molnupiravir, as well as anti-inflammatory agents such as Dexamethasone, Tocilizumab, Sarilumab and Baricitinib. However apart from Dexamethasone, most of the other agents are expensive, not widely available, and several patients deteriorate despite these treatments.

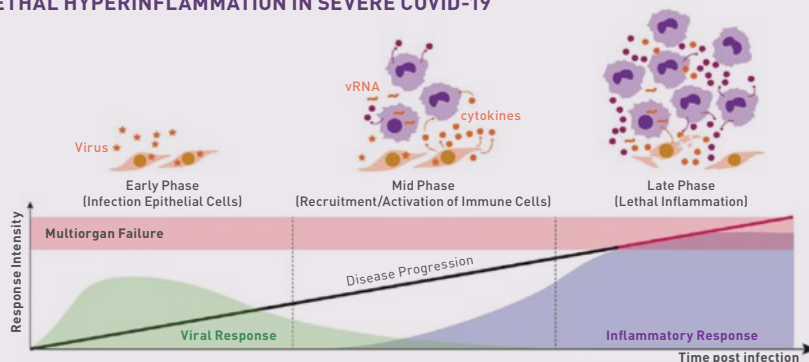
A potential solution to address this gap in therapy was discovered several years before the pandemic

by Dr Ivan Marazzi at Icahn School of Medicine at Mount Sinai in New York. In 2016, his team discovered that inhibition of the DNA unwinding enzyme, Topoisomerase 1 (Top1), suppressed the transcription of genes involved in the inflammatory response to microbial infection. They have subsequently verified in pre-clinical models that Top1 inhibition also blunts the inflammatory response induced by SARS-CoV-2, the virus responsible for Covid-19.

Top1 inhibitors are a widely used class of chemotherapeutics for cancer treatment. Given that the dose of Top1 inhibitor required to suppress the viral inflammatory response was much lower than that given to cancer patients, the possibility of using such drugs to treat moderate to severe Covid-19 patients was immediately apparent. To understand the feasibility and clinical ramifications of administering a chemotherapeutic to Covid-19 patients, Dr Marazzi consulted our team at NCIS.

With Dr Marazzi as a collaborator, we obtained funding from the National Medical Research Council (NMRC), Singapore, to carry out a clinical trial incorporating low doses of a Top1 inhibitor, Topotecan, into the current Covid-19 management regimen (Remdesivir and Dexamethasone). We opted to run the trial in India, which at that time had almost 5 million confirmed cases with approximately 80,000 confirmed deaths, versus approximately 60,000 confirmed cases and only 27 deaths in Singapore. The trial was initiated in March this year at the Christian Medical College (CMC), Vellore - with NCIS as the sponsoring institution.

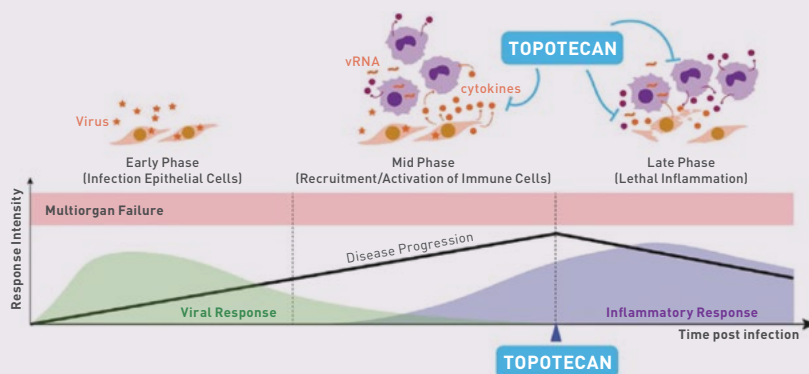
## LETHAL HYPERINFLAMMATION IN SEVERE COVID-19



*\*Diagram depicting the disease progression over time in severe Covid-19 patients following viral infection.*

*(Top) The initial viral response to infection is followed by a delayed inflammatory response that can result in multi-organ failure.*

## PROTECTION FROM LETHAL HYPERINFLAMMATION BY LATE TOPOTECAN THERAPY



*(Bottom) Administering Topotecan can blunt the inflammatory response preventing multi-organ failure. Diagram from Ho, J. S. Y. et al. TOP1 inhibition therapy protects against SARS-CoV-2-induced lethal inflammation. Cell 184, 1-15, doi:10.1016/j.cell.2021.03.051 (2021).*

Reprinted from Cell; Volume 184, Issue 10; Jessica Sook Yui Ho, Bobo Wing-Yee Mok, Laura Campisi, Tristan Jordan, Soner Yildiz, Sreeja Parameswaran, Joseph A. Wayman, Natasha N. Gaudreault, David A. Meekins, Sabarish V. Indran, Igor Morozov, Jessie D. Trujillo, Yesai S. Fstkhyan, Raveen Rathnasinghe et al.; TOP1 inhibition therapy protects against SARS-CoV-2-induced lethal inflammation; P2618-2632; Copyright 2021; with permission from Elsevier.

Currently we are in the phase I stage with the primary goal of identifying a suitable Topotecan dose to be carried forward into phase 2, taking into consideration pharmacokinetics and toxicities. Our initial results demonstrate that low-dose Topotecan administration does not affect white blood cell counts, and may even reduce the duration of oxygen support. The next stage, phase 2, will involve a randomised clinical trial designed to establish whether this treatment regimen is superior to the current management strategies of moderate to severe Covid-19.

The economic cost of treating Covid-19 is high for both hospitals and patients and therefore both will benefit from therapies specifically designed to reduce Covid-19 associated hyperinflammation. Furthermore, substituting expensive therapies such as Tocilizumab with a low-cost chemotherapeutic like Topotecan makes this such treatment available to poorer, developing countries. Indeed, this trial has garnered worldwide interest.

We believe that should Topotecan be found to be effective in treating moderate to severe Covid-19 patients, this will be a landmark development: an effective and low-cost method available to all, that saves lives and relieves the strain on healthcare institutions worldwide. We eagerly await the outcomes of this trial.



Article by:

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Dr Anand D. Jeyasekharan is clinician-scientist and Consultant Medical Oncologist at the Department of Haematology-Oncology, NCIS. He is also Assistant Professor at the Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore and Principal Investigator at Cancer Science Institute of Singapore, National University of Singapore. Dr Jeyasekharan has a clinical interest in identifying and developing novel drug combinations for relapsed lymphoma. His laboratory focus is on understanding the intracellular determinants through which DNA damaging anti-cancer agents regulate the immune milieu in tumours. The long-term objective of these lines of his research is the rational design of immunotherapy/ chemotherapy combinations for clinical trials in lymphoma.



Article by:

**Dr Jocelyn Thng Yu Qing**

Resident

Department of Internal Medicine  
National University Hospital

Dr Jocelyn Thng Yu Qing graduated from the Yong Loo Lin School of Medicine, National University of Singapore and is currently a 2<sup>nd</sup> year resident training in the Department of Internal Medicine at the National University Hospital.



# LOW DOSE RADIATION THERAPY

Epithelial ovarian cancer is the most lethal amongst the gynaecological malignancies. Close to 75% of women who present with this advanced-stage disease will eventually suffer a relapse and resistance to platinum-based chemotherapy. Radiation to the whole abdomen has been shown to be effective for ovarian cancers, however, its use has been limited by toxicity from the radiation, such as nausea, diarrhoea and myelosuppression. These side effects are worsened if chemotherapy is given concurrently.

In preclinical experiments, low dose radiation of (50cGy x 4 fractions) enhanced cell death as compared to a single high dose fraction of 200cGy. The mechanism of action is hypothesised to be from the first dose fraction arrest of cells in the radiosensitive G2/M phase of the cell cycle and subsequent fractions resulting in the cell death. While low dose radiation may not be immediately lethal to the cell, unrepaired DNA damage and genomic instability are prevented from accumulating by triggering apoptosis, thus leading to a relative increase in cell death.

The taxane family of microtubule inhibitors has been hypothesised to be synergistic with low dose

radiotherapy, due to their action in stabilising and inhibiting disassembly of microtubules, arresting cancer cells in the radiosensitive G2/M phase. By enriching the proportion of tumour cells in G2-phase, this allows evasion of the early G2/M checkpoint, allowing inappropriate transition of radiation-damaged cells into mitosis, carrying with them unrepaired double-stranded DNA breaks and resulting in mitotic catastrophe. The combination of taxanes with low-dose fractionated radiation has been studied in several preclinical experiments of colorectal cancer, head and neck cancer, as well as ovarian cancer.

We hypothesised that weekly Paclitaxel with Low-dose Fractionated Whole Abdominal Radiotherapy (LDFWART) as a chemotherapy-sensitiser could improve both abdominal and systemic disease control in patients with platinum resistant ovarian cancer. In this phase I trial, we aimed to evaluate the combination of weekly Paclitaxel and LDFWART to determine the maximum tolerated dose and dose-limiting toxicities of this combination, as well as to evaluate for preliminary signals of clinical activity.

This was a prospective, single-arm, dose de-escalation phase I study conducted in two parts. In Part A, patients received de-escalating doses of Paclitaxel as a 60-minute infusion, weekly, on days 1, 8, 15, 22, 29 and 36 in combination with LDFWART. Patients with histologically confirmed high-grade serous (HGS) subtype of ovarian cancer were recruited for Part B of the study to confirm dose safety and efficacy (see Figure 1).

Patients were eligible if they had histologically confirmed epithelial ovarian cancer, primary peritoneal carcinoma or fallopian tube carcinoma, which was platinum-resistant, defined as experiencing disease progression following platinum therapy of less than 6 months.

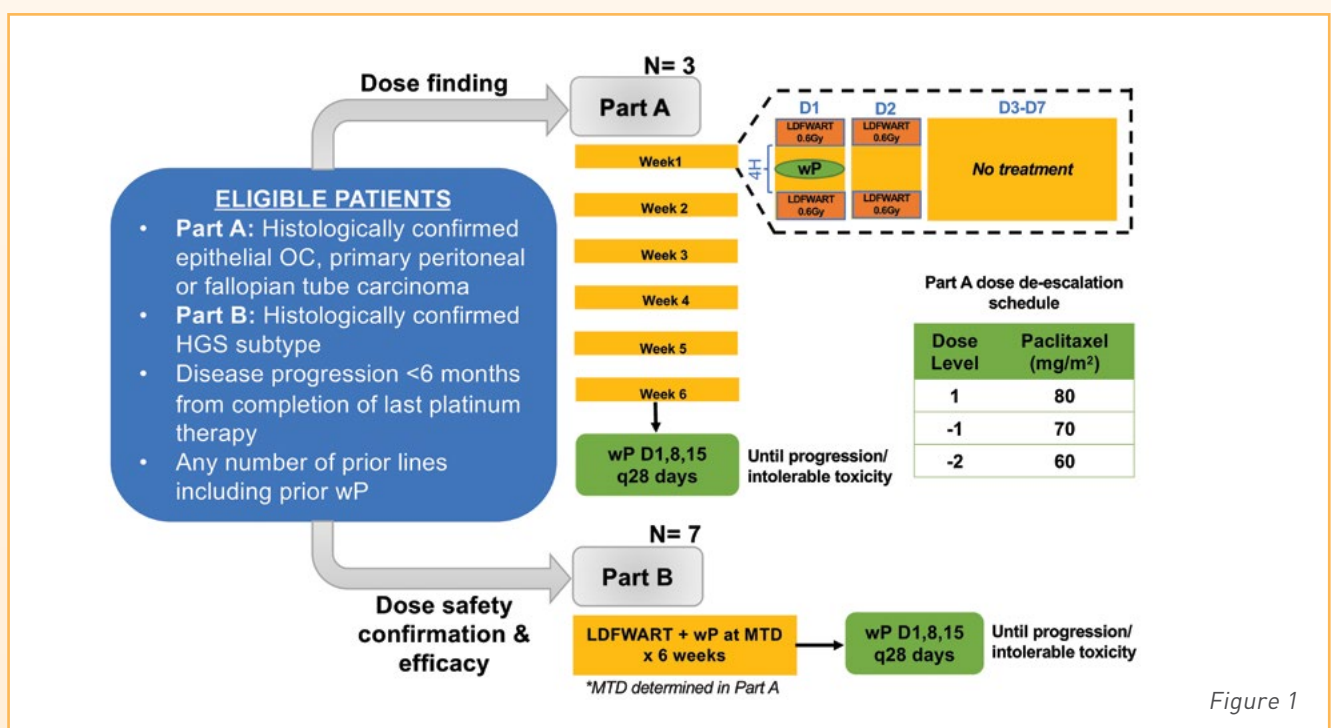


Figure 1

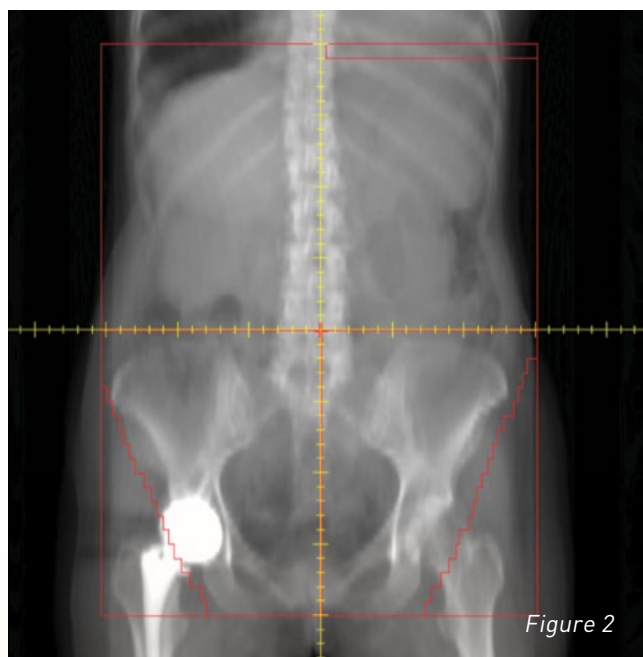


Figure 2

Pre-planned dose levels were Paclitaxel 80 mg/m<sup>2</sup>, 70 mg/m<sup>2</sup> and 60 mg/m<sup>2</sup> weekly. LDFWART was administered as 0.6 Gy fractions, twice-daily, with a minimum 4-hour inter-fraction interval, on days 1-2, 8-9, 15-16, 22-23, 29-30 and 36-37 during the 6-week period to a total dose of 14.4 Gy in 24 fractions. The clinical target volume for the radiotherapy included the entire peritoneum from the diaphragm to the pelvic floor, encompassing both the visceral and parietal surfaces as well as the pelvic and para-aortic lymph nodes. Large anterior and posterior fields of 10 MV photons were used (see Figure 2).

The first 3 patients were recruited to the planned dose-level of Paclitaxel 80 mg/m<sup>2</sup> weekly. If 0 out of 3 initial patients in the highest dose 80 mg/m<sup>2</sup> cohort developed any dose limiting toxicities, that dose of weekly Paclitaxel would be declared as the maximum tolerated dose as well as the recommended phase II dose.

Adverse events and safety were assessed using the Common Terminology Criteria for Adverse Events (CTCAE) Version 4.03. In the event of any dose limiting toxicity, treatment would be delayed until the toxicity was no longer clinically significant, and treatment could be resumed after dose adjustments were made, if it continued to be safe in the Investigator's opinion. Treatment delays of up to 2 weeks at a time were allowed and was resumed when severe toxicities had resolved to baseline, and the following haematological criteria were met: ANC  $\geq 1.0 \times 10^9$  /L and platelet  $\geq 80 \times 10^9$  /L, prior to each treatment. LDFWART was not administered if a dose of weekly Paclitaxel was withheld for any reason during the 6-week period of combined therapy, given the hypothesis that it functions as a chemotherapy-sensitiser.

Treatment assessments were performed using physical examination, serum CA125 and cross-sectional imaging with computed tomography (CT) scan of the thorax, abdomen and pelvis pre-study. Measurable tumour responses were defined by Response Evaluation Criteria in Solid Tumours (RECIST), version 1.1. The disease

control rate (DCR) was defined as the proportion of patients achieving partial response (PR) or stable disease (SD)  $\rightarrow$  6 weeks. Biochemical responses were defined by Gynecologic Cancer Intergroup (GCIG) criteria.

60% (6/10) of patients completed 6 weeks of wP+LDFWART. 10 patients received at least 1 week of LDWART. The median inter-fraction interval on days of LDFWART was 7 hours (range 4 – 9 hours). Reasons for premature discontinuation of wP+LDFWART included disease progression (3 patients; 75%) and non-treatment related death (1 patient; 25%). Upon completion of 6 weeks of wP+LDFWART, 5/6 patients continued with weekly Paclitaxel for additional 3-18 weeks after the initial 6-week treatment with wP+LDFWART.

We found the of maximum tolerated dose of weekly Paclitaxel was 80mg/m<sup>2</sup>. 9 patients were evaluable for response. 1 patient achieved an objective partial response, while 5 patients achieved stable disease as best response. The median progression free survival for all 10 patients was 3.2 months (95% CI 0.7- 5.6 months, standard error (SE) 1.3 months), and median OS was 13.6 months.

LDFWART with weekly Paclitaxel for 6 weeks was safe and tolerable with primary toxicities of myelosuppression, gastrointestinal complaints and fatigue. The maximum tolerated dose as well as the recommended phase II dose was 80mg/m<sup>2</sup>.

Our study is limited by the small population of patients involved, but the encouraging efficacy seen in this heavily pre-treated population suggests that LDFWART may be useful in the treatment of ovarian cancer. Additional questions remaining unanswered include the benefit and tolerability of LDFWART being continued beyond the initial 6 weeks, and the question of whether subsequent LDFWART with Paclitaxel rechallenge may be beneficial upon progression. It is hoped that future studies using this established recommended phase 2 dose backbone will lead to improved outcomes for women with this challenging disease.

**Dr Vicky Koh**

Consultant  
Department of Radiation Oncology  
National University Cancer Institute,  
Singapore

Dr Vicky Koh is a Consultant in the Department of Radiation Oncology at NCIS and an Assistant Professor at Yong Loo Lin School of Medicine at the National University of Singapore. She is a associate faculty at the Singapore Institute of Technology. She was awarded the HMDP and the AMDA awards for postgraduate training at the Royal Adelaide Hospital and the Peter MacCallum Cancer Centre respectively. She also completed a fellowship in paediatric oncology at KK Women's and Children's Hospital. Dr Koh currently leads the paediatric subspecialty in radiation oncology. Her subspecialty and research interests are in paediatric, breast and gynaecologic cancers.

# GERIATRIC ONCOLOGY

A cancer diagnosis is difficult for anyone, but it is especially challenging in an older person also living with multiple comorbidities, functional limitations or cognitive impairment.

The specialised NCIS Geriatric Oncology service understands these areas of vulnerabilities and the impact they have on an older adult's life. By incorporating geriatric and oncology principles, this integrated specialty provides a better understanding of the interface between physiological ageing and cancer, and hence allows better provision of personalised care for older adults with cancer.

Our multi-disciplinary team works with each patient and their caregiver to provide individualised holistic cancer management plans and interventions to support them along their cancer journey. By doing so, we can advocate for our patients to receive appropriate cancer treatment while maintaining their quality of life and also provide support for patients' caregivers.

This service has been available in both National University Cancer Institute, Singapore (NCIS) and Ng Teng Fong General Hospital (NTFGH) since 2019.

## The GOLDEN (Geriatric Oncology LongituDinal End to eNd) Programme

The GOLDEN programme is an end-to-end service provided by the NCIS Geriatric Oncology team. The programme comprises:

- A Comprehensive Geriatric Assessment (CGA) of an older patient's fitness for cancer treatment and tailoring the treatment according to each individual's suitability
- A Management and Innovation for Longevity in Elderly Surgical patient (MILES) pre-rehabilitation programme for patients planned for cancer surgery to achieve optimal post-surgery recovery
- Tailored interventions by a multi-disciplinary team of geriatricians, oncologists, oncology nurses, care coordinators, medical social workers, dietitians, pharmacists, physiotherapists and occupational therapists
- Close follow-up via telehealth during their cancer treatment to check on their health status and to manage the side effects of treatment
- Survivorship follow-up to co-manage challenges faced by cancer survivors, other comorbidities and geriatric syndromes



Components of a Comprehensive Geriatric Assessment



DOMAIN	ASSESSMENT
Comorbidities	<ul style="list-style-type: none"> <li>Past medical and surgical history</li> </ul>
Cognition	<ul style="list-style-type: none"> <li>Mini-Cog test</li> <li>Clock-Drawing test</li> <li>Mini-Mental Status Exam (MMSE)</li> <li>Montreal Cognitive Assessment (MoCA)</li> </ul>
Functional Ability	<ul style="list-style-type: none"> <li>Basic Activities of Daily Living (BADLs)</li> <li>Instrumental Activities of Daily Living (IADLs)</li> <li>Timed-Up &amp; Go (TUG)</li> <li>Fall assessment</li> <li>Vision and hearing assessment</li> </ul>
Medication Reconciliation	<ul style="list-style-type: none"> <li>Polypharmacy</li> <li>Adherence to medication</li> <li>Administration technique</li> <li>Immunisation history</li> </ul>
Nutrition	<ul style="list-style-type: none"> <li>Weight loss in the past 6 months</li> <li>3-minute nutrition screening</li> </ul>
Psychological State	<ul style="list-style-type: none"> <li>Distress scale</li> <li>Geriatric Depression Scale (GDS)</li> </ul>
Social Support	<ul style="list-style-type: none"> <li>Home environment</li> <li>Social activities and support network</li> <li>Caregiver</li> <li>Financial status</li> </ul>



### The benefits of the GOLDEN programme

- Personalised treatment tailored to suit older cancer patients according to their fitness level and functional status
- One-stop centre with a multi-disciplinary team for management of issues unique to older adults with cancer
- Support for caregivers of older adults with cancer
- Long term survivorship follow-up to address unique issues faced by older adults with cancer

Our pilot study assessed the potential impact of this programme upon the quality of life of patients and caregivers' burden for patients receiving chemotherapy/radiation therapy, comparing their baseline scores and that at 3 months post-therapy. The results revealed that for patients, there was an improvement in the functional domains of social functioning and emotional functioning. In terms of symptoms, there was an improvement in patients who had insomnia and constipation at the time of presentation. Patients who cited financial difficulties also had their concerns addressed adequately.

Since the commencement of the GOLDEN programme, we have screened 1,133 patients, of whom 941 (83%) were suitable for it. 640 (68%) were referred by their physicians, and 610 (95%) patients had required interventions of which 565 (92%) of them had undergone the interventions recommended. 82% of the patients were satisfied with the programme and 57% reported an overall improvement in their quality of life.

### Adaptation of the GOLDEN Programme During the Covid-19 Pandemic Using A Hybrid Telehealth Model

During the Covid-19 pandemic, it was necessary for healthcare systems to reduce the number of clinic visits for vulnerable older patients and turn to alternatives such as telehealth to continue to provide medical care for these patients.

However, as some members of the older adult population in Singapore have limited digital literacy, this has also proved to be a challenge in the implementation of full telehealth measures in the care of the elderly population.

Our GOLDEN programme had to adapt a hybrid telehealth model to be able to continue caring for our patients.

A CGA and medication reconciliation is performed by our nurses, coordinators and pharmacists via telehealth a day prior to the clinic visit. And a discussion with the multi-disciplinary team is held before the patient's appointment, to help facilitate the tailored interventions required for the visit.

During phase 2 of the pandemic, there were limitations to the movements of our physicians between NCIS and NTFGH, hence we had to further adapt our hybrid telehealth clinic model.

In NTFGH, the usual combined geriatrician-oncologist consultations were transformed to a hybrid consultation with the geriatrician assessing the patient in person in NTFGH, while the oncologist joins in via a virtual platform from NCIS.

After the initial clinic visit, our geriatric oncology nurses will then follow up with the patients through scheduled telehealth phone calls to assess for toxicities related to their treatment. Subsequent geriatric oncology reviews will be conducted via telehealth, if appropriate.

Our team will then follow up with the patients who have completed their cancer treatment via telehealth or in person for cancer survivorship surveillance.

### Geriatric Oncology (GO) Clinic Visit and Follow-up

- 
**Screening of all Cancer Patients ≥ 65 years old**
  - Screening by care coordinator/nurse
  - If suitable, a memo will be issued to the primary medical oncologist to consider referring the patient to the GO service
- 
**Referral from Primary Oncologist**
  - Upon reviewing the patient, the primary oncologist can decide to refer the patient to the GO service
- 
**Day-1 Telehealth CGA and Medical Reconciliation**
  - Conducted by GO nurse and pharmacist
  - 1 day prior to GO clinic visit
- 
**Multi-disciplinary Round**
  - Frailty classification
  - Determine risk of chemotherapy-related toxicities
  - Identification of intervention and recommendations
- 
**Geriatric Oncology Consultation and Allied Health Intervention**
  - Individualised holistic cancer management plans and interventions delivered to patient and caregivers
- 
**Follow-up**
  - After initiating cancer treatment, follow-up phone calls will be conducted by GO nurse to review symptoms, toxicities and geriatric syndromes
- 
**Geriatric Oncology Review**
  - Subsequent GO reviews and surveillance follow-ups can be done via telehealth or in person

### Members of the team



**Team Lead / Medical Oncologist**  
**Dr Angela Pang**

With our strong like-minded team in the GOLDEN programme, I aspire to not only improve the outcomes for older adults with cancers, but also provide an educational platform for all

healthcare professionals to learn about how to optimise the care for our geriatric oncology population. With the lack of existing geriatric oncology research, I hope that we can provide a platform for research opportunities in the older adult population to improve the evidence base for their treatment.



**NUH Geriatricians**  
**Dr Matthew Chen & Dr Natalie Ling**

We provide clinical expertise in comprehensive geriatric assessment of older cancer patients, which is systematic, objective, holistic and has shown to be effective in identifying and addressing vulnerabilities and gaps in an older person's health status and overall care, thereby improving outcomes and making one's cancer journey less daunting and more meaningful. Through our work, we hope we can empower and influence

clinicians and patients alike in making appropriate decisions about cancer treatments. Upstream frailty screening, assessment and management should be an integral part of every older cancer patient's regular care.



**Surgical Oncologist**  
**A/Prof Alfred Kow**

Geriatric surgery is becoming a very important field as the world's population, including Singapore, is ageing rapidly. In the GOLDEN and MILES programmes, we aim to conduct robust assessment

of fitness versus frailty in our elderly surgical patients, in order to identify frail elderly patients who might benefit from peri-operative enhancement through prehabilitation, nutritional intervention, emotional psychosocial support and physical therapies. This is especially key to preserving the quality of living of elderly surgical oncology patients in our society. Through collaboration and research, we can improve the way we care for elderly patients needing major surgeries and improve their outcomes.



**Radiation Oncologist**  
**Dr Francis Ho**

As a radiation oncologist, I aspire to increase the awareness of the unique challenges and needs faced by geriatric oncology patients in the oncology fraternity. Having been the caregiver to a

family member with cancer multiple times, I see myself as a champion for these patients and their caregivers alike. I believe so much more can be done in personalising the cancer care for our geriatric oncology patients to get the best cancer outcome possible with the least toxicity, and with the appropriate cancer plan.



**Haematologist**  
**Dr Melissa Ooi**

I am a haematologist with an interest in myeloma and myelodysplasia. These conditions tend to affect older patients and as a result, I am able to provide an insight to the difficulties that older

cancer patients face. Blood cancers are more debilitating than solid organ cancers as there is an additional burden of low blood counts and the need for regular transfusions.

My goal is to help optimise patients who are receiving chemotherapy and ensure that patients remain in good health throughout their treatment. For those that are not as well, we aim to improve their fitness level, so they can continue their treatment to wellness.



**NTFGH Geriatrician**  
**Dr Nydia Camelia Mohd Rais**

My role as a geriatrician in the GOLDEN programme is to help older adults navigate cancer management.

An older person's health status is intricately intertwined with his functional, psychological, social and cognitive well-being. We integrate these into the decision-making process of cancer management to provide a holistic assessment of their health prior to and during chemotherapy. A comprehensive geriatric assessment addresses vulnerabilities and gaps in the care of the older person, optimises their health status, and increases their chances of completing treatment successfully.

There is no one-size-fits-all approach in the management of cancer and I believe the strength of the GOLDEN programme lies in our passionate team of doctors and allied health professionals who appreciate and understand the importance of tailoring cancer management for older adults.



**Advanced Practice Nurse**  
**Ms Noorhanah Mohd Said**

Being in the nursing team to care for our GOLDEN patients, we assess the older adults using comprehensive geriatric assessment to identify geriatric syndromes, predict possible toxicities and offer early tailored interventions to minimise their frequent clinic visits.

We are the bridge to the needs of our older adults in our complex healthcare system. We ensure they remain safe in the community through our proactive assessment via telehealth when they decide to embark on the journey of cancer treatment. My aspiration is to dispel the myth on ageism, because everyone deserves a chance to have their individualised treatment and to be given the best possible care.



**Care Coordinators**  
**Ms Ng Yean Shin & Ms Chun Meiling**

Navigating through the healthcare system can be challenging for anyone, especially for an older person who has to manage multiple needs with different healthcare providers. By understanding their needs, values and preferences, we can guide them through the system and bridge their care across different disciplines. We collaborate closely with a team of doctors and allied health professionals to review

and follow through with a personalised care plan that is tailored to each patient. Our goal is to deliver person-centred care where rapport and trust can be built with patients and their caregivers.



**NUH Pharmacist**  
**Ms Yao Yao**

As a pharmacist on the GOLDEN team, I review the patients' medication history, including over-the-counter medications, health supplements and vaccination history. This

allows me to identify, resolve and prevent drug-related problems. By doing so, I hope to optimise medication use and provide holistic care, while promoting medication adherence in the elderly population.



**NTFGH Pharmacist**  
**Ms Joey Chien**

My role as a pharmacist in the GOLDEN programme is to ensure that older patients with cancer are on the most suitable medications. This programme looks at the patient holistically, enabling me to identify drug-related problems and to address any concerns that the patient may have, as well as tailoring the medications to fit the individual needs of each patient. It is fulfilling to be part of this team to enable older patients with cancer to live out their best possible years.



**Medical Social Worker**  
**Ms Vivian Luah**

A cancer diagnosis can be challenging emotionally and practically, especially for an older adult.

As I believe that these older adults are experts in their own lives, I help facilitate conversations to empower them, so that they can express their wishes and preferences in their treatment plan.

If I assess that they require support in their psychosocial needs, I also provide them with financial assistance, care planning and individualised counselling. To ensure the older adults' needs are met throughout their cancer journey, I connect them with the relevant community resources and services to help them feel supported.

I am thankful to be part of this amazing and caring multi-disciplinary team, where we engage the patients and their families to deliver patient-centred care.



**Physiotherapist**  
**Ms Loy Yijun**

My role as a physiotherapist allows me the opportunity to contribute towards patients' quality of life by facilitating and improving their mobility and physical health. A great part of this responsibility lies in thoughtful assessments and translating that into collaborative rehabilitation plans, while developing an appreciation for the patient's individual needs. The beauty of the Golden programme is the consistent team effort in driving and delivering such a meaningful and comprehensive service. It is a privilege to be part of a service that seeks not just a simple cure, but works through complexities to define and support a well-lived life.



## FEATURE STORY



**Occupational Therapist**  
**Ms Ong Jie Xin**

As an occupational therapist, we look at how we can optimise our patients' functions to engage in day-to-day living and desired activities safely and independently wherever possible,

to improve their quality of life.

Through assessments, education regarding symptom management, activity adaptation and environmental modification, we aim to support these older adults with cancer and their unique set of needs through their cancer and ageing journey.

In GOLDEN, we believe that the essence of cancer care lies in personalising appropriate treatment, while also taking care of their overall well-being.



**Dietitians**  
**Ms Wong Wei Yee & Ms Sarah Lim**

Nutrition is an integral part of geriatric oncology patient care. The Golden programme involves a multi-disciplinary team to provide a holistic assessment and early identification of patients at risk of malnutrition. These patients are then seen by a dietitian who would provide further thorough nutritional assessment and tailored intervention to help correct nutritional deficiencies and optimise the nutritional status

of patients in preparation for upcoming treatments. We aspire to improve their clinical outcomes and quality of life through good nutrition.



**Administrative Executive**  
**Ms Tay Ruixian**

My role as an administrator is to support the programme lead to manage and coordinate the development of the GOLDEN programme with the various stakeholders to ensure a

smooth running process. The GOLDEN programme is a meaningful programme for both patients and caregivers, which I hope will continue to expand and become a mainstream service in the near future.

### Where to find us

The Geriatric Oncology service was developed at the National University Cancer Institute, Singapore (NCIS) and has been operational at NUH and NTFGH since 2019.

For more information, visit [www.ncis.com.sg](http://www.ncis.com.sg).



To understand more about geriatric oncology, scan the QR code or visit [www.ncis.com.sg/GO](http://www.ncis.com.sg/GO).



Article by:  
**Angela Pang**  
Consultant  
Department of Haematology-Oncology  
National University Cancer Institute,  
Singapore

Dr Angela Pang is a Consultant in the Department of Haematology-Oncology in NCIS, with a special interest in Geriatric Oncology. She is currently the lead for the NCIS Geriatric Oncology Service in NUH and NTFGH.

Dr Pang obtained her medical degrees from the National University of Singapore (MBBS), the Royal College of Physicians, United Kingdom and the Masters of Medicine Singapore. Having completed her advanced specialist training in Oncology at the NUH, she then pursued a Graduate Diploma in Geriatric Medicine at the Yong Loo Lin School of Medicine (YLLSOM) and trained in Geriatric Oncology in the Memorial Sloan Kettering Cancer Center, New York.

Upon her return, she was awarded the Singapore Cancer Society research grant in 2016 for a pilot project evaluating the practical feasibility of a comprehensive geriatric assessment in our local oncology setting.

She was one of the leads in the setting up of the NCIS Geriatric Oncology Service and also the co-principal investigator for the GOLDEN Programme supported by the Jurong Health Fund Grant.

# RADIATION ONCOLOGY TRAINING PROGRAMME

## Why Radiation Oncology?

Radiation oncology is a multi-faceted discipline which engages the whole doctor. It shares in common with other oncology disciplines the process of engaging, journeying with cancer patients and exercising clinical judgement when deciding on therapeutic options. In addition, it has a technical dimension in radiotherapy planning, which is a skill that is honed over years of experience.



## What does Radiation Oncology training encompass?

Radiation oncology training in NCIS consists of a 5-year programme accredited by the Royal Australian and New Zealand College of Radiologists (RANZCR).

The programme is broadly divided into 2 portions – Phase 1 covers radiation physics, anatomy and radiobiology, culminating in a written exam. Phase 2 covers pathology, clinical oncology and radiotherapy, culminating in both written and viva exams.

The strengths of the training programme are a clearly spelt out syllabus and training policies. There are regular assessments by training supervisors and remediation plans for those who are lagging in the programme.

Upon completion of the rigorous training programme, candidates are conferred Fellowship to the College, which is a widely recognised specialist certificate.

## Which hospitals will trainees be posted to?

Trainees are rotated to two training sites, Tan Tock Seng Hospital and National University Hospital. The sites differ in casemix, and permits trainees wide exposure

to the oncology cases they will see as a specialist. In addition, advanced trainees will spend three months in an accredited site in Australia or New Zealand to attain exposure to treatment of skin cancers.

## Is Radiation Oncology Training part of the Residency Programme?

The programme is not part of residency locally. Trainees are part of the Basic Specialist Trainee (BST)/ Advanced Specialist Trainee (AST) seamless programme which is still administered under the Joint Committee on Specialist Training (JCST), which is appointed by the Specialist Accreditation Board (SAB).

## I'm interested. How do I get started?

We recommend those who are interested to first experience radiation oncology as a MOPEX posting. You can contact the Education Director (Dr Koh Wee Yao) or Directors of Training (Dr Timothy Cheo or Dr Ivy Ng) to explore this further.

“Radiation Oncology is a specialty I fell in love with after I completed my Internal Medicine residency. It marries the science of oncology and technology with the art of personalising the radiotherapy plan for each patient. I made the career path switch with no regrets as I love my job and I come to work happy!”

**Dr Ivy Ng**

Recent graduate of the Radiation Oncology Training and Director of Training



Article by

**Dr Timothy Cheo**

Consultant

Department of Radiation Oncology  
National University Cancer Institute,  
Singapore

Dr Timothy Cheo obtained his medical degree from the National University of Singapore (MBBS). He later completed his specialist training with the Royal Australian and New Zealand College of Radiologists (RANZCR) in radiation oncology. As part of his training, he spent 6 months with Peter MacCallum Cancer Centre in Melbourne, Australia.



## A Day in the Life of a **RADIATION ONCOLOGY RESIDENT**

### **Can you describe a typical day at work?**

Radiation oncology is an outpatient-based specialty and a typical day at work would start with seeing patients in the clinic. These include new referrals, patients on follow-up, and those undergoing daily radiotherapy. Throughout the day, we also review patients on an ad-hoc basis in various settings (e.g. CT simulation room, radiotherapy machine) to manage acute issues or concerns which may affect the quality of images obtained as these are very important for planning and optimal treatment delivery. During our on-call week, we see blue letter cases referred for consideration of radiotherapy and arrange treatment for suitable cases.

In addition to clinical duties, we attend site-specific tumour board meetings of which there is at least one every day and spend time to plan patients' radiotherapy treatment by delineating target volumes and organs at risk on images obtained from CT simulation scans. Plans have to be optimised to the best possible version so patients can receive the most benefits with the least complications. This is done together as a team with the dosimetrists, physicists, and radiation therapists. Research is highly encouraged as it is an important aspect of improving clinical practice and there is excellent support within the department for those who are interested.

### **What are some skills that you have acquired during this training programme and how has this fellowship changed you as a doctor?**

I have gained valuable skills in the management of cancer with radiotherapy and it is an ongoing learning process due to its complexities and challenges. Assessing a patient's suitability for radiotherapy involves taking into account many considerations to ensure that overall benefit outweighs risks. Discussing these aspects with patients and their families can be challenging at times.

Planning radiotherapy treatment is an essential skill that I am continually trying to improve and learn from seniors. The ultimate aim is to ensure that each patient's treatment is optimised to its absolute best so that they can gain the most benefits and complete their treatment with minimal toxicities, however this comprises balancing many factors and knowing which ones have to be prioritised and what can be compromised requires knowledge and experience. I have come to realise the value of assessing our patient's preferences and to address what matters most to them when considering treatment as this can impact their quality of life.

Most recently, as part of the RANZCR radiation oncology exam preparations, I have learnt radiation physics, radiobiology and anatomy in great depths, all of which



are fundamentally important in radiotherapy and will build upon these knowledge to improve my skills and for subsequent exams.

### **Was there any specific experience or patient that really affirmed your decision to work with cancer patients?**

My first experience of working with oncology patients was at the Royal Marsden Hospital in London. I worked with Professor Ian Smith and the breast cancer team. Prof Smith was very inspiring and motivated me to pursue a career in oncology. He made me realise how much of a difference we can make in the lives of our patients and the importance of valuing quality of life every step along the way. He extended my rotation in his breast cancer team to six months (instead of the standard 2-monthly rotations through the different oncology subsites) so that I could grasp how essential continuity of care is in oncology. I found it rewarding to be able to see patients on a regular basis, building good rapport with them and their families, and going through their journey with them. They have taught me how precious life is and to appreciate every moment of it.

### **What are some personal goals and dreams that you hope to achieve?**

My personal goal is to make the most out of the training opportunities and pass the specialty exams. It has been a steep learning curve but definitely a worthwhile journey

to embark upon. Beyond exams, learning will continue as there will always be updates and advances in all aspects of treatment; from planning through to treatment delivery. I strive to provide the best possible care to my patients, balancing clinical recommendations with their best interests at heart. I hope that I can manage my time well enough to be able to contribute to research projects and learn new skills along the way.

### **Any words of advice for others who are thinking of joining the Radiation Oncology Training Programme?**

Radiation oncology is an intellectually stimulating specialty which combines clinical knowledge with constantly evolving technology, and plenty of opportunities to get involved in research. As physics is a fundamental component of radiotherapy, a good foundation and strong interest will go a long way. Good communication skills and the ability to work well in teams are essential as radiation oncology is a multi-disciplinary specialty involving close working relationship with radiographers, dosimetrists, physicists, nurses, and clinicians from other specialties. It is a rewarding specialty that allows you to make a difference in patients' lives and to be part of their journey. If you are interested in joining radiation oncology, do consider applying for a rotation to have a better taste of what is involved and also for the department to get to know you too.

#### **Dr Caryn Wujanto**

Chief Resident

Department of Radiation Oncology

National University Cancer Institute, Singapore



Big Bore RT



## Understanding Mechanisms of Resistance to HER2 Targeted Therapies and Developing Novel Combinations to Improve Outcome in

# HER2 POSITIVE BREAST CANCERS



### Introduction

About one-quarter of breast cancers over-express or amplify the HER2 gene and are driven by the HER2 signalling pathway. These cancers are very sensitive to treatment with anti-HER2 targeted drugs such as Trastuzumab, a monoclonal antibody against HER2, and Lapatinib, a small molecule tyrosine kinase inhibitor against HER2. The development of a suite of anti-HER2 targeted therapies in the last two decades has transformed the management of patients with HER2 positive breast cancer, curing more early-stage patients and prolonging the survival of advanced-stage patients. However, resistance to HER2 targeted therapies exists, either intrinsically or is acquired after treatment, resulting in a relapse in some patients with early-stage disease and inevitable death in advanced cancer patients. Understanding the mechanisms of resistance to anti-HER2 therapies can facilitate the development of novel, rational combinations in the clinic to improve treatment outcomes.

### Mechanisms of resistance to anti-HER2 targeted therapy

Among various known mechanisms of anti-HER2 drug resistance is the aberrant activation of the PI3K/AKT/mTOR pathway downstream to HER2. The use of PI3K, AKT and mTOR inhibitors have been tested to target this mechanism of resistance, but has had limited success disappointingly, in part due to negative feedback induced by these inhibitors resulting in ineffective reversal of resistance.

### PPP2R2B is a tumour suppressor protein that confers resistance to anti-HER2 therapy

PP2A is a family of tumour suppressor proteins that negatively regulates numerous oncogenic pathways including PI3K/AKT and can directly dephosphorylate AKT and mTOR targets. The PP2A family comprises multiple subunits. We used data from two public databases and correlated the breast cancer expression of 18 PP2A subunits with patient survival. PPP2R2B

stood out among 18 PP2A subunits as the one whose expression was most significantly associated with survival in HER2 positive breast cancer, but not in other subtypes of breast cancers; low PPP2R2B expression was associated with poorer survival. Using clinical samples from a therapeutic trial that was conducted at NCIS, we found newly diagnosed HER2 positive breast cancer patients who had low tumour PPP2R2B expression to be less likely to respond to anti-HER2 therapies. We also found tumour PPP2R2B expression to be significantly lower in HER2 positive metastatic lesions from patients who have failed Trastuzumab treatment, compared to that in primary, untreated HER2 positive breast cancers. Collectively, these observations suggest low tumour PPP2R2B expression to be more common in HER2 positive tumors that have poor survival, have metastasised, have prior Trastuzumab exposure, and that are resistant to conventional anti-HER2 therapies.

### Low tumour PPP2R2B expression is associated with intrinsic resistance to HER2-targeted therapies

We studied PPP2R2B expression in 3 HER2+ breast cancer cell lines in the laboratory and found correlation between PPP2R2B expression and sensitivity to HER2 targeted therapies. One cell line BT474 has high PPP2R2B expression and is very sensitive to HER2 targeted therapies, while the other two cell lines SKBR3 and UACC812 have low PPP2R2B expression and are resistant. Artificial induction of PPP2R2B expression in the intrinsically resistant SKBR3 cell lines restored their sensitivity to HER2 targeted therapies. Conversely, artificial knockdown of PPP2R2B in intrinsically sensitive BT474 cell lines caused them to be resistant to HER2 targeted therapies.

### Finding a way to control the expression of PPP2R2B as a strategy to reverse resistance to HER2 targeted therapies

Previous reports have shown that PPP2R2B can be silenced by an epigenetic mechanism called DNA hypmethylation. We compared the ability of three

classes of epigenetic inhibitors to increase PPP2R2B expression: DNA methyltransferase inhibitor, 5-azacytidine; histone deacetylase inhibitor, trichostatin; histone methyltransferase EZH2 inhibitor, EPZ-6438. Among these three classes of epigenetic inhibitors, only the histone methyltransferase EZH2 inhibitor increased the expression of PPP2R2B. These observations suggest that an EZH2 inhibitor can potentially be used to increase tumour PPP2R2B expression to reverse resistance to anti-HER2 targeted therapies.

#### Combining an EZH2 inhibitor with anti-HER2 therapy to enhance anti-cancer effects in HER2 positive breast cancers

We combined EZH2 inhibitor EPZ-6438 with anti-HER2 targeted therapy in the laboratory and found the combination to be very active in intrinsically resistant HER2 positive breast cancer cell lines that did not respond to single agent anti-HER2 therapy. The combination of EZ-6438 and anti-HER2 therapy was next tested in mice with intrinsically resistant HER2 positive breast cancer. While single agent EPZ-6438 or single agent Trastuzumab led to limited response, the combination effectively abrogated tumor growth in mice and was well tolerated with minimal toxicity.

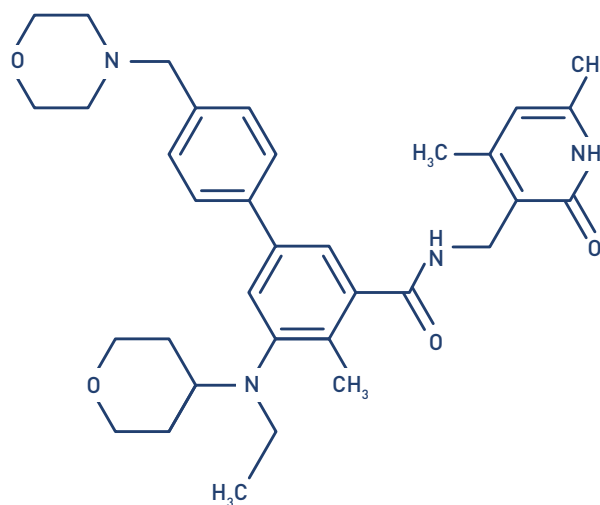
#### PPP2R2B downregulation is associated with acquired resistance to anti-HER2 therapy

To simulate the development of acquired resistance in patients following treatment pressure, we developed cell lines with acquired resistance to anti-HER2 therapy by exposing the cells to increasing concentrations of anti-HER2 targeted therapy for several months. The PPP2R2B expression of these cell lines with acquired resistance was low compared to their parental cell lines. Treatment with an EZH2 inhibitor to increase PPP2R2B expression successfully restored sensitivity of these cells to anti-HER2 treatments.

#### Clonal cellular heterogeneity accounts for acquired resistance to anti-HER2 therapy

One problem in the clinic is the development of acquired drug resistance despite initial sensitivity. This has in part been attributed to tumour heterogeneity with the emergence of resistant sub-clones following treatment pressure. While the bulk tumour may comprise largely of intrinsically sensitive clones, minority sub-clones that are intrinsically resistant can progressively expand and become dominant resulting in eventual treatment failure and patient death. In the laboratory, we studied BT474 cells which are intrinsically sensitive to anti-HER2 therapies at the single cell level. Single cells were isolated from BT474 cells and expanded into single cell-derived clones. Most single cell-derived clones from BT474 had high PPP2R2B expression and were sensitive to anti-HER2 therapy; however, two clones had very low PPP2R2B expression that could survive high doses of anti-HER2 therapy. When bulk BT474 cells were treated with trastuzumab alone, cell growth could be eliminated almost completely; however, after a period of drug wash-off, cells eventually re-grew, indicating the emergence of resistant clones. On the other hand, when bulk BT474 cells were treated upfront with EZH2 inhibitor + anti-HER2 therapy, there was minimal cell recovery

after drug wash-off, indicating that upfront combination therapy could eliminate intrinsically resistant sub-clones to prevent the eventual emergence of resistance to HER2 targeted therapies.



#### Potential clinical implications

Our results suggest that tumour PPP2R2B expression can be used as a biomarker to identify cancers that are resistant to conventional anti-HER2 therapies. An EZH2 inhibitor can be used to increase tumour PPP2R2B expression to restore sensitivity to anti-HER2 therapy. When combined upfront with anti-HER2 targeted therapy, this can potentially eliminate intrinsically resistant tumour clones and delay the emergence of acquired resistance in the clinic. EPZ-6438 or Tazemetostat has been approved by the United States Food and Drug Administration for the treatment of epithelioid sarcoma and follicular lymphoma and is now available in the clinic. It will be of interest to test this promising combination in HER2 positive breast cancer in clinical trials.



#### Professor Lee Soo Chin

Head & Senior Consultant  
Department of Haematology-Oncology  
National University Cancer Institute,  
Singapore

Professor Lee Soo Chin is also the Associate Director of Research at NCIS, Professor at the Department of Medicine, National University of Singapore, and Senior Principal Investigator at the Cancer Science Institute, Singapore. Her research focus is on early phase drug development and breast cancer. She directs the Haematology-Oncology Research Group (HORG), a cancer clinical trials unit that supports approximately 200 phase I-III therapeutics clinical trials at NCIS. She is a National Medical Research Council Singapore (NMRC) Senior Clinician Scientist Award recipient and has more than 200 peer-reviewed publications.



# APN-led URGENT CARE CLINIC (UCC)

Chemotherapy, along with new targeted therapies predispose patients to a list of potential side effects. Due to the complexity of cancer care and chemotherapy as a subset, patients with cancer often require urgent frequent reviews during the acute episodes of illness and common associated treatment toxicities such as fever, rashes, vomiting, diarrhoea and pain. Most of them seek treatment at the Emergency Department (ED) for such acute non-life-threatening illnesses.

In reality, most cancer-related symptoms or treatment-related side effects can be treated safely in the outpatient oncology setting. Nurse-led symptom review clinics are increasingly being recognised to value-add by reducing waiting time and improving organisation of cancer care. The Urgent Care Clinic (UCC) at the NCIS Ambulatory Cancer Centre was established with the primary aim of providing a comprehensive assessment and treatment in an effective and timely manner. Fully equipped with the essential knowledge and skills in oncology, the Advanced Practice Nurses (APNs) are in the best position to provide such services. This innovative cancer care strategy can reduce unnecessary ED visits that often result in hospitalisation. With the current Covid-19 pandemic, avoidance of unnecessary utilisation of ED resources and admission are crucial; hence the UCC at the oncology ambulatory setting offers a feasible alternative to manage oncology patients with unique needs.

The NCIS APN practice model adopts a hybrid model with the role of a generalist and specialist. A generalist renders care provision to a non-specific cancer group, whereas the specialist provides care to specific cancer groups like breast cancer care, colorectal cancer care, etc. This hybrid model has enabled APNs to develop their competency and confidence in breadth and in depth.

The UCC provides an ideal platform for APNs to exert the role as a generalist nurse practitioner. The APNs become the first responder to patients presenting with symptoms or complications related to disease and/or treatment toxicities. They perform a holistic assessment on symptom complaints; after which individualised patient-centric interventions are tailored for these patients, in collaboration with the physician



in-charge. These interventions not only encompass medical, but also nursing care which includes care transition and collaboration with other allied health care professionals as well as community partners. The continuity of care is preserved through a tight communication loop among the team.

Furthermore, the APNs are in a vital role in equipping patients with knowledge in recognising cancer-related signs and symptoms before they become more severe and require hospitalisation. If patients turn up acutely ill and require emergency intervention, they will be swiftly transferred to the ED to receive timely treatment.

Following the initiation of UCC service, the oncology APNs have expanded their role to cover bone marrow biopsies and the removal of pig-tailed drainage catheters.

This model allows our patients to enjoy several tangible benefits.



Firstly, care is rendered in a timely and safe manner. This also means avoidance of ED visits for non-threatening acute conditions and potential hospital admission. One such example is the management of patients with febrile neutropenia. This saves a lot of time and is potentially life-saving as these patients do not need to be admitted to the ED which is often overcrowded and may not be attended to immediately. Such accessibility and timeliness to care at UCC enhance positive patient experiences in their cancer care journey. In addition, APNs in the UCC are the first responder in managing hypersensitivity reaction at the cancer center. The timely assessment and intervention reduces the risk of severe anaphylaxis reaction.



Secondly, besides the convenience, patients enjoy lower consultation fees as compared to the cost incurred at the ED.



Thirdly, running this urgent care service allows the organisation to be leaner in resource utilisation and reduces waste. Traditionally, patients with symptoms would be required to wait for the medical doctors to review them for suitability for chemotherapy. This takes a substantial wait time and hence, a delay in timely utilisation of chemotherapy chairs. Timeliness in the decision-making of proceeding with chemotherapy is key so that resource wastage is reduced. The chair can be released to the next patient if the current patient reviewed is deemed unfit for chemotherapy.



Finally, for professional growth as a whole, UCC APNs are in a crucial position to lead and teach nurses about comprehensive symptoms assessment using real-world examples. This helps nurses apply the theories they have learnt in school or any advanced cancer care course, which will enhance their confidence and competence in managing patients within the continuum of cancer care.



APN Lee Kim Hua started her training as an oncology nurse in 2003 at the National Cancer Centre Singapore (NCCS). Managing chemotherapy side-effects and nurturing young nurses has always been her passion as an oncology nurse. A constant thirst for knowledge and skills, APN Lee pursued her Masters in Nursing (Acute Care Nurse Practitioner Programme with Oncology Minor) at the University of Pennsylvania, USA and became a full-fledged APN in 2013. After serving 17 years with NCCS, APN Lee made a move and joined NCIS in February 2020. She is now specialised in gynaecological oncology with a special interest in women's health and sexuality.



APN Ednajoy Ngo is currently an Advanced Practice Nurse at NCIS. She graduated with a Masters in Nursing from the National University of Singapore in 2012 and has 25 years of experience in the fields of oncology, haematology, neurosurgery, paediatric surgery and ambulatory services. She was the pioneering APN in symptom management service at the chemotherapy centre and was instrumental in setting up breast cancer survivorship programme.



1

**The Covid-19 vaccine is effective for patients on cancer treatment.**

**Fact.**

Studies have shown that the Covid-19 vaccine can provide protection for patients on cancer treatment. Patients with weakened immune systems may experience a weaker immune response to the vaccine but vaccination is likely able to confer some benefits. It is important for cancer patients to be vaccinated to reduce the risk and severity of a Covid-19 infection.



2

**The Covid-19 vaccine is safe for cancer patients undergoing treatment (chemotherapy, immunotherapy, targeted therapy or radiation therapy).**

**Fact.**

Studies have shown that the Covid-19 vaccine is safe for cancer patients undergoing treatment. International expert groups have recommended that cancer patients receive the Covid-19 vaccine to protect themselves.

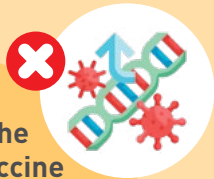
# COVID-19 AND CANCER: FACT OR MYTH?

3

**I've heard that the Covid-19 mRNA vaccine will change my DNA and make my cancer grow quickly.**

**Myth.**

mRNA never enters the nucleus of our cell where our genetic material is located, so it cannot change or influence our genes. Our cells break down mRNA and get rid of it a few days after vaccination.



4

**If I had cancer in the past or am in remission, I am unable to get the Covid-19 vaccination.**

**Myth.**

Persons with a history of cancer or who are in remission can be vaccinated.



5

**I should receive my third dose of vaccination earlier if I have active cancer.**

**Fact.**

It is recommended that cancer patients receive a third dose of a mRNA vaccine two months after the second dose. You are encouraged to discuss with your oncologist the optimal timing for your Covid-19 vaccination.





6

**The side-effects from the Covid-19 vaccine are similar to patients who are not on cancer treatment.**

**Fact.**

Side-effects are similar to those experienced by patients who are not on cancer treatment. Most side-effects of this vaccination are mild - such as pain at the injection site, muscle ache, fatigue, headache and fever, and these can last for a day or two. This is a sign of the body's normal immune system response to recognise and fight the Covid-19 virus.

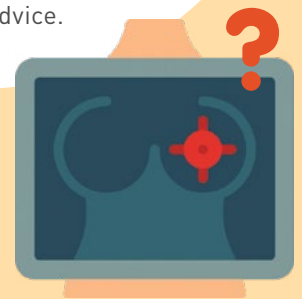


7

**The Covid-19 vaccination may affect my mammogram results.**

**Fact.**

Some patients may experience swollen lymph nodes after the vaccination. For patients with a history of breast cancer, the vaccine should preferably be injected on the opposite side of the affected breast. For the same reason, mammograms should be scheduled either before the first dose of the Covid-19 vaccine, or at least 4 to 6 weeks after the second or third dose. Discuss with your doctor if you need to go for a mammogram soon after you get the vaccine. We advise patients not to delay their mammogram without seeking a doctor's advice.



8

**I have cancer. I should take the Sinovac-CoronaVac Covid-19 vaccine.**

**Myth.**

There is limited data on the protection conferred by the Sinovac-CoronaVac vaccine against the Delta variant with rapid decline in antibody level. You are encouraged to take the mRNA vaccines in preference to the Sinovac-CoronaVac vaccine, given the higher efficacy of the mRNA vaccines. Nevertheless, the Sinovac-CoronaVac COVID-19 vaccine has been included in Singapore's national vaccination programme as a three-dose regime since October 2021.



9

**I am scheduled for a PET-CT scan and therefore, should avoid being vaccinated.**

**Myth.**

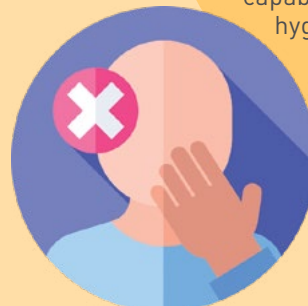
The Covid-19 vaccine is safe for patients who will be undergoing a PET-CT scan. However, some patients may experience swollen lymph nodes after the vaccination, and this may affect the PET-CT results. If possible, PET-CT scans should be scheduled either before the first dose of the Covid-19 vaccine, or at least 2 to 4 weeks after the second or third dose.

10

**After vaccination, I do not need to wear a mask.**

**Myth.**

Vaccination is only part of the strategy to protect yourself from a Covid-19 infection. You should continue to wear a mask with high filtration capability, practice good hand hygiene and appropriate social distancing.



For more information about the Covid-19 vaccination and patients with cancer, scan the QR code or visit [www.ncis.com.sg/Covid19andCancer](http://www.ncis.com.sg/Covid19andCancer).

# SPECIALIST AND TUMOUR GROUP LISTING

## BLOOD CANCERS AND BLOOD DISORDERS

### Bone Marrow and Stem Cell Transplant Programme

#### Haematology-Oncology

A/Prof Koh Liang Piu (Lead)

Dr Joanne Lee

Dr Michelle Poon

Dr Tan Lip Kun

#### Diagnostic Imaging

Dr Loi Hoi Yin

#### Radiation Oncology

Asst Prof Bala Vellayappan

#### Coagulation

#### Haematology-Oncology

Dr Chee Yen Lin (Lead)

Dr Lee Shir Ying

Dr Winnie Teo

Dr Yap Eng Soo

#### General Haematology

#### Haematology-Oncology

Dr Lee Shir Ying (Lead)

Asst Prof Liu Te Chih

Dr Clarice Choong

Dr Jen Wei Ying

Dr Joanne Lee

Dr Lee Chun Tsu

Dr Cheryl Lim Xiu Qi

Dr Lui Pak Ling

Dr Cinnie Yentia Soekojo

Dr Tan Lip Kun

Dr Winnie Teo

Dr Tung Moon Ley

#### Leukaemia, Myelodysplastic and Myeloproliferative

#### Neoplasms (MDS/MPN)

#### Haematology-Oncology

Dr Melissa Ooi (Lead)

A/Prof Koh Liang Piu

Dr Esther Chan

Dr Jen Wei Ying

Dr Lui Pak Ling

Dr Tan Lip Kun

Dr Winnie Teo

Dr Tung Moon Ley

#### Diagnostic Imaging

Dr Loi Hoi Yin

#### Pathology

A/Prof Ng Siok Bian

A/Prof Tan Soo Yong

#### Radiation Oncology

Asst Prof Bala Vellayappan

#### Lymphoma

#### Haematology-Oncology

Dr Michelle Poon (Lead)

Dr Esther Chan

Dr Chee Yen Lin

Dr Sanjay De Mel

Dr Anand D Jeyasekharan

Dr Joanne Lee

Dr Tan Lip Kun

#### Radiation Oncology

Asst Prof Bala Vellayappan

Asst Prof Wong Lea Choung

#### Diagnostic Imaging

Asst Prof Arvind Kumar Sinha

Dr Lenith Cheng

Dr Loi Hoi Yin

#### Pathology

A/Prof Ng Siok Bian

A/Prof Tan Soo Yong

Dr Susan Hue

Dr Wang Shi

#### Multiple Myeloma

#### Haematology-Oncology

Prof Chng Wee Joo (Lead)

Dr Sanjay De Mel

Dr Melissa Ooi

Dr Cinnie Yentia Soekojo

#### Diagnostic Imaging

Asst Prof Arvind Kumar Sinha

Dr Loi Hoi Yin

#### Pathology

A/Prof Ng Siok Bian

A/Prof Tan Soo Yong

#### Radiation Oncology

Asst Prof Bala Vellayappan

Asst Prof Wong Lea Choung

## BRAIN CANCER

#### Neurosurgery

A/Prof Yeo Tseng Tsai (Lead)

Dr Low Shiong Wen

Dr Sein Lwin

Dr Vincent Nga

Dr Ira Sun

Dr Teo Kejia

#### Diagnostic Imaging

Dr Andrew Makmur

Dr Tan Ai Peng

Dr Jocelyn Wong

Dr Clement Yong

#### Haematology-Oncology

Dr Yvonne Ang

Dr Andrea Wong

#### Paediatric Oncology

Dr Miriam Kimpo

#### Pathology

Dr Tan Char Loo

#### Radiation Oncology

Asst Prof David Chia

Asst Prof Koh Wee Yao

Asst Prof Bala Vellayappan

## BREAST CANCER

#### Surgical Oncology

A/Prof Mikael Hartman

A/Prof Philip Iau

Dr Shaik Buhari

Asst Prof Tang Siau-Wei

Dr Celene Ng

Dr Jesse Hu Shulin

Dr Lui Su Ann

Dr Jane Lim

Dr Lee Hanjing

Dr Yap Yan Lin

#### Diagnostic Imaging

A/Prof Quek Swee Tian

Dr Wynne Chua

Dr Eide Sterling Ellis

Dr Goh Yong Geng

Dr Pooja Jagmohan

Dr Jeevesh Kapur

Dr Premilla Gopinathan Pillay

Dr Felicity Pool

Dr Wong Ying Mei

#### Haematology-Oncology

Prof Lee Soo Chin

Dr Matilda Lee

Dr Joline Lim

Dr Lim Siew Eng

Dr Lim Yi Wan

Dr Samuel Ow

Dr Andrea Wong

#### Pathology

A/Prof Thomas Putti Choudary

#### Radiation Oncology

Dr David Chia

Dr Koh Wee Yao

Dr Vicky Koh

Dr Leong Yiat Horng

Dr Ooi Kiat Huat

Dr Tan Teng Hwee

Dr Michelle Tseng

## COLORECTAL CANCER

#### Surgical Oncology

A/Prof Tan Ker Kan (Lead)

Asst Prof Chong Choon Seng

Dr Cheong Wai Kit

Dr Lee Kuok Chung

Dr Bettina Lieske

Dr Christopher Keh

Dr Gregory Heng

Dr Ng Jing Yu

Dr Seow Choon Sheong

#### Diagnostic Imaging

Dr Bertrand Ang

Dr Amanda Cheng

Dr Wynne Chua

Dr Koh Huiliang

Dr Lim Mei Chin

Dr Low Ying Liang

Dr Thian Yee Liang

#### Gastroenterology & Hepatology

Prof Lawrence Ho

Dr Bhavesh Kishor Doshi

Dr Koh Jianyi Calvin

Dr Jonathan Lee

Dr Mark Dhinesh Muthiah

#### Haematology-Oncology

Dr Gloria Chan

Dr Chee Cheng Ean

Dr Joan Choo

Dr Ho Jingshan

Dr Raghav Sundar

Dr Tan Hon Lyn

Dr Yong Wei Peng

#### Pathology

Prof Teh Ming

Dr Jeffrey Lum

Dr Gwyneth Soon

#### Radiation Oncology

Dr Francis Ho

Dr Soon Yu Yang

Dr Tan Teng Hwee

Dr Jeremy Tey

Dr Balamurugan A Vellayappan

## GERIATRIC ONCOLOGY

Dr Angela Pang (Lead)

A/Prof Alfred Kow

Dr Matthew Chen

Dr Clarice Choong

Dr Natalie Ling

Dr Francis Ho

Dr Ng Jing Yu

Dr Melissa Ooi

Dr Nydia Camelia Rais

## GYNAECOLOGIC CANCER

#### Gynaecologic Oncology

Dr Jeffrey Low (Head)

A/Prof Arunachalam Ilancheran

Dr Lim Li Min

Dr Joseph Ng

Dr Khalil Razvi

Dr Pearl Tong

Dr Jeslyn Wong

#### Diagnostic Imaging

Dr Bertrand Ang

Dr Wynne Chua

Dr Thian Yee Liang

#### Haematology-Oncology

A/Prof David Tan

Dr Lim Siew Eng

Dr Lim Yi Wan

Dr Natalie Ngoi

#### Pathology

A/Prof Raju Gangaraju Chungal

Dr Diana Lim

#### Radiation Oncology

Dr Vicky Koh

Dr Leong Yiat Horng

Dr Michelle Tseng

## HEAD & NECK CANCER

#### Surgical Oncology

A/Prof Thomas Loh (Lead)

Dr Donovan Eu

Dr Goh Xueying

Dr Lim Wei Sian

Dr Ng Li Shia

Dr Joshua Tay

Dr Yohanes Ting

#### Diagnostic Imaging

Dr Lenith Cheng

Dr Faimee Erwan

Dr Lim Mei Chin

Dr Loi Hoi Yin

Dr Andrew Makmur

Dr Arvind Sinha

Dr Betsy Soon

Dr Tan Ai Peng

Dr Jocelyn Wong

Dr Clement Yong

#### Haematology-Oncology

Prof Goh Boon Cher

Dr Chong Wan Qin

#### Oral & Maxillofacial Surgery

A/Prof Philip McLoughlin

Asst Prof John Loh

#### Plastic, Reconstructive &

#### Aesthetic Surgery

Dr Jane Lim

Dr Yap Yan Lin

#### Radiation Oncology

Dr Francis Ho

Dr Vicky Koh

Dr Leong Yiat Horng

Dr Ooi Kiat Huat

Dr Soon Yu Yang

Dr Wong Lea Choung

Dr Balamurugan Vellayappan

**Pathology**

A/Prof Fredrik Petersson  
A/Prof Nga Min En  
Dr Wu Bing Cheng

**General Surgery**

Asst Prof Ngiam Kee Yuan  
Dr Rajeev Parameswaran  
Dr Tan Wee Boon

**Endocrinology**

Dr Chionh Siok Bee  
Dr Kathleen Sek  
Dr Samantha Yang

## LIVER, PANCREATIC AND BILARY (HPB) CANCER

**Surgical Oncology**

A/Prof Alfred Kow (Lead)  
Prof Krishnakumar Madhavan  
A/Prof Iyer Shridhar Ganpathi  
A/Prof Glenn Bonney

Dr Gao Yujia  
Dr Pang Ning Qi  
Dr Nigel Tan

**Diagnostic Imaging**

Dr Anil Gopinathan  
Dr Stanley Loh  
Dr Sheldon Ng  
Dr Pavel Singh  
Dr Mangat Kamarjit Singh

**Haematology-Oncology**

Dr Gloria Chan  
Dr Chee Cheng Ean  
Dr Joan Choo

Dr Ho Jingshan  
Dr Raghav Sundar  
Dr Tan Hon Lyn

Dr Yong Wei Peng

**Gastroenterology & Hepatology**

Prof Dan Yock Young  
Prof Lim Seng Gee  
Prof Lawrence Ho  
Dr Constantinos Anastassiades

Dr Bhavesh Doshi  
Dr Kristie Fan

Dr Calvin Koh  
Dr Lee Guan Huei

Dr Jonathan Lee  
Dr Lee Yin Mei

Dr Leo Hartono Juanda  
Dr Loo Wai Mun

Dr Low How Cheng  
Dr Mark Dhinesh Muthiah

Dr Alex Soh

**Pathology**

Dr Gwyneth Soon  
Dr Pang Yin Huei

**Radiation Oncology**

Dr Francis Ho  
Dr Leong Cheng Nang  
Dr Jeremy Tey  
Dr Balamurugan A Vellayappan

## LUNG/THORACIC CANCER

**Haematology-Oncology**

Dr Ross Soo (Lead)  
Prof Goh Boon Cher

Dr Yvonne Ang

Dr Huang Yiqing

**Cardiac, Thoracic & Vascular Surgery**

A/Prof John Tam  
Dr Li Yue

Dr Harish Mithiran Muthiah  
Dr Ooi Oon Cheong

**Diagnostic Imaging**

Dr Lenith Cheng  
Dr Loi Hoi Yin  
Dr Low Ying Liang  
Dr Sheldon Ng

Dr Ong Ching Ching  
Dr Ong Han Yang  
Dr Arvind Kumar Sinha

Dr Lynette Teo  
Dr Yee Yong Chen

**Pathology**

Dr Lau Kah Weng  
Dr Jeffrey Lum  
Dr Seet Ju Ee

**Radiation Oncology**

Asst Prof Koh Wee Yao  
Asst Prof Leong Cheng Nang  
Dr Soon Yu Yang

**Respiratory and Critical Care Medicine**

A/Prof Lee Pyng  
Dr Chan Hiang Ping  
Dr Adrian Kee

Dr Khoo Kay Leong  
Dr Jeffrey Ng

Dr See Kay Choong

## MUSCULOSKELETAL CANCER/SARCOMA

**Hand & Reconstructive Microsurgery**

Dr Mark Puhaindran (Lead)  
Dr Chan Chung Ming  
Dr Kumaran Rasappan

**Diagnostic Imaging**

A/Prof Quek Swee Tian  
Dr James Hallinan  
Dr Agrawal Sachin Nandkishore  
Dr Louise Elizabeth Pearce

Dr Salil Singbal Babla  
Dr David Sia

Dr Arvind Kumar Sinha  
Dr Tan Loon Ying

**Pathology**

A/Prof Victor Lee  
Dr Susan Hue

Dr Mok Ying Ting

**Haematology-Oncology**

Dr Matilda Lee  
Dr Angela Pang

**Radiation Oncology**

Asst Prof Timothy Cheo  
Dr Ooi Kiat Huat

Dr Tan Teng Hwee

**Paediatric Haematology-Oncology**

A/Prof Quah Thuan Chong  
Dr Miriam Kimpo  
Dr Bernice Oh

**Surgical Oncology**

Dr Cheong Wai Kit  
Dr Tan Wee Boon

## PAEDIATRIC HAEMATOLOGICAL MALIGNANCIES

**Paediatric Haematology-Oncology**

A/Prof Allen Yeoh (Lead)  
A/Prof Quah Thuan Chong  
A/Prof Tan Poh Lin

Dr Miriam Kimpo  
Dr Koh Pei Lin

Dr Shawn Lee  
Dr Bernice Oh

Dr Frances Yeap

**Diagnostic Imaging**

Dr Jeevesh Kapur

**Pathology**

A/Prof Tan Soo Yong

**Radiation Oncology**

Dr Vicky Koh  
Dr Michelle Tseng

## PROSTATE/ UROLOGY CANCER

**Surgical Oncology**

A/Prof Edmund Chiong (Lead)  
Prof Kesavan Esuvaranathan

Dr Chua Wei Jin

Dr David T Consigliere

Dr Benjamin Goh

Dr Joe Lee

Dr Lu Jirong

Dr Tiong Ho Yee

Dr Wang Ziting

Dr Wu Qinghui

**Diagnostic Imaging**

Dr Bertrand Ang

Dr Wynne Chua

Dr Stanley Loh

Dr Edwin Siew

**Haematology-Oncology**

Dr Natalie Ngoi

Dr Alvin Wong

**Pathology**

Dr Thomas Paulraj Thamboo

**Radiation Oncology**

A/Prof Keith Lim

Asst Prof David Chia

Asst Prof Jeremy Tey

Dr Ooi Kiat Huat

## SKIN CANCER

**Dermatology**

Dr Mok Zhun Rui (Lead)  
Dr Nisha Suyien Chandran

Dr Liao MeiQi May

Dr Chris Tan

Dr Adeline Yong

**Haematology-Oncology**

Dr Chong Wan Qin

**Hand & Reconstructive Microsurgery**

Dr Mark Puhaindran  
Dr Tan Kong Bing

Dr Justin Wong

**Plastic, Reconstructive & Aesthetic Surgery**

A/Prof Lim Thiam Chye  
Dr Lee Hanjing

Dr Jane Lim

Dr Yap Yan Lin

**Radiation Oncology**

Asst Prof Timothy Cheo

**Surgical Oncology**

A/Prof Thomas Loh  
Dr Ng Li Shia

## THYROID CANCER

**Surgical Oncology**

A/Prof Thomas Loh (Lead)  
Asst Prof Ngiam Kee Yuan

Dr Donovan Eu

Dr Lim Chwee Ming

Dr Rajeev Parameswaran

Dr Tan Wee Boon

**Diagnostic Imaging**

Dr Arvind Sinha

**Endocrinology**

Dr Chionh Siok Bee  
Dr Kathleen Sek

Dr Samantha Yang

**Haematology-Oncology**

Prof Goh Boon Cher

**Pathology**

A/Prof Nga Min En  
A/Prof Fredrik Petersson

## UPPER GASTROINTESTINAL CANCER

**Surgical Oncology**

Prof Jimmy So  
Asst Prof Kim Guowei

Dr Cheong Chern Yuen

Dr Lin Zhimin

Dr Aung Lwin

Dr Asim Shabbir

Dr Soon Yuen

Dr Teh Jun Liang

**Diagnostic Imaging**

Dr Amanda Joanne Cheng

Dr Lim Mei Chin

Dr Sheldon Ng

Dr Ong Han Yang

Dr Prapul Chander Rajendran

Dr Pavel Singh

Dr Joannathan Sng

Dr Yang Cunli

**Gastroenterology & Hepatology**

Prof Lawrence Ho

Dr Jonathan Lee

**Haematology-Oncology**

Dr Gloria Chan

Dr Chee Cheng Ean

Dr Joan Choo

Dr Ho Jingshan

Dr Raghav Sundar

Dr Tan Hon Lyn

Dr Yong Wei Peng

**Pathology**

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Dr Francis Ho

Dr Tan Teng Hwee

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