THIS IS WHAT *Hope* LOOKS LIKE

Volume I

*Celebrating **50 Years** of Renal Transplantation & Medicine*

Singapore General Hospital

50

THIS IS WHAT *Hope* LOOKS LIKE

Volume I

Singapore General Hospital

SingHealth

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Editors: Terence Kee, Lu York Moi and Tee Ping Sing

Singapore General Hospital
Outram Road
Singapore 169608

Tel: (65) 63214436
Fax: (65) 62202308
Email: SGH_Renal_Medicine@sgh1.com.sg
Website: www.sgh.com.sg/patient-care/specialties-services/Renal-Medicine

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Bair Hugger

Epigraph

A dream for life

We labour in fields of human misery
Our reward sometimes the death of happiness
Watching the sunset in their eyes
Amidst vanishing hopes and anguished tears
Though we may appear nonchalant
Deep within echoes yet another cry

At our harvest a pair of fresh kidneys
For two long suffering victims of renal failure
Ushering, breathing hope
Extending a lease of life
We barter the joy of life with analytics
A gain for some and loss for others

Let us refashion the dimension
To enhance a 3D imagery
Discard the disarray of DNA
Engage machine learning, robotics
Build the scaffold, symbiotic
Bionics of life renal cells

So unfold the panorama
Transform into reality
Endow the promise
Fulfillment in a shower
Of raindrops, each drop
A dream for life

Woo Keng Thye
4th September 2019

This book is dedicated to our patients, for without them,

we would not have our purpose in life.

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Foreword

This book bears testimony to what good teamwork and leadership can achieve. It is a record of milestones documenting half a century of renal medicine in Singapore as it begins its fledgling journey in the 1960s to the present 2020.

The department was conceived in an era of attap huts and pre-war government flats serving the interest of patients afflicted with kidney diseases. Its doctors were imbued with an active curiosity to elucidate the cause of asymptomatic haematuria among national service registrants at the central manpower base (CMPB). Subsequently these doctors published the initial papers on IgA nephritis, the commonest glomerulonephritis worldwide.

Spread throughout its pages, historical photographs interspersed with passages of prose recollect the development of a rudimentary but unique kampong style nephrology service to its present first world status and offers readers a glimpse of the pioneering spirit prevailing even in those early days, the same spirit which enabled the continuing success of the present generation. In the first few decades nephrology trainees were sent abroad to learn new skills and returned home to set up such skills and impart the knowledge to their peers but over the past decade the department has morphed into an academic centre of excellence and the staff now train nephrology fellows from the surrounding regions. The various chapters chart the development of the specialties in nephrology in clinical nephrology, hypertension, dialysis, transplantation and the areas of education and research involving clinical trials and translational research.

It has been said that the past binds us to our present through which we build our future. Nowhere is this true when we ponder over our achievements and the role members of our staff play as office holders or faculty members in the nephrology community at home and abroad.

We owe what we have today to the wisdom of our founding fathers, Professor Khoo Oon Teik who planted the seeds of nephrology in SGH and Dr Lim Cheng Hong who nurtured the seedlings as the founding Head of Renal Medicine. For the department's present achievements, we are also indebted to the younger heads and leaders who have brought the department to greater glory.

Our sincere thanks to Associate Professor Terence Kee, the Director of Renal Transplantation who initiated the idea for the book and Associate Professor Marjorie Foo, the previous Head of Department for her unstinting support and Associate Professor Tan Chieh Suai, the present head. Mention should also be made of Ms. Lu York Moi and Ms. Tee Ping Sing, our transplant programme managers who painstakingly coordinated efforts to collate the articles and photographs from various sources.

Professor Woo Keng Thye
Emeritus Consultant and Advisor
Department of Renal Medicine

Message from SingHealth Group Chief Executive Officer

My very warmest congratulations to the SGH Department of Renal Medicine on this momentous celebration of your 50th Anniversary. The numerous significant successes and key milestones are meticulously documented in two volumes of the Anniversary Book. These achievements have brought about many laudable improvements in patient care and outcomes.

However there are current and growing challenges to tackle and the future is bright, with deeper insights, newer diagnostic and therapeutic modalities, to accelerate the progress in the years ahead. The SGH Department of Renal Medicine is well placed to continue to lead in impactful advancements towards new horizons in renal medicine.

Professor Ivy Ng

Message from Chief Executive Officer

"This is what hope looks like."

Behind this anniversary slogan which aptly captures the impact and difference made to our patients and their loved ones, are our dedicated colleagues from across diverse disciplines – all working as one unified team, dedicated to improving the lives of our patients. My heartfelt congratulations to our Renal Transplant team for bringing hope to our patients, and presenting them with the gift of life

We have stood on the shoulders of giants to get to where we are today. They had dared to dream and to make things happen, often when there was no precedent. On this foundation, we built the expertise, capability and capacity which enabled us to carry out the first renal transplant ever performed in Singapore in 1970. Since then, successive generations and teams of colleagues have taken our renal transplant programme to greater heights.

As we celebrate the progress and journey of our renal programme over the past 50 years, the Department of Renal Medicine is also honest and courageous in sharing lessons and how these have led to improved practices and contributed to our relentless pursuit and commitment to Target Zero Harm. I am humbled by the team's strength and resilience to emerge stronger, to be better for our patients.

We are entering a new era in healthcare and in the world, deeply impacted by the COVID-19 pandemic. What remains steadfast is our unwavering commitment to our shared purpose, to put "Patients. At the Heart of All We Do."

Purpose. Passion. Courage. Grit. We are proud of our renal transplant team. We celebrate them, their dedication and professionalism on this momentous milestone.

Happy Anniversary!

Professor Kenneth Kwek

Message from
Chairman, Medical Board

Department of Renal Medicine has come a long way over the past 50 years and in many ways its progress has been one of the success stories of healthcare in Singapore. The department has evolved from providing competent clinical nephrology services within the country to a respectable academic nephrology set up that has become a thought leader in the country and the world.

One of the pinnacles of nephrology is the renal transplantation programme which celebrates its 50 year anniversary this year. Since 1970 when the first renal transplantation was performed in SGH, our patients suffering from end stage renal disease have benefited from the success of the programme with an improvement in the quality of their life.

The success of the transplant programme boils down to a committed multidisciplinary team who have worked collaboratively, keeping the patients at the heart of all that they do. Each member of the team plays an important role to collectively provide holistic clinical and psychosocial support for our patients and their loved ones. Over the years, the close relationships developed between the care team and patients have built a strong community that mutually supports and inspires each other. This is especially evident during the trying times the team faced following the Hepatitis C outbreak and more recently, the COVID-19 pandemic.

The nephrology landscape continues to evolve and look set to face many challenges with the prevalence of chronic kidney disease expected to rise. It is heartening to know that the Department of Renal Medicine continues to be at the forefront of tackling this significant disease burden. These efforts range from improving public awareness on kidney disease, addressing the importance of advanced care planning to expanding peritoneal dialysis and interventional nephrology services, exploring innovative wearable artificial kidney and extracorporeal blood purification. My heartiest congratulations to the Department of Renal Medicine on the successes achieved by the team in their journey to achieving this significant milestone.

Associate Professor Ruban Poopalalingam

Message from
Chairman, Division of Medicine

The history of organ transplantation in Singapore started with the first renal transplant in SGH in 1970. Since then, other organs have been included in the transplant list and renal transplantation has made tremendous progress along the way. This is contributed by many factors, including better understanding of transplant immunology, improved surgical techniques, improved donor management and organ preservation, and improved laboratory support. Over the years, the multidisciplinary team from SingHealth Duke-NUS Transplant Centre has built a strong programme that continues to evolve and improve. This achievement involved healthcare professionals from different background. Doctors come from many specialties, like Renal Medicine, Urology, Radiology, Anaesthesia, Intensive Care Medicine, Infectious Diseases, to name a few. Not to forget is the important contribution by our nurses, health professionals and administrators. Without the teamwork, it is not possible to achieve the current state of excellence. Ultimately, what is important is that it has translated into better patient care. Patients are at the heart of all we do, and the renal transplant team had worked hard to realise that promise. Renal transplant has become the standard of care for patients with end stage renal disease. As more patients develop renal failure due to diabetes and glomerulonephritis, the option of transplant has improved clinical outcomes and quality of life of these patients.

As we celebrate 50 years of renal transplantation, I would like to congratulate the team for their achievement and good work. I would also like to urge the team to continue to break new grounds, to bring renal transplantation to new heights, and to define tomorrow's medicine.

Associate Professor Loo Chian Min

Message from
Head of Department

Renal Transplantation is the best treatment modality for patients with End-Stage Kidney Disease (ESKD). In 1954, the first kidney transplant in the world was successfully performed in the United States between a pair of twins. With the discovery of immunosuppressants in the 1960s, the foundation of renal transplant between non-twins was laid.

In Singapore, Professor Khoo Oon Teik, Head of Medical Unit II of Singapore General Hospital (SGH), announced plans for SGH to perform kidney transplantation in 1967. Medical Unit II was one of the three Medical Units in SGH. Medical Unit II had strong expertise in renal medicine and was the precursor to the Department of Renal Medicine in Singapore General Hospital.

In 1970, the first kidney transplant in Singapore was successfully carried out in SGH. Over the next 50 years, numerous patients with ESKD and their families have entrusted their health and lives to our transplant team. Our transplant programme has not only grown to become the crown jewel and flagship programme of the Department of Renal Medicine, but also a cornerstone of the SingHealth Duke-NUS Transplant Centre.

As an academic centre, and with the unwavering support from the Department of Renal Medicine, SGH, and SingHealth, I am confident that our transplant programme will continue to grow from strength to strength. As we celebrate the 50th anniversary of the first kidney transplant in Singapore in 2020, we will continue to build on the solid foundation and great achievements that our pioneering doctors have established. We will continue to impact lives and offer the best transplant services to our patients with ESKD.

Associate Professor Tan Chieh Suai

Message from the Editors

The year 2020 was supposed to be a year filled with joyful events to celebrate 50 years of renal transplantation. We had plans to hold a photography and art exhibition, a walk with patients and their families round the Padang during one of the car-free Sundays every month, hold several education meetings for both patients and healthcare providers as well as this book. But with a stroke of bad luck, the COVID-19 pandemic hit Singapore and it turned the country upside down. Never before in the history of Singapore, did we witness empty streets and hawker stalls or thousands of people in Singapore get infected with a highly contagious virus. Some have died from the virus infection but so much more have suffered the indirect effects of the COVID-19 pandemic by losing their jobs or being separated from loved ones trapped in other countries. Despite the overwhelming impact of the COVID-19 pandemic, our healthcare system and other frontline services stood united and strong to contain the virus and permit Singapore to regain some sense of normality.

While we were busy responding to COVID-19 for the year, we remained adamant that we needed to do something to celebrate half a century of renal transplantation at SGH. The concept of this book came about 1 year ago and instead of a book focusing on renal transplantation at SGH, we agreed that renal transplantation would not have been possible without the other facets of nephrology practice at SGH. For example, transplantation would never be a success without the bridging therapies of dialysis. Transplantation would also not be sustainable if we didn't have curative or retardative therapies provided by the chronic kidney disease and glomerulonephritis programmes to reduce the number of patients needing renal replacement therapy. As a result, we decided to produce a book that will celebrate not only half a century of transplantation but of the practice of Renal Medicine at SGH. We were also motivated by the need to have a book that will be a reference for future generations of nephrologists at SGH to know the heritage of the department. The last time a book was produced documenting the historical milestones of the department was the Lim Cheng Hong Festschrift in 1996 but so much has changed since.

This book is the product of everyone in the Department. Many staff in the Department have helped to contribute articles and share their photographs for the book. Of note, we are greatly indebted to Professor Woo Keng Thye for helping us ensure the historical accuracy of the contents of the book and gracing the first pages of the book with a beautiful poem and a foreword. We are also thankful to our immediate past Head of Department, Associate

Professor Marjorie Foo who gave her wholehearted support for the book when it was conceived during her headship as well as Associate Professor Tan Chieh Suai, our current Head of Department for continuing the enthusiasm to produce this book.

It has been a momentous task to produce this book. We are indebted to our co-authors who have been receivers of many calls, text messages and emails to get their articles submitted and revised in a timely fashion. We also like to thank the SGH museum, the library services at SGH as well as at the National Library of Singapore for helping us to source difficult to find manuscripts and newspaper articles. Finally, we would like to thank our families for the time we spend away from home at our offices and the libraries to edit the articles and organise the hundreds of photographs we receive.

As we received the articles and read them, we are amazed by the richness of our heritage as well as the tenacity of our people to advance nephrology in Singapore to improve the lives of those affected by renal disease. We are also touched by the personal reflections of our staff as they share how patients motivated them to be the best of what they are. Renal Medicine would not also be possible without the greater support from other departments and we are greatly indebted to their enthusiasm to improve the care of our patients. Finally, we smile and feel touched when we see the photos of wonderful people that has sacrificed and contributed so much to the Department over the years. We hope that this book will serve as a reference text of the history of nephrology in Singapore as well as a compass to how our younger generations of nephrologists will take the Department of SGH in the next 50 years to the next level. As we embrace new advances in medicine and change the model of renal practice in Singapore, we, however, must never forget to put patients at the hearts of all we do and be beacons to them so that they will always trust us to make their lives better. This is what Hope looks like!

Associate Professor Terence Kee
Senior Consultant and Medical Director of the Renal Transplant Programme

Ms. Lu York Moi
Manager (Clinical Quality, Education and Research), Renal Transplant Programme

Ms. Tee Ping Sing
Manager (Operations), Renal Transplant Programme

Our Heritage at SGH

> *It has been said that the past binds us to our present through which we build our future.*
>
> *- Professor Woo Keng Thye*

Our Heritage at SGH

1960 to 1979

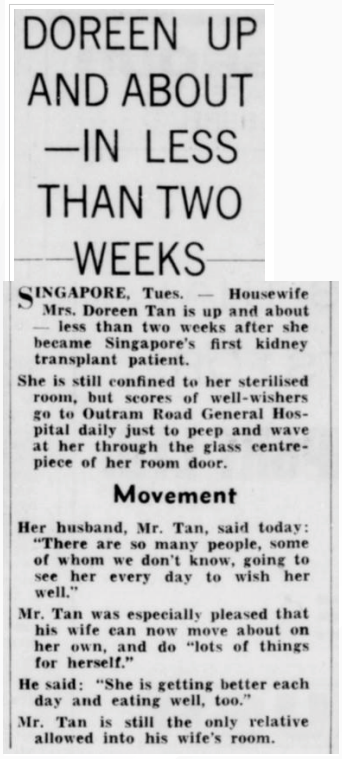
1961

- The first haemodialysis treatment in Singapore is given for a patient with acute renal failure.

1968

- An 8-bedded haemodialysis unit is set up to provide chronic haemodialysis.

A standard Kiil dialyser with mounting point required 10 hours to do dialysis where else another standard Kiil dialyser without mounting point required 15 hours to do dialysis. Each Kiil dialyser weighs 38kg. It required 350cc - 500cc of blood to prime the bloodline and dialyser. Dialysis was performed using cuprophane membranes.



DOREEN UP AND ABOUT —IN LESS THAN TWO WEEKS

SINGAPORE, Tues. — Housewife Mrs. Doreen Tan is up and about — less than two weeks after she became Singapore's first kidney transplant patient.

She is still confined to her sterilised room, but scores of well-wishers go to Outram Road General Hospital daily just to peep and wave at her through the glass centre-piece of her room door.

Movement

Her husband, Mr. Tan, said today: "There are so many people, some of whom we don't know, going to see her every day to wish her well."

Mr. Tan was especially pleased that his wife can now move about on her own, and do "lots of things for herself."

He said: "She is getting better each day and eating well, too."

Mr. Tan is still the only relative allowed into his wife's room.

1970

- The first kidney transplant in Singapore is performed from a deceased donor.
- Launch of the home haemodialysis programme, where patients perform their own haemodialysis treatments at home.

1973

- Establishment of the Department of Renal Medicine with Dr Lim Cheng Hong as the first Head of Department.

1974

- The First Asian Colloquium in Nephrology is held in Singapore by the Department of Renal Medicine.

1975

- The first Self Dependency Dialysis Unit (SDDU) is set up at Alexandra Hospital.

The first self dependency unit was set up in an abandoned old Gurkha kitchen at the Alexandra Hospital in 1975. It had a capacity for 44 patients.

1976

- The first living related kidney donor transplant in Singapore is performed.

1980 to 1989

1980

- Continuous Ambulatory Peritoneal Dialysis (CAPD) is introduced as an alternative form of dialysis.

1981

- The new SGH is officially opened by Prime Minister Mr. Lee Kuan Yew and the Department receives its own inpatient unit (ward 42).

Patients undergoing training in peritoneal dialysis during the 1980s.

Our Heritage at SGH

1983

- The second SDDU is set up at Tan Tock Seng Hospital.
- Start of the Trans-Pacific Organ Sharing Programme with the United States and Canada to increase the supply of kidneys for transplantation.

1984

- First successful childbirth by a kidney transplant recipient.

Transplant woman makes local history with baby

MORE THAN two years ago, when police officer Maznan bin Awi married Nurain binti Abdullah, he knew that she had kidney trouble.

She went for dialysis treatment for a year before she was given a kidney transplant last year. But she was told that she could not have any children.

Last Sunday, when a bouncing baby girl was born, her husband said: "I'm so happy. It's a miracle."

Madam Nurain is believed to be the first kidney transplant patient here to have a baby.

Ms. Sally Kong (standing fourth from left) with Professor Woo Keng Thye and nephrologists from both SGH and NUH come together to celebrate the 500th kidney transplant at the Bowyer Block in 1994.

1985

- Continuous arteriovenous haemofiltration is introduced to treat patients who were haemodynamically unstable and herald the development of critical care nephrology in Singapore.
- Introduction of Cyclosporine into the kidney transplant immunosuppressive regimen significantly improves patient and graft survival.

1986

- Ms. Sally Kong becomes the first transplant coordinator in Singapore.

1987

- First CAPD unit in Singapore is set up.
- End of the Trans-Pacific Organ Sharing Programme as outcomes were poor.

Sister Florence Fan was the first nurse in charge of the CAPD centre.

1988

- Cyclosporine is established as mainstay immunosuppression for kidney transplantation at SGH.

1989

- Histocompatibility testing is transferred from SGH to a national laboratory.
- Professor Woo Keng Thye takes over Dr Lim Cheng Hong as the second Head of Renal Medicine Department at SGH.

1990 to 1999

1990

- CAPD unit at SGH is designated a regional reference centre in 1990.
- Introduction of Automated Peritoneal Dialysis.
- Cyclosporine for kidney transplantation receive financial subsidies from the Government.
- Celebration of 20 years of kidney transplantation at SGH.

The CAPD unit was designated a Regional Reference Centre in 1990 by Baxter Healthcare in recognition of the high standard of PD practice it set.

Our Heritage at SGH

1991

- Living donor kidney transplantation from spouses are permitted.
- First kidney transplantation is performed in a patient with Systemic Lupus Erythematosus.

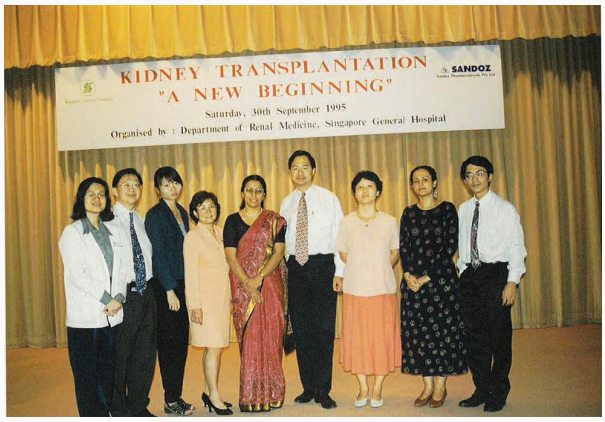
1992

- Ms. Long Chey May become the first renal medical social worker.
- The haemodialysis centre in SGH undergoes its first renovation and upgrades.
- First kidney transplantation is performed in a patient with Diabetes Mellitus.

Ms. Long Chey May is the first renal medical social worker at SGH.

1993

- CAPD unit is redesignated the PD Centre.



Ms. Lu York Moi was the first clinical transplant coordinator (standing fourth from left) and first introduced herself to kidney transplant patients at a patient education seminar.

1994

- SGH celebrates performing its 500th kidney transplant.

1995

- Ms. Lu York Moi becomes the first dedicated clinical transplant coordinator.

1996

- Appointment of Ms. Connie Yong as the first dialysis coordinator.
- SDDU programme ends and is assimilated into the Kidney Dialysis Foundation.
- Incorporation of pharmacists to accompany ward rounds of renal physicians.

Ms. Connie Yong May Chin with renal physicians at a lunch gathering.

1997

- Peritoneal dialysis becomes subsidised by the Government.

1998

- The Urology Centre opens and allows living kidney donor transplant surgeries to be performed in adjacent operating theatres to reduce cold ischemia time.

2000 to 2009

2000

- Mr. Khoji Lugasan is appointed the department's first anaemia coordinator.

Mr. Khoji Lugasan was the department's first anaemia coordinator (1st man on the right in front) and is seen here celebrating his birthday with renal and transplant coordinators.

Our Heritage at SGH

2002

- Associate Professor Wong Kok Seng takes over Professor Woo Keng Thye as the third Head of Department of Renal Medicine.
- Professor Woo Keng Thye, as Chairman of the Division of Medicine, appoints Associate Professor Lina Choong as the Director of Dialysis while Professor Vathsala Anantharaman is appointed as the Director of Renal Transplantation at SGH.
- Molecular Adsorbent Recirculation System (MARS) liver dialysis service starts.
- Everolimus becomes available as an alternative mTOR inhibitor.

Associate Professor Tan Han Khim with his team delivering the first MARS treatment in the surgical intensive care unit.

2003

- Membrane separation therapeutic plasma exchange is introduced to treat immunological diseases.

2004

- Ward 64 becomes the second ward assigned for renal inpatients.
- The PD centre at SGH moves to the old School of Nursing with expanded facilities and space to meet the demands of a growing PD population. This new PD centre was supported by the Singapore Children's Society.

2007

- Renal Health Pte Ltd is set up to provide dialysis for outpatients at SGH and allow the haemodialysis centre in SGH to dedicate its services only to inpatients.
- Solid phase assays become available to detect donor-specific anti-HLA antibodies and facilitate capability to perform high immunological risk kidney transplantation.

2008

- Professor Chan Choong Meng takes over Associate Professor Wong Kok Seng as the fourth head of Department of Renal Medicine.
- Set up of the Renal Transplant Bone Osteoporosis Clinic at the LIFE Centre (Life Style Improvement and Fitness Enhancement Centre).
- The first HLA incompatible kidney transplantation is performed using Thymoglobulin and Therapeutic Plasma Exchange.
- Associate Professor Terence Kee takes over directorship of the renal transplant programme from Professor Vathsala Anantharaman who left SGH to lead the renal transplant programme at the National University Hospital.

2009

- Replacement of Cyclosporine and Azathioprine with Tacrolimus and Mycophenolate as the mainstay immunosuppressive regimen for kidney transplantation.
- SingHealth Transplant is established with the kidney transplant programme becoming a part of the new transplant centre.
- SGH performs its first ABO incompatible living kidney donor transplant.
- SGH performs a living kidney donor transplant from one of the oldest (75 years old) living kidney donor in Singapore.
- SGH performs the first dual deceased donor kidney transplant in Singapore from an expanded criteria donor.
- Opening of the SGH Kidney Centre at Clinic M which incorporated counselling rooms, a computer booth to educate patients about renal replacement therapy options and a wall mural highlighting the department's historical milestones.

75 AND A KIDNEY DONOR

MADAM Chee Leng Yin is Singapore's oldest living organ donor after giving a kidney to her daughter. Miss Shirley Lau, 46, would have had to join a queue of more than 500 kidney patients and wait about nine years for a suitable organ. But Madam Chee stepped up, proved a suitable donor, brushed aside her daughter's protests, and the transplant went ahead. "I had to scold and persuade her," said Madam Chee, 75. ST PHOTO: CAROLINE CHIA

2010 to 2020

SGH's new haemodialysis centre after undergoing renovations.

2011

- Haemodialysis centre undergoes its second renovation.
- Acute peritoneal dialysis programme is introduced where interventional nephrologists insert peritoneal dialysis catheters.
- The department receives its first renal advance practice nurse.

2012

- Start of Glomerulonephritis Disease Management Clinic.
- Opening of the upgraded renal intermediate care unit capable to support continuous renal replacement therapies.

Our Heritage at SGH

2013

- Opening of the Transplant Centre at Block 7 Level 1.
- PD centre relocates to Renal Health Dialysis Centre at Block 4.
- High Volume Haemofiltration (HVHF) is introduced to help treat sepsis.
- Start of the SingHealth Renal Medicine Residency Programme to replace the advance specialty trainee programme in renal medicine.

It was the vision of Professor Tan Ser Kiat when he was Group CEO of SingHealth to set up a transplant centre in SingHealth which would include a physical transplant outpatient centre to serve patients from various transplant programmes. His vision came true in 2013 when he gave the opening address at the opening of the Transplant Centre.

2014

- Associate Professor Marjorie Foo takes over Professor Chan Choong Meng as the fourth Head of Department of Renal Medicine.
- Regional citrate anticoagulation (RCA) is introduced as alternative anticoagulation for continuous renal replacement therapies.
- Introduction of Renal Resident Nurses into clinical renal practice.

2015

- Start of Nephritis Clinic at the Autoimmunity and Rheumatology Centre.
- Start of the Low Clearance Clinic Programme to improve chronic kidney disease management and transition to end-stage renal failure.
- PD centre relocates again to level 1 of the Diabetes and Metabolism Centre.
- Development of the Critical Care Nephrology Team.
- Completion of the interventional nephrology suit 2 which is equipped with fluoroscopy equipment to support endovascular interventions.
- First paired kidney donor exchange in Singapore is performed between SGH and the National University Hospital.
- First outpatient kidney transplant biopsy is performed at the transplant centre.
- An outbreak of hepatitis C occurs in ward 67 where renal patients are affected.

21 patients at SGH hit by hepatitis C; MOH orders probe

Four deaths linked to viral infection; hospital says transmission of virus in ward has stopped

Salma Khalik
Senior Health Correspondent

At least 21 kidney patients have been infected with hepatitis C at Singapore General Hospital (SGH), with the needles used to inject insulin coming under scrutiny.

Eight of these patients have died, with four deaths linked to the viral infection that affects the liver. Three died of unrelated causes while a question mark still hangs over the last death.

The hospital is confident that the transmission of the virus in its newly renovated Ward 67 has stopped, said its chief executive officer, Professor Ang Chong Lye.

Health Minister Gan Kim Yong said yesterday that he was "deeply concerned" by the infection at SGH, which he was told of at the end of last month. He said: "My thoughts are with the affected patients and their families."

He has set up an independent committee to "provide a critical review of SGH's investigation and findings".

This committee, headed by Professor Leo Yee Sin, director of the Institute of Infectious Diseases and Epidemiology, is expected to complete its review in two months.

The first case surfaced on April 17, Professor Fong Kok Yong, chairman of SGH's medical board, told reporters yesterday.

But it was not till mid-May, some five cases later, that liver specialists started suspecting the infection could have occurred in the hospital.

It was not easy to spot a pattern earlier because the hospital sees three to four hepatitis C patients in a month, who often consult different liver experts.

But when it was observed that several of these hepatitis C patients were also kidney failure patients, alarm bells rang, especially since all had been warded at the hospital this year.

Tests then showed that 22 were infected with a virus of the same genotype, indicating that they were from the same source.

The 22 patients, including the possible index case, range in age from 24 years to 70 years, with the majority in their 50s and 60s. The latest case was diagnosed on Sept 18.

SGH set up a review committee but it was not able to ascertain the source, although Prof Fong said the virus was likely spread through multi-dose vials, which it stopped using throughout the hospital by June.

These vials contain more than one dose and one vial is usually shared between two or three patients, said chief nurse Tracy Ayre.

But a new needle has to be used each time the medicine – in this case, most likely insulin – is taken. The needle is then discarded.

Prof Ang yesterday apologised unreservedly to all affected patients and their families.

The hospital will pay for all necessary treatments. So far, two patients have been given newer antiviral medicine that costs $90,000.

Said Prof Ang: "We should and must take responsibility for these patients."

salma@sph.com.sg
facebook.com/ST.Salma

SEE TOP OF THE NEWS A6-7

TOP PRIORITIES

Our first priority is to extend our help and support for our patients, to ensure that their conditions are managed... and also provide support for the family members. And our second priority is to look at how we can strength our precautionary measures and safeguards to ensure that this doesn't happen again.

HEALTH MINISTER GAN KIM YONG

2016

- Implementation of urgent-start PD programme to initiate patients first on PD.
- Start of biennial Interventional Nephrology Workshop.
- Start of transplant multidisciplinary team meetings.
- Introduction of double filtration plasmaphresis as an alternative to therapeutic plasma exchange for desensitisation of highly sensitised kidney transplant candidates and those receiving ABO-incompatible kidney transplants.
- Launch of "A New Sprout of Life" Facebook community for SGH kidney transplant recipients.
- First annual end-of-year patient dinner and symposium for kidney transplant recipients which subsequently became an annual event for the department.

Transplant multidisciplinary meetings became a weekly affair with nursing staff, transplant coordinators, pharmacists, physiotherapists, dieticians and medical social workers in the early 2010s. The meetings were initially held in ward 64 tutorial room but later had to shift to bigger rooms in Academia as the team grew.

Dr Jasmine Chung (here with Associate Professor Terence Kee and Dr Sobhana DO Thangaraju) is the first transplant infectious disease physician embedded in the renal transplant programme where she is a resource personnel for transplant infectious diseases and infection control for the programme. She attends the weekly multidisciplinary renal transplant programme meetings, provides advice and consults and drive initiatives to improve the management of infectious diseases and infection control for the programme.

2017

- Start of PD multidisciplinary team meetings.
- Start of PD initiation clinic services to optimise the transition to PD for patients.
- Appointment of PD care coordinator to provide pre-PD counselling to patients.
- Prescription and monitoring for continuous renal replacement therapies go online.
- Commencement of ultrasound surveillance clinic to monitor vascular access for dialysis.
- Introduction of Glycosorb immunoadsorption for the removal of anti-ABO antibodies to facilitate ABO-incompatible kidney transplantation.
- Transplant Infectious Disease Physician becomes embedded into the kidney transplant programme clinical services.

Our Heritage at SGH

2018

- Completion of the First-in-Human safety trial of AWAK PD device at SGH.
- First use of AVF as vascular access for continuous renal replacement therapy.
- First use of Polymyxin B Haemoperfusion and oXiris adsorbing filter to remove inflammatory mediators in septic patients at SGH. It was also used to treat a patient with fulminant dermatomyositis – related fulminant interstitial lung disease.
- First concurrent use of continuous renal replacement therapies with other extracorporeal treatments e.g. centrifugal plasma exchange, extracorporeal membrane oxygenation.
- Renal supportive care multidisciplinary service is introduced to care for patients on conservative management for end-stage renal failure.

Associate Professor Terence Kee with Ms. Lai Yoke Ling who became the 1000th deceased donor kidney transplant recipient in Singapore.

The first combined urology and nephrology transplant meeting.

2018

- oXris haemofilter is used to treat sepsis associated acute kidney injury.
- SGH performs its 1000th deceased kidney donor transplantation.
- SGH performs its first HLA and ABO incompatible kidney transplant using a hybrid protocol involving double filtration plasmaphresis and Glycosorb immunoadsorption.
- The Department assists the liver transplant programme at SGH to successfully perform the first ABO-incompatible liver transplant in Singapore.
- Regional citrate anticoagulation is introduced for double filtration plasmaphresis procedures.
- First Renal Biopsy Clinicopathological Workshop is held with the Department of Pathology.
- First Transplant Nephrology and Urology Review Course is held with the Department of Urology.

2019

- The renal intermediate care unit expands its capabilities by providing inotropic support with norepinephrine for critically ill patients.
- AWAK PD receives Breakthrough Device designation by the US Food and Drug Administration.
- First use of double filtration plasmaphresis to treat neurological diseases (autoimmune encephalitis).
- Extracorporeal carbon dioxide removal (ECCO2R) with Novalung/ Prismaflex is used.
- First concurrent use of continuous renal replacement therapy with membrane separation plasma exchange in series parallel configuration for a patient with acute liver failure.

SGH new renal intermediate care area.

- Start of outreach transplant counselling services to Changi General Hospital and Sengkang General Hospital to improve uptake of transplants from regional hospitals.
- Pilot programme with NKF to train nurses to provide transplant education to SGH patients receiving dialysis at NKF.

The COVID-19 Pandemic has changed the world and it will not return back to normal like the pre-pandemic period until effective vaccines are available. Wearing a mask and social distancing are now the new norms.

2020

- COVID-19 Pandemic is declared by the World Health Organisation – the Department set up an acute respiratory ward in ward 42 to admit and screen febrile dialysis and transplant patients for COVID-19.
- SGH celebrates 50 years of kidney transplantation.
- Telemedicine takes on a wider role in the Department of Renal Medicine in response to the COVID-19 Pandemic.
- Regional citrate anticoagulation is introduced for membrane separation therapeutic plasma exchange.
- Intraoperative thymoglobulin is introduced for antibody induction of high-risk kidney transplant recipients.
- Tocilizumab is introduced to treat chronic antibody mediated rejection.
- The Renal Health Pte Ltd dialysis centre moves to SingHealth Tower at the Outram Community Hospital.

Renal Leadership in 2020

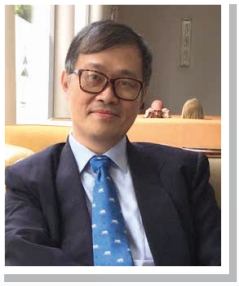
"Be fair to your patients and colleagues."

- Dr Lim Cheng Hong

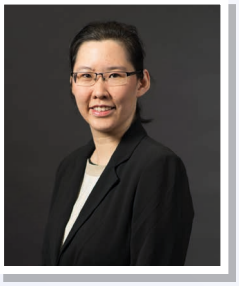
Renal Leadership in 2020

Associate Professor Tan Chieh Suai
Head of Department,
Director of Interventional Nephrology

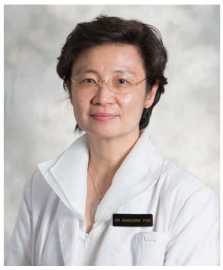
Professor Woo Keng Thye
Advisor



Associate Professor Tan Han Khim
Director of SingHealth Renal Medicine
Senior Residency Programme



Dr Sheryl Gan
Director of Haemodialysis



Associate Professor Marjorie Foo
Director of Peritoneal Dialysis

Associate Professor Terence Kee
Director of Renal Transplantation

Associate Professor Jason Choo
Director of Glomerulonephritis and
Chronic Kidney Disease,
Director of Academic Nephrology

Dr Manish Kaushik
Director of Critical Care Nephrology

Dr Cynthia Lim
Director of Research

Our People in 2020

"The renal unit at SGH is made up of highly intellectual, self-motivated, ambitious and compassionate people, who want to excel and do well by our patients."

- Associate Professor Marjorie Foo

PHYSICIANS OF THE DEPARTMENT

(Left to right)
Second row standing: Dr Alvin Tng, Dr Tan Chee Wooi, Dr Guo Wei Wen, Dr Tan Hui Zhuan, Dr Ng Rui Zhi, Dr Charles Ng, Dr Liew Zhong Hong, Dr Teh Swee Ping
First row standing: Dr Wong Jiunn, Dr Elizabeth Oei, Dr Sobhana D/O Thangaraju. Dr Teo Su Hooi, Dr Riece Koniman, Dr Phang Chee Chin, Dr Pang Su Chien, Dr Htay Htay, Dr Mathini Jayaballa, Dr Tan Ru Yu, Dr Liu Peiyun, Dr Kwek Jia Liang, Dr Ho Quan Yao, Dr Kanagasabapathy Kamaraj
Seated: Dr Sufi Muhammad Suhail, Dr Manish Kaushik, Associate Professor Jason Choo, Associate Professor Terence Kee, Professor Chan Choong Meng, Associate Professor Marjorie Foo, Professor Woo Keng They, Associate Professor Lina Choong, Associate Professor Tan Han Khim, Dr Sheryl Gan, Associate Professor Tan Chieh Suai, Dr Cynthia Lim

SENIOR NURSING STAFF

(Left to right)
NC Sumathi D/O Silva Thore, ANC (APN Intern) Huang Zhihua, SSN (APN Intern) Wang Wei, SSN Liew Sing Hui, NC Amy Lim, SNC (APN) Michelle Ng, Ms. Susan Quek (SPEM), NC (APN) Maslinna Binte Abdul Rahman, NC Li Yang, NC Ivy Liang, NC Wu Sin Yan, NC Maimunah Sim, ANC Kok Su Fong and NC Muhamamad Nadzlan Bin Rosli

HAEMODIALYSIS CENTRE

(Left to right)
Third row: NC Sumathi D/O Siva Thore, SEN Sri Narashimini Chakkaravarthy Naidu D/O Bala Subramaniam, SSN Zu Limei, SSN Yang Boyao, SSN Ye Hong En, SSN Chen Wei, Dr Wong Jiunn
Second row: SEN Khoo Liang Teck, Dr Manish Kaushik, SNC (APN) Michelle Ng, SSN Joharah Bee D/O KM Hussein, SSN Joyce Castro Vizcarra, NC Amy Lim, SSN Gay Tuo Wah, SSN Audrey Lee, NC Ivy Liang, PEN Thanalatshmi D/O Gurusamy, SSN Aladin Garing Zamora
First row: EN Aprilyn Pasco Lalusin, Associate Professor Lina Choong, Dr Sheryl Gan, SN Jeaneby Dequina Garganera

PERITONEAL DIALYSIS TEAM

(Left to right)
Standing: SSN Ng Peishi, SSN Reshmah D/O Shamsherutheen, SSN Mastera Bte Mohd, SSN Kong Lau Peng, SSN Evangeline Bahian Jacinto, SSN Cassier Kwok, PEN Ng Liting, SSN Aw Mei Yi, PEN Faezah Binte Zakaria
Seated: ANC Kok Su Fong, NC Wu Sin Yan, Dr Elizabeth Oei, Associate Professor Marjorie Foo, Dr Htay Htay, Dr Mathini Jayaballa, Ms. Pindar Yu

WARD 42

(Left to right)
Back row: NC Ng Seaw Fee, SN Saw Yu New Zin, SSN Luqman Afig Bin Latiff, SN Hsieh Pei Yun, PEN Chua Lee Yan
Front row: SNM Kan Foong Ming, NC Gladys Chong, SSN Albian Gipol, SN Nurulashikin Bente Ahmad, SN Radhakkannu Sangari, SSN Veronica Lew, SN Nur Iryanti Binte Abdul Rahim, SSN S Amala, SSN Molina George Jr Moral

WARD 64

(Left to right)
Second row: SN Yang Wen-Ru, SSN Yan Shuxia, SN Carol Jiani Li Daelo, SSN Siti Nadiah Binte Masnor, SSN Li Mengnan, SSN Siti Aisyah Binte Dolmat, PEN Siti Ruzaimah Binte Haron, SN Wu Ting, SSN Mary Antonette Adolfo Cepe, EN Nur Raffhanah
Seated: NC (APN) Maslinna Binte Abdul Rahman, ADN Leong Siew Teing, SSN Masalunga Sandra Gaong, SSN Seri Rahayu Binte Mohamed Salleh, NC Li Yang, ANC (RN) Jamaliah Binte Jamali

INTERVENTIONAL NEPHROLOGY TEAM

(Left to right)
Standing: Dr Alvin Tng, SSN (APN Intern) Wang Wei, Associate Professor Tan Chieh Suai, Dr Tan Ru Yu, Dr Shahbaj Ahmad (Fellow from India), Dr Pang Suh Chien, PEN Teng Hwee Siang, SSN Toh Zhen Jun, SSN Siti Zahirah Bte Zazali, Mr. John Frederick Cirillo Galura (Radiographer), Mr. Josef Ray Alvendia Manipor (Radiographer)
Squatting: ANC (APN Intern) Huang Zhihua, SNC (APN) Michelle Ng, ANC Wu Xinfang, NC Joyce Liu, SSN Hao Kena, SSN Fathin Aadilah Bte Azman, SN Naw Eh May Paw, SSN Ng Bao Shan, NC (APN) Maslinna Binte Abdul Rahman

DIABETES METABOLISM CENTRE

(Left to right)
Standing: PSA Irene Sng, NC Geraldine Lim, PSA Cecila Chong, PSA Kelly Ang, SPSAE Becky Teo, PSAE Joan Ng, SHCA Annie Woo, SSN Yee Leng Mui, PSA Farah Adilah Binte Jamaludin, SHA Latifah D/O Shaik Dow, PSA Jolinda Chua, PSA Kalaivili D/O K K K, PSA Florence Lee
Seating: Mr. Jeremy Lim, Dr Ho Quan Yao, Dr Manish Kaushik, Associate Professor Marjorie, Dr Riece Koniman, Dr Teo Su Hooi

LOW CLEARANCE CLINIC

(Left to right)
Standing: ANC (APN Intern), Ms. Janelle Chan (Senior Medical Social Worker), Ms. Tung Yu-Tzu (Principal Clinical Pharmacist), Ms. Ummi Hani Abdul Kader (Renal Coordinator), Ms. Hong Yun Quan Darlene (Programme Coordinator), Dr. Sim Mui Hian (Principal Clinical Pharmacist), SNC (APN) Chan Yoke Ling, Ms. Yong Pay Wen (Dietitian), Ms. Thian Ai Ling (Senior Dietitian), Ms. Ma Whye Chung (Dietitian)
Seated: Mr. Clinton Shi (Medical Social Worker), NC Lim Ee Lin Amy, Dr Kwek Jia Liang, Associate Professor Jason Choo Chon Jun, Dr Teo Su Hooi, Ms. Lydia Lim (Programme Manager), SNC (APN) Michelle Ng

TRANSPLANT CENTRE

(Left to right)
Standing: HCA Subbulakshmi D/O Krishnasamy, SPSA Jayapratha D/O Krishnan, SPSA Srihayana Binti Noordin Asmar, SSN Nuraini Lee Bte Ismail Lee, SSN Eleanor Ng, SSN Lim Chui Khim, PSA Vivian Kee, PSA Zalina Mokthar
Seated: NC (APN) Maslinna Binte Abdul Rahman, SNM Diana Chia, NM Wong Sau Lai, SM Ms. Yeo Shuan Khiag, PSAE Norashikin Ahmad

RENAL COORDINATORS AND ADMINISTRATION

(Left to right)
Ms. Tan Meidan, Ms. Felicia Loo, Mr. Vincent Tan, Ms. Lydia Lim, Ms. Chan Kai Wen, Ms. Teo Xin Xin, Ms. Christina Tan

TRANSPLANT COORDINATORS AND ADMINISTRATION

(Left to right)
Ms. Natelie Kwan, Ms. Yong Jinhua, Ms. Diana Foo, Ms. Jenny Leong, Ms. Judy Tan, Ms. Tee Ping Sing, Ms. Constance Lee and Ms. He Xia

MEDICAL SOCIAL SERVICES

(Left to right)
Mr. Matthew Ng, Ms. Goh Soo Cheng, Ms. Janelle Chan, Ms. Tan Jie Bin, Ms. Faith Wong, Ms. Jackie Erh, Ms. Wendy Rong Huilian, Ms. Caroline Pan, Ms. Yar Yi Pin, Mr. Clinton Shi

RENAL LABORATORY

(Left to right)
Ms. Teng Wei Ling Esther, Professor Chan Choong Meng, Associate Professor Marjorie Foo, Professor Woo Keng Thye, Dr Cynthia Lim, Ms. Chin Yok Mooi

RENAL MEDICINE DEPARTMENT ADMINISTRATION

(Left to right)
Ms. Ivy Ho, Ms. Ratna Bte Abdul Rahman, Associate Professor Marjorie Foo, Ms. Wan Xinyi, Ms. Connie Lew

Remembering Dr Lim Cheng Hong

Founding Father of Nephrology and His Legacy of Pioneership in Nephrology

"He discharged himself gloriously and won honours for all of us."

- Professor Woo Keng Thye

Remembering Dr Lim Cheng Hong

Founding Father of Nephrology and His Legacy of Pioneership in Nephrology

Professor Woo Keng Thye,
Emeritus Consultant and Advisor

As we remember with fond memories Dr Lim Cheng Hong, Mentor and Friend to all of us, we take heart that he has left a vast legacy in nephrology which has survived the three past Clinical Heads of Department who succeeded him together with three entire generations of nephrologists. Together, they continue to keep alive his good works in nephrology throughout the many hospitals in Singapore, providing first world nephrology service not only to Singaporeans both poor and rich but also to our surrounding countries where the practice of nephrology may not at all be on par with the standards upheld by Dr Lim's protégés and their students. In Singapore today, nephrology service is offered in eight hospitals and various other medical centres, catering to a population of about 5.6 million among whom diabetic nephropathy is the commonest cause of end stage renal failure with some 450 new patients recorded every year.

When Dr Andrew Chew, Director of Medical Services, posted me to work with Dr Lim Cheng Hong at the Department of Renal Medicine in 1975, he gave me the chance to specialise in Nephrology. My M Med degree in Internal Medicine served at that time as a passport to subspecialty training in Medicine. After a few months of exposure to Nephrology working with Dr Lim, I told him that I would like to do the FRACP in Nephrology which would require a training period of three years with part of it conducted in Australia. He graciously agreed to be my supervisor and helped obtain a fellowship for me in Australia to train with Professor Priscilla Kincaid Smith, who other than being the foremost nephrologist in Australia and the President of the Australasian College of Physicians, also happened to be a good friend of Dr Lim's. Dr Lim was an inspiring mentor who provided me with whatever support I needed. Under his tutelage, I acquired the basic skills in renal medicine including dialysis and renal transplantation. The Australian

Dr Lim Cheng Hong, founding father of the Department of Renal Medicine at the Singapore General Hospital. We owe what we have today to his vision and lifelong commitment to developing nephrology in Singapore.

College had stipulated that all trainees had to spend six months for the acquisition of basic laboratory research experience. Dr Lim kindly granted me six months of protected time to do research in Immunology with Professor Chan Soh Har at the WHO Research Laboratories located at MacAlister Road. This was a crucial first step in the establishment of my research career. The Department owes much of the reputation it enjoys in research today to the foresight of Dr Lim. When the Department was first set up, he had provided for renal research laboratories. He was himself interested in research and knew the

Dr Lim Cheng Hong (seated fourth from left) spent his early years of postgraduate training at Johor Bahru General Hospital. Dr Wilberforce Smith (seated seventh from left) was influential in his pursuit of a career in institutional medicine.

The first haemodialysis was performed in Singapore on 5 July 1961. Dr Lim Cheng Hong is shown here (standing first from left) with a team of Indonesian nephrologists and health officials at "The Attic" - the first dialysis facility in Singapore.

importance of research as nephrology was then a young science and much research was required in order to advance our knowledge. I benefitted from his vision and upon my return from Australia, was able to help build up the research infrastructure in the department with the help of our senior scientist Dr Lau Yeow Kok.

Dr Lim Cheng Hong taught me two principles which have guided my life ever since:

1st: "Be humble if you do not know and do not pretend that you do. It is only when you acknowledge your ignorance that you will make progress."

2nd: "Be fair to your patients and colleagues."

Looking back, I remember those as the days when we had to play God, because only those who were accepted into the dialysis programme had the chance to go on living. Dialysis places were very few then and many had to be left to die. In deciding who to accept into the programme, we had to be fair and not favour any particular patient or doctor taking care of the patient because everyone must be treated equally. So, if we have to play God, we should be a Good God.

What exactly do we mean when we say that Dr Lim has left a vast legacy in Nephrology in Singapore? To answer this, we have to be aware of the differences in practice between the past (in 1973 when the Department was founded) and the present (in 2020). In the early 1970s many patients with end stage renal failure had to face death because facilities for dialysis were very limited. Very few people were lucky enough to receive kidney transplants.

Today we are in much happier circumstances, largely because of the contributions of the National Kidney Foundation and the Kidney Dialysis Foundation as well as the People's Dialysis Centre. Together, these three voluntary welfare organisation (VWO) centres provide most of the dialysis facilities for many of our needy patients.

Since 1987, with the passage of the Human Organ Transplant Act, we could procure about 50 kidneys a year for kidney transplantation, whereas before then we averaged only about five kidneys a year. The options for various forms of kidney transplants have also grown wider. The law now allows living donor transplants between spouses, friends or good Samaritans in addition to those from parents or siblings. In view of this development, NKF has set aside a fund of S$10 million for donor expenses and compensation plus insurance coverage should anything go amiss during the transplant operation/ donation. Furthermore, we should also consider some of the exciting frontiers being explored in Nephrology today. The three main pillars in the practice of Nephrology are in Clinical Nephrology, Dialysis and Renal Transplantation. For Clinical Nephrology, we can now detect many types of kidney diseases at a very early stage and offer treatment before the disease begins causing harm to the kidneys. For those with established kidney diseases and already suffering from kidney damage with renal failure, we can now offer treatment to arrest the progression of the kidney failure and for those with mild renal failure, we can even reverse their condition with drugs currently available.

Dr Lim (seated seventh from left) came to Singapore General Hospital in 1959 to pursue his medical career. His initial interest was in Chest Medicine. But very soon, he developed a keen interest in nephrology and is shown here with colleagues from Medical Unit II, SGH in 1966.

Dr Lim Cheng Hong was President of the Singapore Society of Nephrology and under his helm, the society gained international repute. He was Organising Chairman of the 3rd Asian-Pacific Congress of Nephrology in 1986.

In the field of dialysis, what is waited for most eagerly by many patients is the launch of the Automated Wearable Artificial Kidney (AWAK). AWAK technologies was incorporated in 2007 and dedicated to the development of wearable artificial kidneys. It was jointly founded by Dr Gordon Ku (Chairman of Kidney Dialysis Foundation), and the two chief scientists and inventors Professor David Lee and Dr Martin Roberts from UCLA, USA. AWAK is based on the technique of peritoneal dialysis and sorbent-based regeneration of used dialysate. It is both bloodless and waterless and provides round-the-clock dialysis and ultrafiltration, representing the ultimate form of frequent dialysis which provides a steady state metabolic and fluid regulation. It weighs only about 2 pounds and is battery operated. The first clinical trials were conducted in SGH under the leadership of Associate Professor Marjorie Foo, Director of Peritoneal Dialysis Centre in SGH, and the device has recently been approved by FDA.

In renal transplantation, a big taboo area was ABO incompatibility, but the issue has now been bypassed with the latest technology for removal of ABO antibodies via plasma exchange and newer methods of immunomodulation. As a result, more patients can now be eligible for transplantation. In fact, over the past 10 years, most of the barriers to transplantation including the one pertaining to donors or recipients being elderly have been successfully surmounted. Now, as long as patient is fit and does not have significant comorbidities, he could be in his seventies and yet be able to receive or even donate kidneys under the "Old for Old Renal

Dr Lim Cheng Hong's holidays were devoted to his second love - golfing.

Transplantation Programme", first initiated in the USA and now practiced in most established renal transplant centres. This is as it should be, in view of our aging population which means many renal patients are surviving into their eighties. In addition, with the Expanded Criteria Donor (ECD) programme adopted by MOH, the yield of donor kidneys for deceased donor renal transplantation in Singapore will improve further.

Consider the kampong-style nephrology in the early years of Singapore and compare that with what you see around you today, how nephrology is being practiced in the various hospitals. You will realise what Dr Lim has left behind for us who are his protégés and successors and see how far we have come since those years. For those who are unaware or not around at that time, let us call to memory the scenario we faced in the past, more than four decades ago.

Haemodialysis in Singapore started in 1961 when a patient with acute renal failure was dialysed using the twin coil artificial kidney. In 1968, a chronic haemodialysis programme was established in the SGH, involving an 8 bedded dialysis centre housed in an attic above the Surgery A unit of the old SGH; dialysis was performed using Cuprophane membranes in a standard Kiil dialyser and patients were dialysed six to eight hours thrice weekly. In 1975, the first Self Dependency Dialysis Unit (SDDU) was set up in Alexandra Hospital and in 1983, the second SDDU was set up in Tan Tock Seng Hospital. These were the subsidised state-supported haemodialysis programmes where patients were dialysed with the help of their spouses or relatives. In 1981, with the opening of the new SGH, a new dialysis centre was set up there. This remains today as Singapore's main dialysis centre, where patients facing problems with dialysis at the National Kidney Foundation Centres or other centres are referred, including those requiring renal transplant workup.

Continuous Ambulatory Peritoneal Dialysis (CAPD) was introduced in Singapore in 1980 when the first five patients were enrolled in the programme. In 1987, a CAPD unit was established in SGH to provide an integrated approach to patient training, management and education. Now, in 2019, there are close to 450 patients on CAPD in SGH. Today, with technical advances, the peritonitis rate is one in 60 patient months. CAPD has proven to be an equally viable alternative to haemodialysis. Nowadays, most patients are on APD or Automated Peritoneal Dialysis where PD is performed by the machine at night with the patient asleep, which leaves him free to go to work in the daytime.

Renal transplantation remains the ideal renal replacement therapy, then and now. The first deceased donor renal transplant in Singapore was performed in July 1970, while living-related donor renal transplant has been performed since 1976. From 1970 to 1985, the immunosuppressive regimen consisted of azathioprine and prednisolone. Since 1985, cyclosporine A has been in use and this has resulted in better transplant survival rates. Over on the legislative front, the Medical Therapy, Research and Education Act was passed by Parliament in 1972. Under this Act, individuals can pledge or will their kidneys for transplant purposes in the event of death. Relatives of deceased persons are also allowed to give consent for kidneys to be retrieved for transplantation. Faced with a shortage of deceased donor kidneys, the Human Organ Transplant Act (HOTA) was implemented in 1988. Under HOTA in its current form, if an individual, aged 21 and above, had not in his lifetime objected to removal of his kidneys in the event of death, then the kidneys can be recovered if suitable, as it is presumed that he has given his consent by not objecting or opting out. The passage of HOTA has therefore resulted in a dramatic increase in the yield of kidneys from deceased donors.

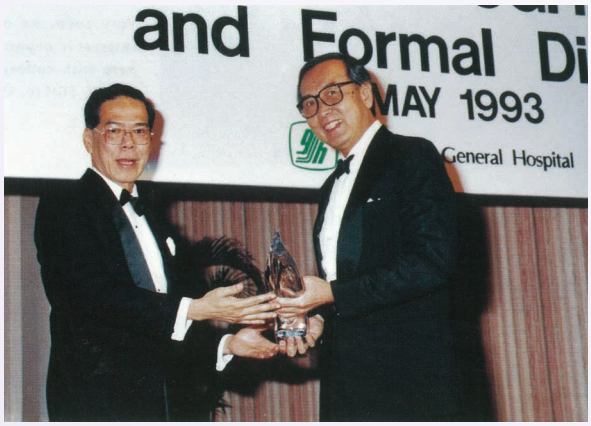
Dr Lim Cheng Hong hosting a faculty dinner at the Inaugural Scientific Meeting of the Singapore Society of Nephrology 27th - 28th August 1988.

The bulk of clinical service work was in the area of Clinical Nephrology with Glomerulonephritis constituting the major portion. Asymptomatic haematuria and proteinuria were the commonest presentation for patients with glomerulonephritis. This group of patients we now know have IgA nephritis, which is the commonest form of glomerulonephritis seen in Singapore and many other countries. Other common diseases at that time were hypertension, urinary tract infection, renal stones, lupus nephritis and diabetic nephropathy. It is to the credit of Dr Lim and the first-generation nephrologists in Singapore that one year after the founding of the Singapore Society of Nephrology with Dr Lim as the Founding President, they organised the First Asian Colloquium in Nephrology held in November 1974. The papers published included those on Glomerulonephritis, Urinary Tract Infection, Acute Renal Failure, Haemodialysis and Renal Transplantation. The idea for the Colloquium, however, came from Professor Khoo Oon Teik who was then the Chairman of the National Kidney Foundation (NKF).

In 1989, Dr Lim Cheng Hong became Chairman of the Division of Medicine and a member of the Medical Board at SGH. He is shown here with members of the Medical Board in 1995.

Talent Development and Research: Dr Lim's modus operandi for success

At the very beginning of my career as a nephrologist, Dr Lim had always been encouraging me in the area of research. He would attend meetings overseas and when he returned would pass me new materials and shared with me about his impressions of various people he met overseas, what they were doing and how one day we must be as good if not even better than them. He said that we already had renal research laboratories and all that was needed was for us to go for training overseas, then come home to set up research projects in our own departments. He spoke about people like Craig Tisher and Thomas Hostetter and that we would have to invite them over to lecture in Singapore and later send our people to their units for training. He had always had a healthy respect and an abiding interest in research and as I listened to him, I too became fired by his enthusiasm. He would also tell me who the good speakers were that we could invite as plenary lecturers, people like Stewart Cameron and Richard Glassock. This was especially relevant in a young science like nephrology where many things were still largely unknown and treatment for many forms of kidney diseases was very empirical, more based on gut feelings rather than scientific evidence.



Dr Lim Cheng Hong, on occasion of being conferred the title of "Emeritus Consultant" in 1993 by Dr Kwa Soon Bee (then Director of Medical Services), an acknowledgment and recognition of his distinguished services as well as teaching and research contributions to SGH.

Dr Lim Cheng Hong with Prof Charles Ng (Chairman of the Medical Board of SGH 1992-1998) at the presentation of his Festschrift on 26th September 1996.

He was impressed by those gifted with good thinking ability and used to tell me about Professor Robert Schrier and his work on renal physiology and fluid and electrolytes. He invited Professor Schrier to the department as a Visiting Expert and the Professor went on to conduct a Clinical Pathological Conference for SGH in the old Pathology Lecture Theatre. It revolved around a patient with acute renal failure with electrolyte disorders and Professor Schrier held the audience spellbound with his intellectual prowess. Perhaps because of this and subsequent to his visit here, Dr Lina Choong went to train for one year with Professor Schrier.

Professor Richard Glassock was also among those headhunted personally by Dr Lim. The latter managed to persuade Mr. Thambirajah Tharamadurai or T.T.Durai, the then Secretary General of the NKF, to fund a special Khoo Oon Teik Lecture in honour of Professor Khoo Oon Teik, the Chairman of the National Kidney Foundation at that time. Richard Glassock, the first lecturer, spoke about Glomerular Perm-selectivity, a topic which Dr Lim himself was always talking about. However, before Richard, we referred to it as Protein Selectivity which Dr Lim learned about from his good friend, Dr Barry Hulme from St Mary's Hospital in London. Dr Lim and Barry had trained together as nephrologists in their younger days. I subsequently secured the help of Dr Hulme when he was our HMDP expert for two weeks in Singapore to help write a paper on protein selectivity. Dr Grace Lee later went on to train with Professor Richard Glassock and Professor Sharon Adler in UCLA for one year.

Dr Evan Lee, from the University Unit of Medicine (MU 1) joined the Department for training in Nephrology. Later, Evan became the Head of Nephrology in the National University Hospital in Kent Ridge when the University moved from their campus in Outram to this new location. Evan also went to Professor Priscilla Kincaid Smith for training at the Royal Melbourne Hospital, obtaining his MD with a thesis on Pregnancy and Kidney Diseases and going on to become an authority on that subject.

Professor Wong Poi Kong, the Head of MU 1, had wanted to have lecturers trained in Nephrology. With funds from the University, Professor David Lee, a Singaporean previously attached to UCLA was invited to join the department as Renal Expert for two weeks.

I took advantage of Professor Lee's presence and persuaded him to help write my paper on Natural History of IgA Nephritis in Singapore, the same way Barry Hulme helped me with the Protein Selectivity paper. Dr Lim set a rule requiring the experts to help each of his doctors' write up a research project during their two-week visit to Singapore. Since then, David became a great friend and continued to work with Dr Gordon Ku, a University Nephrologist from MU II who later became the Chairman of the KDF and is currently also handling the AWAK project with David and Marjorie Foo.

After Evan Lee, another nephrologist from the University to be trained by Dr Lim was the very exemplary Dr Tan Chorh Chuan. He was quick on the uptake, intelligent, full of initiative and brimming with bright ideas. He learned fast and was always ready to lend me a helping hand, especially at that time when I happened to be working on my Textbook of Nephrology. He would volunteer to check the data in the book and help me to convert all the traditional units to SI units, as we were making such a change for all our biochemical work at that time. Chorh Chuan also helped in our papers, collating data for Dr Lim's project on asymptomatic haematuria and proteinuria and helping to edit my chapters on fluid and electrolytes and acid base balance. I was very pleased and told Dr Lim about this bright young registrar from NUH. Dr Lim's reply was, "Of course he is good. If you know his scholastic records, then you will know who he is." Cryptic remarks, I told myself then, and it wasn't until years later when I happened to read Chorh Chuan's CV that Dr Lim's words echoed in my memory. Chorh Chuan subsequently spent a year at Oxford with Professor PJ Ratcliffe to do his PhD thesis on Erythropoietin. In that one year, under the guidance of PJ Ratcliffe and EU Eckardt, he had chalked up nine publications, all in high impact international journals, a rare achievement which to my mind nobody has surpassed. Today, he remains an expert on Erythropoietin. We had intended to send him to Thomas Hostetter for training in renal retardation, studying the five sixth nephrectomy model in the rat, but he declined. Years later, when T. T. Durai invited Hostetter as his guest lecturer at the International NKF Renal Retardation Symposium, I brought Chorh Chuan to meet Hostetter and we all had a good laugh. Chorh Chuan was then Director of Medical Services and T. T. Durai's Guest of Honour at the function. Professor Tan Chorh Chuan subsequently became the Dean, then Provost and finally President of the National University of Singapore.

The next generation... His commitment to patient care, teaching and research has left a legacy in the field of nephrology. The Department of Renal Medicine (1995) has been enriched by his guidance. Many of the doctors pictured here became world class leaders in different facets of nephrology.

(Left to right)
Standing: *Ms. Amy Yuen, Yoke Peng, Ms. Irene Ow, Ms. Long Chey May, Ms. Chin Yok Mooi, Dr Lau Yeow Kok, Dr Stephen Chew, Dr Morris Wo, Dr Tan Han Khim, Dr Martin Lee, Dr Doreen Ang, Dr Lim Soon Thye, Dr Sitoh Yih Yeow, Dr Asok Kurup.*

Seated: *Dr Grace Lee, Dr Lina Choong, Dr Vathsala Anantharaman, Dr Pwee Hock Swee, Dr Woo Keng Thye, Dr Akira Wu, Dr Wei Serh Sherng, Dr Wong Kok Seng, Dr Lee Wan Tin*

One of the most important meetings which Dr Lim organised was the Third Asian Pacific Congress in Nephrology (APCN) which was held in Singapore in 1986. For this meeting we had Professor Khoo Oon Teik as President and Dr Lim as the Organising Chairman with Mr. T. T. Durai and the NKF providing the administrative and secretarial support. Professor Feng Pao Hsii, Dr Gordon Ku, Dr Pwee Hock Swee, Dr RPS Edmondson, Dr Akira Wu, Dr Evan Lee, Dr Tan Chorh Chuan and Dr Lenny Tan were among the Committee Members of the 3rd APCN.

Much of the time Dr Pwee served as the Head Honcho, someone who we had dealings with as he was very involved in the running of the dialysis and renal transplantation programme. Whenever Dr Lim was away, Dr Pwee would be the Acting Head. Dr Akira Wu was a full-fledged FRACP in Nephrology from Monash University who joined us as Senior Registrar. He was a bright chap with a critical mind and would scoff at practices in the department which he considered did not pass muster. Dr Lim, ever watchful and alert, would readily grasp what Akira was hinting at and would make the necessary changes in support of him, changes which eventually benefitted the department anyway. Not long after, however, Akira followed Gordon's footsteps into the private sector but to their credit, both continued to contribute to continuous medical education and practice sound nephrology.

Dr Robert Piers Seymour Edmondson was another fully qualified and well-trained nephrologist from St Thomas's Hospital in London. Piers came to join us as his wife was from Kuala Lumpur. He was a very handsome and skillful guy, very good at procedures and a first-class computer programmer. At that time Dr Kwa Soon Bee, the Medical Director of the hospital, had acquired an Apple II E computer and given it to Dr Lim's Department as he knew of his keen interest in research. It became our new toy. Piers was tasked with the formulation of the Tissue Typing Programme for Transplant Recipient Selection. We must thank him for writing a wonderful programme which was the forerunner of the National Programme and which we continued to use for years. He also helped me with the cumulative survival graphs for IgA nephritis and our other clinical trials and was superb at it. Computerisation and the use of graphics and statistical package certainly went a long way to facilitate research work. Piers was my co-author in many papers together with Akira and Evan. It was therefore a great tragedy that our beloved Piers Edmondson, good friend and colleague, passed away from Carcinoid Syndrome just before the 3rd APCN. It caused us much pain. During the Congress, I dedicated the paper on IgA nephritis to my co-author Piers and also read out a poem in his memory. Piers is survived by his wife, his eldest daughter and a set of twin daughters. Today, his daughters are three beautiful and charming lawyers practising in UK, all having previously won state scholarships to read law at local universities.

After the 3rd APCN in Singapore, Dr Lim attracted to himself his three Charlie's Angels and three Male Stars to complement the Angels. The first amongst the three was Dr Vathsala, whom he sent to Professor Barry Kahan to help develop Renal Transplantation in Singapore. To his credit, Vathsala did a fantastic job and he was most proud of her achievements and never ceased to sing her praises. Vathsala excelled in renal pharmacodynamic research in Cyclosporine, which was the rage at that time as Cyclosporine was newly introduced as a new transplant immunosuppressant drug. Vathsala subsequently succeeded Professor Evan Lee as Head of Dept. in NUH. Dr Terence Kee succeeded Dr Vathsala as Director of Renal Transplantation after she left for NUH. Terence was trained in Sydney by Professor Jeremy Chapman and under Terence, the transplant programme continued to flourish and underwent many changes including ABO incompatible transplantation and the introduction of newer immunosuppressant agents to replace cyclosporine A which was causing calcineurin induced nephrotoxicity.

Dr Grace Lee, who had a talent for research, was posted to Professor Richard Glassock and Professor Sharon Adler's department. She specialised in cell culture research and worked on an animal model for diabetic nephropathy. For her work, Grace was awarded the Galloway Memorial Lectureship for Research from the Academy of Medicine. She was also interested in the development of Continuous Ambulatory Peritoneal Dialysis [CAPD], which was newly introduced by Dimitrios Oreopoulos and Karl Nolph, and managed to gain experience in this area

Dr Lim Cheng Hong retired to his loves - his family. He was a proud father of two and a doting grandfather as well - his wife and his son are on the left and his daughter on the right.

at UCLA through the good offices of Professor David Lee. Upon her return she set up the cell culture lab in the department. She also established the CAPD Unit in the department and became director of the unit.

Dr Lina Choong went to Professor Robert Schrier to train in renopathophysiology and returned with skills in calcium transduction signalling. Upon her return she continued honing her skills in the renal lab. She had chosen to specialise in haemodialysis and in time became the Director of Haemodialysis. Later on, she succeeded Professor Evan Lee as President of the Singapore Society of Nephrology (SSN) and has led the organisation to this day to continue the mission earlier set forth by Dr Lim Cheng Hong and Dr Khoo Oon Teik. She has indeed done a steadfast job as President of the SSN. Much credit goes to her for her valiant efforts to perpetuate the legacy of Professor Khoo Oon Teik and Dr Lim Cheng Hong in this respect.

Of the three male heirs, the first, Dr Wei Sher Sherng, spent time with Professor Donald Vidt and Professor JT Daugirdas in Cleveland. He returned after his training and was able to complement the haemodialysis facilities in the Department with computerisation of dialysis data and sodium profiling for dialysis patients. Dr Wei subsequently left for greener pastures and is now practicing in Perth, where he is known to be doing very well.

Dr Wong Kok Seng went to Professor Judith Whitworth in Sydney and obtained training in hypertension and experimental surgery, becoming an expert in hypertensive rats and developed a model for cyclosporine toxicity in the rats. He later became the 3rd Head of Dept. of Renal Medicine. He was succeeded by Dr Chan Choong Meng, the 4th Head. Dr Chan Choong Meng and Dr Marjorie Foo were both recruited from London by Dr Wong Kok Seng, and both were very well qualified with their London training together with the pursuit of their PhD. Choong Meng became Head of Department after Kok Seng whilst Marjorie became Director of Peritoneal Dialysis. Marjorie subsequently succeeded Choong Meng as the next Head of Department.

Dr Tan Han Khim was the latest addition to that generation of nephrologists of which Kok Seng and Ser Sherng were also members. He obtained his Higher Education in Nephrology under Professor Rinaldo Bellamo, a world class expert in acute renal failure and Continuous Renal Replacement Therapy (CRRT) and ICU Nephrology. Under him, Han Khim excelled and published several seminal papers in CRRT and to this day continues to be productive in this line of research, following the footsteps of his mentor and serving as a source of inspiration to the younger generation of nephrologists. He has published several papers on MARS and liver dialysis, of which he is also an expert, and also holds an MD from the National University of Singapore for his work on CRRT. He continues to do good research work in the area of Dialysis and CRRT.

Together with Han Khim there was also Dr Stephen Chew who was groomed in CAPD by Grace Lee and later sent to Duke's University where he did quite well, but on his return was disenchanted with public service and chose to follow Grace's footsteps into the private sector together with Akira Wu, Gordon Ku and Pwee Hock Swee. But this generation of nephrologists continue to have their CME links with the Department and the Singapore Society of Nephrology and continue to contribute to the educational welfare of the younger nephrologists.

Another important contribution of Dr Lim was his foresight in developing Paediatric Nephrology. Dr Yap Hui Kim was an outstanding medical officer in our department in the late 1970's and Dr Lim felt that since she was keen in both paediatric as well as Nephrology, she was best poised to develop the field of Paediatric Nephrology. She went to Professor Stanley Jordan's department and upon the completion of her training returned to the University Hospital where she set up the National Paediatric Nephrology Service. Hui Kim is very passionate about research and for years continued to work with us and led many breakthroughs in research in the field of paediatric nephrology. Through the auspices of the NKF she persuaded Mr. T. T. Durai who was then its CEO to develop the Shaw Foundation Children's Dialysis Centre. Hui Kim also developed CAPD and Renal Transplantation for children and today she has become the Grand Dame of Paediatric Nephrology in Singapore. Hui Kim has contributed many important high impact papers on childhood nephrotic syndrome. In recognition of her contributions the Ministry of Health conferred on her the Outstanding National Clinician Scientist Award, which is an honour bestowed only on a very few.

As you can see from these elaborate writing concerning the development of nephrology talent in Singapore, Dr Lim was very much into developing people's talent (or a people legacy) which in fact is the kernel or core of his strength, because he believed that whatever we do, if we wish to succeed we must first develop people with the right skills and expertise who are able to lead in that area. With this formula he has been able to nurture the first two generations of nephrologists, with the second in turn nurturing the third generation and leading them to excel not only in their clinical work but also in clinical research to the point where they could compete on the world stage.

Dr Lim was a people's man, a charming and generous host who would spend his own money entertaining our visitors to good and lavish dinners and lunches for his guests and of course his doctors when there was occasion to dine. His main agenda was to attract people who could help in the development of his staff talent, the betterment of his doctors being always foremost on his mind. He had a great thirst for bringing out the best in his staff and never spared himself in the process. To this end he was sometimes a strict taskmaster and had no patience for fools. He would bring us to his various country clubs where he was a golf convenor and we had indeed enjoyed many sumptuous meals with Dr Lim as the gracious host. There was once he even invited us all for dinner at his grand bungalow at Bin Tong Park, which is well known to be the reserve of the rich and famous in Singapore. Dr Lim's father was the Charcoal King in Taiping and had already made Dr Lim himself a millionaire when he was still a medical student. Once, during tea, he jokingly told us that his salary from the hospital was not even enough to pay for his income tax. Despite his wealth, he could be very down to earth and simple. He ate in hawker centres and took a bus when convenient rather than drove his car. Once he challenged me by asking me if I knew how to take a bus. Fortunately, I was able to answer that I was familiar with many bus routes in Singapore. Instead of going to the gymnasium at his country club he would often frequent the one in his community centre as it was closer to home. But make no mistake, his is the profile of a millionaire: the

way he walks and talks, the clothes he wears, the food he eats, his car and house and of course the kind of children he raised, but he knew how to come down to our level and is a true gentleman. For me, he has always been very kind though rather stern, helping to look after my family when I was away in Melbourne for one year. He told me to consider my Melbourne stint as part of national service and that he had plans for me on my return. He had been a good friend to me too, continuing to drop by my office to see me after his retirement. He loved the char kway teow across Outram Road and would walk over to Pearl's Hill to wait with the rest of the crowd in queue for his plate of local lunchtime cuisine.

I conclude by stating that more important than any of his other attributes, Dr Lim was indeed a leader with an unusually far vision, not myopic like some other leaders who were only interested in the immediate and short-sighted goal of achieving fame and glory for themselves. Dr Lim was a man who was too tall for such as these. He did not have to stand on the shoulder of any giant to see further, because he himself was a genomic giant, gifted with the ability to see the obvious and do the proper and appropriate with an unflinching sense of duty. He discharged himself gloriously and won honours for all of us, leaving behind many protégés who will in turn pass on his flame of glory as we serve the many patients afflicted with kidney disease at home or on near and distant shores.

On a lighter note, I must add that Dr Lim also has a rare attribute, i.e. he had a lot of common sense, again a rarity in many people and finally, we will all agree that he also had a very strong sense of humour which embodied a nimble wit.

Chapter 1
Leading in Nephrology

"It is a journey worth taking together with all the selfless men and women who fight alongside you."

- Associate Professor Wong Kok Seng

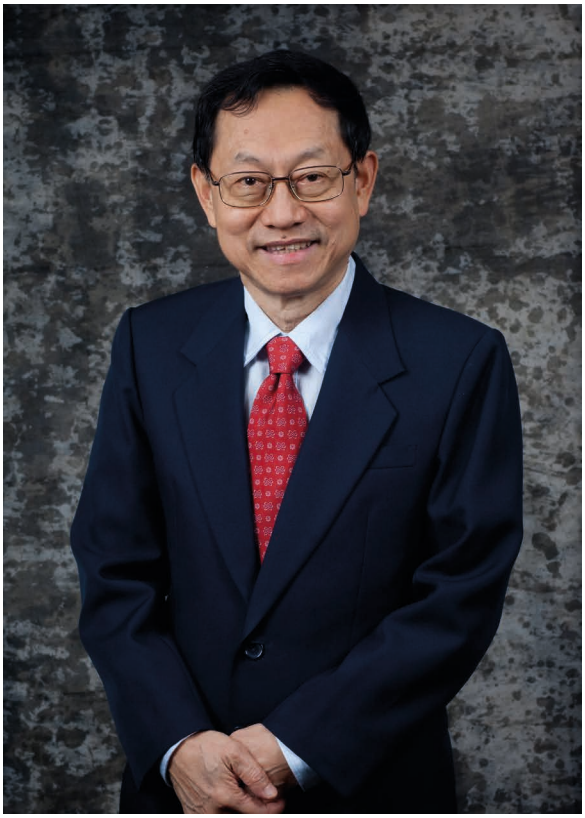
I am a reluctant leader and would rather somebody else lead while I follow.

Professor Woo Keng Thye, Emeritus Consultant and Advisor
Head of Department, 1989 - 2002

When I was a consultant in the Department my great interest was in research. Usually, when Dr Lim Cheng Hong, fondly known to myself as the boss, is away, Dr Pwee who is his right hand man would step up to be Acting Head. At that time, which was in the mid-seventies, Dr Pwee was regarded by all as the unofficial Deputy Head. In fact, he was already put in charge of the Self Dependency Dialysis Unit (SDDU) at Alexandra Hospital and once a month would attend the Heads of Unit meeting at that hospital instead of Dr Lim. Similarly, when the boss could not be at MINDEF for the CMPB/Specialist Clinic meeting to medically board out or downgrade National Servicemen, Dr Pwee would be asked to go in his place. When a royalty in Brunei needed medical care, Dr Pwee would be the one asked by MOH to fly to Brunei to attend to the case. Each time he returned he would show me the gifts he obtained, such as a silver pen or lighter and whenever he was given some nice cigars, would pass them to me as he did not smoke and knew I appreciated good cigars.

So indeed, I was happy and contented doing my work at the home base. However, when the second SDDU was formed at Tan Tock Seng Hospital, Dr Pwee said he was already handling the one at Alexandra Hospital and wanted Woo i.e. me to take care of the one at TTSH. So, given no choice, I had to visit the unit at TTSH at least once a month.

When Mr. T. T. Durai had the great idea to source for overseas kidneys for deceased donor transplantation, Dr Pwee was very glad to help. Those kidneys would usually had been around for about 50 hours in the USA without any match being found, and so T. T. Durai managed to get SIA to fly them in at no cost. We had about 30 such kidneys and each time one became available, Dr Pwee and the Chief Transplant Surgeon Professor Foong Weng Cheong would be waiting at the Changi airport VIP room for the plane to touch down. As soon as the plane landed, they would be driven to the tarmac and the kidneys,



Professor Woo Keng Thye

usually a pair in a carton, would be hand delivered to them. Either T. T. Durai, Professor Foong or Pwee would be the one receiving it, after which they would be speedily whisked off in an ambulance and brought to the Operation Theatre in SGH for the transplant operation. Once Pwee confided to the boss that I had not been doing my part in retrieving the kidneys from the USA and so for the next retrieval, I went along with Pwee. I remember that one of the recipients happened to be my own patient and I am glad to say that she is the only one among the American kidney recipients to be still alive today, about 31 years after her transplant.

That was the happy state of affairs for me until one day when I was called to the boss's office. In those

days we used the intercom; whenever it sounded it would usually be the boss calling out, "Keng Thye, can you come over to my office?" and I would respond, "Yes, Dr Lim". His was only a few rooms away from mine, the first and the largest, just next to the toilet.

So, this time round, the boss aka Dr Lim told me, "Keng Thye, there's something important I want to talk to you about". I knew from past experience that when he took that tone of voice, it would be a task I would not like very much. He started by telling me that I well knew the hospital would be undergoing restructuring and there would be an American team headed by an American CEO and they would be in charge of the hospital. He added that I should be aware of that fact as I would have been already serving in one of their committees. He said that a search had been made for his successor as Head of Dept. and I was the chosen one; the Medical Director Dr Wong Kum Leng would soon be speaking to me about the Headship.

I told Dr Lim I was not interested in the job and that Dr Pwee should be the head. As it was, he had been his deputy and the one performing the job of an Acting Head whenever he, Dr Lim was away. Dr Lim told me it had already been decided by the hospital authorities. I told him I saw no reason why he, Dr Lim, should not continue to serve as the head. That's when Dr Lim revealed that he would be taking up a new post, that of Chairman, Division of Medicine. I countered that he could continue to be Head of Dept. and Chairman of Division at the same time. He told me no such arrangement could be allowed. I told him I had done well in research and the international community was getting to know me and my work, and I had been invited as a member to the International IgA Club in recognition of our work on IgA nephritis. I would be presenting papers and travelling and would prefer to remain as I was. He should speak to the hospital committee and tell them to nominate Dr Pwee as head. He told me flatly that it had already

Professor Woo Keng Thye as the host of the presentation of Dr Lim Cheng Hong Festschrift on 26th September 1996. Here is him listening to Dr Lim Cheng Hong speak on his Festschrift with other nephrologists and colleagues at SGH.

Professor Woo introduced the grand ward round that was conducted once a week on Mondays and then Wednesdays. This is a picture of one of the grand rounds in 1993. Dr Sufi Muhammad Suhail, one of the department's longest serving consultant is seen on Professor Woo's left too when he was a renal fellow in the department. He used to answer Professor Woo's questions with accuracy and eloquence during the grand ward rounds.

Professor Woo Keng Thye having a dinner with nephrologists who attended the Festschrift Presentation to Dr Lim Cheng Hong in 1996.

been decided. As a last resort, I pleaded with him to get them to allow him to stay on as Head and I will assist him rather than take on the headship. His answer was that the decision was final, and I would soon be informed and that was why I had already been roped into some of their committees. I told him the decision would be unfair to Dr Pwee and he would not take it well as he had always been expecting the headship.

I had no choice - I became a most unwilling Head of Department. A few weeks later I was asked to see the Medical Director Dr Wong who informed me that I would be Head and as for Dr Pwee, he would be offered a job to continue as senior consultant. I would get one salary increment and the others would be paid the same under the new administration. I told him that Dr Pwee would not be happy as he expected to be head but Dr Wong told me it was not his decision as they now have a Search Committee for all their key posts.

I was Head of Renal Medicine under the new administration involved in the restructuring of SGH. Hitherto, it was the civil service we were under and we were classified as government employees or civil servants. But suddenly, everything was subsumed under a new order. Nothing was as before and there were all sorts of changes, lots of additional paperwork, a call for increased justification and accountability, as well as many additional layers of approval required along with tighter budgetary constraints. Every single procedure had to be justified and costed. Even what used to be a simple task became complicated because there were now additional steps and new rules. Many of our previous perks and privileges as civil servants were removed and allowances were terminated or reduced especially when it came to medical benefits.

As a new and young head, I had to attend many meetings as head or member of various working committees. I had to see to the smooth running of the department, keeping an eye on the performance of the staff in addition to handling my usual workload. Fortunately, I had with me our three Charlie's Angels, Dr Vathsala, Dr Grace Lee and Dr Lina Choong plus Dr Wong Kok Seng, Dr Wei Sherh Sheng and Dr Tan Han Khim. I left Dr Pwee alone to continue with his usual work, but he told me he would not be staying long, and I could well understand his predicament. He left and went into private practice about two and a half years later, after he had set up his private dialysis centre. I was grateful for whatever help he gave me. He had lost his zest even though he had previously been personally involved in the training of our three Charlie's angels, especially Lina and Grace. Dr Pwee was very good at practical procedures and was generous in imparting his skills to our junior staff. He got on very well with the staff especially those from nursing and they would call on him for help and guidance whenever necessary. Pwee used to be very interested in renal transplantation but Vathsala had also indicated a similar interest and the plan was for her to succeed Pwee, since he had indicated that he would not be staying on for long.

I received my own training in Nephrology in Australia and after obtaining the FRACP in Nephrology and upon my return from Melbourne in 1979, I had started to change things and introduce the Australian system of training and education to the department with Dr Lim's approval. I introduced the Grand Ward

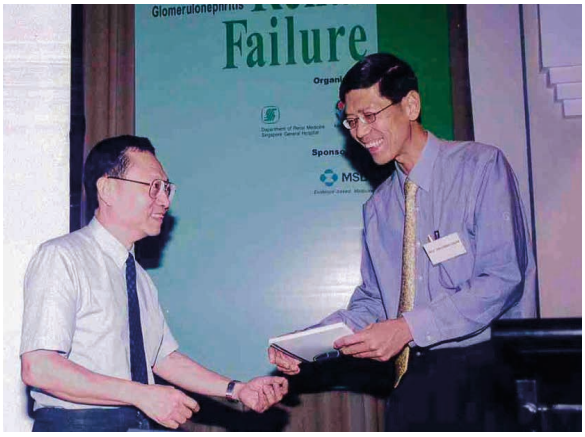
Round, which took place once a week on every Monday and served as a teaching round following each case presentation. Such rounds involved the questioning of registrars and medical officers and could be quite a gruelling exercise since everyone had to be well versed in the patient's condition, be thorough in their practice and care, as well as have the ability to instantly answer questions on various aspects of case management. I would usually try to provide an update on most of the conditions we encounter along the way. Each round was attended by nursing staff as well as dialysis and transplant coordinators, medical social workers, and pharmacists and staff from organisations such as NKF and Baxter, in addition to various visitors and guests. So, once a week there would be a big entourage and the round would take the greater part of the morning, being followed by a lengthy discussion on problem cases, outside the ward area and away from patients for reasons of privacy.

We restructured our clinics, procedures and protocols based on my Melbourne training. At about that time MOH wanted to introduce Specialist Training and Accreditation for the subspecialties. So, I was tasked to chair the relevant committee and put up a proposal for training requirements and an exit system to qualify someone as a trained and certified nephrologist.

MOH realised that we also had to accredit the various dialysis centres and we did not yet have any SOP (Schedule of Operations) for that. I adopted the guidelines and procedures from the American Society of Artificial Internal Organs (ASAIO) plus various other sources and came up with some national guidelines of our own. This allowed us to create a system for granting licenses and auditing of all dialysis centres, including the many under NKF which T. T. Durai was setting up all over Singapore.

In trying to emulate the practice of overseas centres, I realised that we lacked established national registries which would be necessary if we were to publish our data or engage in dialogues with those centres which had expressed interest in collaborating with us.

When I first joined the department as a registrar I had already informed Dr Lim that we needed to set up a Renal Biopsy Registry to keep track of our data and



Professor Woo Keng Thye as Head of the Department of Renal Medicine presenting a copy of the first national guidelines on the management of glomerulonephritis to another renowned renal physician - Professor Tan Chor Chuan who was then Director of Medical Services in 2001.

Professor Woo Keng Thye with Ms. Connie Yong May Chin who was the department's first dialysis coordinator.

for publication purposes. This was especially so when our department was itself involved in the processing of all the biopsies so that our registrars could just go to the renal lab next to our offices the next morning to access the biopsies. For this we had our Medical Technologist, Mdm. Chin Yok Mooi, who was specially trained for the task of processing and cutting the biopsy specimens in our renal lab. This was especially so for urgent biopsy cases. So, fortunately for us, we have a well-established renal biopsy registry serving us today.

One other thing I had in mind was a National Renal Register where we could register every end stage renal failure patient in Singapore and track his progress across the various renal replacement units, whether it was for haemodialysis, peritoneal dialysis or renal transplant. In order to achieve that we had to employ staff to do the work on a national level. I

Professor Woo receives the SingHealth Distinguished Golden Achievement Award in 2014 from SingHealth Group CEO Professor Ivy Ng. This award recognises distinguished leaders for their long standing stewardship and contribution to SingHealth.

Professor Woo Keng Thye at one of the Chapter of Renal Physicians Lecture and Dinner with several generations of leaders - Professor Evan Lee and Professor Yap Hui Kim (seated left and right of Professor Woo Keng Thye), Dr Titus Lau (current Chairman of the Chapter of Renal Physicians), Professor Chan Choong Meng, Associate Professor Marjorie Foo and Associate Professor Wong Kok Seng (standing left to right).

approached Mr. T. T. Durai and so under the auspices of the NKF, a National Renal Registry was established. Years later, this Registry was taken over by the NDRO, National Disease Registry Office under MOH, and today enjoys powers for compulsory acquisition of data from all dialysis and transplant centres as well as hospitals which manage renal patients.

As HOD, I believed that all our consultant staff needed to be attached to overseas centres to advance their professional skills and research capabilities. No matter how good we think we are, it is only when we are exposed to what is done in large overseas centres that we begin to realise how much more we can learn from others. This was especially in the area of research. I had good opportunities for overseas training, not merely as an observer but being immersed in first-hand clinical and research training and with the advantage of grant support to conduct original research. I found this very useful in improving one's skills and perspective and this contribute to one's thinking and confidence. Later on, after returning home we would be able to put in practice new skills in the labs, clinics and wards. So, because I myself had benefitted from such training when I was sent by Dr Lim, in my time I did the same for all my staff, to their great benefit.

In time, as our doctors and our department became more recognised and we expanded our network, we were better able to learn from others, teach the less knowledgeable, and exchange information through research collaboration. In effect, we became part of the worldwide circuit for continuing professional education and through the Singapore Society of Nephrology, Society of Transplantation (Singapore), Asian Transplantation Society and later World Congresses of Nephrology and International Society of Nephrology, nephrology in Singapore's achieved the stage of international recognition. By now, we have trained many doctors and nurses from countries all over the world while our own staff have been proudly invited to serve as experts in certain areas.

In terms of research, our department has been very fortunate. The first haemodialysis was conducted in Singapore in 1961 under the auspices of Professor Khoo Oon Teik, the Head of Medical Unit II, using donated funds and as a result a handful of patients enjoyed access to long term dialysis support. But the money from such donations dried up soon and MOH had to take over the very small dialysis programme, in the process establishing the Department of Renal Medicine in 1973 with Dr Lim Cheng Hong as the first and founding head. It was a government unit funded by MOH and did not come under the purview of the university as was previously the case under Professor Khoo. MOH took over what Professor Khoo had set up lock stock and barrel, so to say, including the Renal Research labs with its scientist and research technicians. When I joined the department I quickly availed myself of the opportunity; with Dr Lim's encouragement and his sending me for research training at the WHO lab in McAlister Road headed by Dr Chan Soh Har, plus a small grant from the Medical Clinical Research Committee (MCRC), I was soon learning how to write my first research paper under

Professor Woo Keng Thye is one of the Department's first clinician scientists, having established the efficacy of anti thrombotic drugs and angiotensin receptor blockers in retarding the progression of IgA nephropathy. He also helped launch Singapore's Good Clinical Practice Guidelines and served as Chairman of the National Medical Research Council from 2003 to 2006. He is here receiving a publication called Saving lives through Clinical Research which document the evolution of clinical research in Singapore over 50 years from 1965 to 2015.

Dr Chan herself. Later and for many years afterwards I was Chairman of the MCRC. Whatever Dr Lim did for me, I did for my staff, starting with Dr Vathsala, Dr Grace Lee, Dr Lina Choong and Dr Wong Kok Seng, Dr Wei Serh Sherng, Dr Tan Han Khim, and all the others that followed. They all benefitted from six months protected time to learn research techniques in immunology and molecular biology. Later, when they returned from their overseas attachment, they each set up their own programme in the Renal Research labs, thus enabling our entire renal research programme to flourish.

I was Head for 13 years, though initially a reluctant head but soon enjoyed myself and had many fulfilling moments. I decided not to be a stern head but believed that a certain amount of discipline was necessary. I prided myself that I was approachable and friendly. I had trained many and hope that I had been a friend to all.

40th Anniversary Commemorative Dinner of Society of Nephrology.

Past luminaries and physicians from the SGH Campus gathered at SGH in 2012 to celebrate 40 years of Nephrology in Singapore, the cradle of renal medicine and renal transplantation.

(Left to right)
Standing Front Row:
Ms. Tan Ah Moey, Ms. Monica Wong, Ms. Theresa Soh, Dr Foong Weng Cheong, Dr Ong Siew Chey, Professor Abu Rauff, Professor Chan Kong Thoe (who performed the first renal transplant), Dr Beatrice Chen, Professor Woo Keng Thye, Associate Professor Lina Choong

Standing Back Row:
Mr. Lee Beng San, Mr. T.T. Durai, Dr Wan Jazilah Binti Wan Ismail (Nephrologist from Malaysia), Dr Hooi Lai Seong (Nephrologist from Malaysia), Dr Satwant Singh Gill (Nephrologist from Malaysia), Dr Gondon Ku, Dr Pwee Hock Swee, Professor Lim Pin, Dr Grace Lee, Ms. Sally Kong, Associate Professor Evan Lee

Idle thoughts……Sweet memories

Associate Professor Wong Kok Seng
Head of Department, 2002 to 2008

When Terence first approached me to write my reflections as Head of Renal Medicine in SGH, I declined his invitation several times. That was because to me, such an endeavour poses a real risk for self-indulgence and hubris. However, after reading those recollections written by Dr Woo, Choong Meng and Marjorie, I felt that by not sharing my own reflections, I would have done the Department a disservice by leaving a void in this collective narrative. Having set my reservations aside, please allow me to now start at the beginning. I was first introduced to the Department of Renal Medicine in SGH during my last six months as a National Service Medical Officer, where we were allowed to spend this last stretch of our NS liability in a hospital department. For me, it was love at first sight with Renal Medicine! I was offered a Renal Traineeship even before passing my MRCP or M.Med, which I thought was a fantastic achievement until my more cynical peers told me that no one in his right mind would want to do Renal Medicine. Indeed, many renal trainees in those days reneged on their commitment and went on to do other specialties like Cardiology.

Back then, Renal Medicine was a very unpopular specialty as there were no healthcare schemes like Medisave, Medishield and Medifund to help needy patients. Receiving a diagnosis of end stage kidney failure was like getting a death sentence unless you were young, married, gainfully employed, and had someone to help you with self-dependent haemodialysis. Yes, those were the days when only patients afflicted with primary renal disease qualified for SDDU (self-dependent dialysis unit). In spite of the circumstances, it was with great anticipation that I started on my Renal Traineeship. Those years turned out to be very tough. No matter what I did and how hard I tried, the Boss, aka Dr Lim Cheng Hong, was very unhappy with me. This was in spite of Drs Woo, Vathsala, Grace and Lina watching my back all the time to warn me of impending dangers and what banana skin(s) not to step on.

Associate Professor Wong Kok Seng

During one of those moments of despair, I went to Dr Woo to inform him of my intention to resign and start my own GP practice. But Dr Woo he saw things differently. He said if Boss really thought that I was beyond redemption; he had powerful enough connections to send me to a certain "Siberian" hospital the very next day! He reminded me that he himself, then a Senior Consultant in the Department, got a roasting from Boss on a regular basis and frequently in full view of all of us as well.

Associate Professor Wong Kok Seng and Professor Woo Keng Thye in a rare fun moment together at the Singapore Malaysian Nephrology Forum in 2006.

Associate Professor Wong Kok Seng supporting a fundraising event with Dr Terence Kee and the renal transplant team in 2014.

My tenure as Head of Renal Medicine took me through the period of the SARS epidemic. It appears that things have come full circle with the current COVID-19 crisis. Thankfully, we had learned our lessons well from SARS and were able to respond appropriately when COVID struck in early 2020.

What are some of the things I look back upon and have fond memories about? Well, here are a few...

1. Going to London to meet Choong Meng and Marjorie and persuading them to uproot themselves from their comfortable careers in UK and return to a manpower deprived Renal Medicine Department in SGH. I am not certain I ever made this "small" detail known to them. This happened via a circuitous route. I first got to know Choong Meng and Marjorie when the then CEO of NKF headhunted them for positions within his organisation. However, they declined the offer as they preferred to practice the full spectrum of Renal Medicine. Some months later, I found myself travelling to the United States with a 12-hour transit in London. So, when I landed in London, I took the opportunity to inquire with the both of them about joining us in SGH. I remember Marjorie having an unbridled enthusiasm for PD. So, I promised her that there will be lots of PD patients in SGH for her to look after. For Choong Meng, there was that MOH HSDP project on retarding progression of renal function that he had an affinity towards. The rest was history, as we went on to have in them two of the finest Nephrologists and Leaders in Renal Medicine.

This was a department photo shot when Associate Professor Wong Kok Seng handed over the headship to Professor Chan Choong Meng in 2008.

2. One lesson SARS taught us is that we should not mix outpatient haemodialysis patients with those who are inpatients as we were then doing in our Ward 42 Haemodialysis Centre. This realisation eventually gave rise to Renal Health that we now have in SGH. There were birth pangs related to this project with some stakeholders in SGH opposing its formation, but thankfully, SingHealth felt it was a project worth supporting and Renal Health still stands today.

3. Persuading MOH to adopt a "PD first" strategy together with Marjorie. Dr Woo had earlier enunciated that with NKF building so many haemodialysis centres, we were having, by default, a "HD only" strategy. That could have been a bottomless pit and we might have ended up with more haemodialysis centres than MacDonald outlets in Singapore! Nevertheless, MOH felt that a "transplant first" policy should be promoted at that point in time.

4. Enthusing young nephrologists to undergo further training in Interventional Nephrology. This project had its share of ups and downs on and witnessed some painful manpower departure. As I have then stepped down as Head of Department, I reminded myself of the need to let go and trust the people succeeding me to forge the way forward for the Department. It is important to step aside gracefully and trust the next generation of leaders to lead, minus any distraction from backseat drivers, especially former Heads of Department.

As I conclude, having already fallen prey to the hubris that I desperately wanted to avoid, what do I really want to share with everyone? Without clichés or motherhood statements...

I am glad for the training and life experiences I received in SGH Renal Medicine. It was like undergoing Navy Seal training and so the faint hearted need not apply. You will be stretched intellectually, but that is actually the easy bit. The tough part comes when you have to navigate the changing landscape that Renal Medicine finds itself in all the time. But it is a journey worth taking together with all the selfless men and women who fight alongside you. I am writing this in the time of COVID-19 – very certainly the crisis of our generation. How do we navigate towards the future when there are no published manuals or model answers for us to follow? Still, I am optimistic. If you are someone who has been trained in Renal Medicine SGH, you are well prepared for the many challenges that life will throw at us!

Associate Professor Wong Kok Seng with renal colleagues including Dr Pwee Hock Swee (centre sitting) at a SGH Formal Dinner.

Associate Professor Wong Kok Seng has a remarkable track record of leadership from leading the department of renal medicine and department of internal medicine to his current position as deputy chief executive officer (clinical services) of SingHealth Community Hospitals. He is here with SingHealth senior leadership at an appreciation event in 2019 to thank the 1200 workers who completed SingHealth Tower where Outram Community Hospital is located.

Privileged to Lead

Professor Chan Choong Meng
Head of Department, 2008 to 2014

Looking back at when I took over the role of Head of Department of Renal Medicine in 2008, I was not exactly sure of what I was supposed to be doing. At a personal level, I felt there were many challenges awaiting me. Fortunately, I found a mentor in Professor Woo Keng Thye and also had my immediate predecessor, Associate Professor Wong Kok Seng, to provide me counsel and advice. It took me from about six months to a year to learn and understand the system in use at that time. Understanding what the existing situation was then allowed me to implement changes to improve the system. In my journey, I was fortunate to have the support and dedication of my Senior Consultant colleagues. We worked hard at expanding our manpower and over the years, not only did our consultants grew in number but we were also able to attract high calibre registrars into our Renal Training Programme. At the same time there was an increase in our Medical Officers even though Renal at SGH remained a "hardship" posting. This was the result of a collective effort by all members of the Department. I can still remember proudly when we officially opened our Renal Intermediate Care Area (RICA) and in the later part of my headship, our Interventional Nephrology Suite with capabilities to perform vascular access intervention. With that, the Department was finally able to offer complete and holistic "Renal Care" to our patients. At the same time, we were able to offer our Renal Trainees the full core curriculum in Renal Medicine in SGH.

Renal Transplant was then headed by a young consultant, Dr Terence Kee, who was passionate and dedicated to his work. Every member of the staff from Associate Consultant to Senior Consultant had contributed in many ways to help bring up the Department.

I feel immensely proud and privileged to have been bestowed the opportunity to helm the department for a whole six years (2008 to 2014). On a more personal note, I must say that I had learned a lot working with my colleagues and trainees. To them, I would like to convey my sincere thanks for being the fitting custodians of the Department.

Professor Chan Choong Meng

The department had the greatest end of year party in 2013 called Renal got Talent, thanks to the support of Professor Chan Choong Meng.

Professor Chan Choong Meng with SGH CEO, Professor Ang Chong Lye and Head of Department of Urology, Professor Christopher Cheng at the opening of the SGH Kidney Centre in 2009.

Professor Chan Choong Meng presiding as chief examiner with his faculty and senior residents who sat for the renal medicine exit examinations in 2016. Professor Chan Choong Meng is an education champion, being Chair of the Renal Residency Advisory Committee and is the Group Chief Education Officer of SingHealth.

Professor Chan Choong Meng delivered the 7th Chapter of Renal Physician Lecture and received the Chapter of Renal Physician Medallion in 2013 from Chairman of the Chapter of Renal Physicians then, Associate Professor Terence Kee. Associate Professor Lina Choong delivered the citation for Professor Chan Choong Meng.

Remembering Humanity Amidst Technological Advancements

Associate Professor Marjorie Foo
Head of Department, 2014 to 2020

Recounting My Six-Year Journey Leading the Renal Unit in SGH

In the winter of 2001, our family relocated from London and joined the SGH family. We (Professor Chan and I) were warmly received when we started as consultants in January 2002. I remember stepping down to do registrar work for 3 months to know the ground and it was a great eye opener. The people were warm and keen to learn and despite the heavy workload still walk out of hospital smiling at the end of the day with a sense of satisfaction. We were very encouraged and felt at home in the department. I succeeded Professor Chan as Head of Department on April Fool's day in 2014 as the first female HOD since its conception in 1973. It was a great honour to serve but was never in my mind that I was capable to do so. I started with some trepidation fearing of not meeting expectation and not doing a good enough job to lift the department to greater heights. There were "giants", before me and new digital technologies challenges of practicing in the 21st century.

Associate Professor Marjorie Foo


Associate Professor Marjorie Foo chairing a renal medicine department retreat in 2019.

The Season of Adaptation

There were many challenges awaiting me at work upon my return from the UK and one of them was to understand and adapt to the local healthcare system and patients. One day after doing a round, I was taken by surprise when the wife of a patient ran after me and asked, "Doctor, would it be cheaper if a junior doctor removes the dialysis catheter instead of you?" and, "Are there cheaper medicines you can prescribe that has the same effect?" At that moment, it struck me that I was no longer working with the National Healthcare System (NHS) - here, every single cent mattered. The concepts of value and quality were not ingrained into me during my earlier training, we were taught evidence-based medicine and we tend to prescribe, and order investigations based what should be done rather than what needs to be done. We focus on managing the disease and somehow forgotten to manage the person in front of us that is seeking our help. The patient factor seldom come into the equation. This, of course is now history and we are transforming chronic kidney care into a person-centred model with focus on quality care and value-based outcome bearing in mind the saying: ***"Not everything that can be counted counts, and not everything that counts can be counted" - William Bruce Cameron.***

Fulfilling Moments: Getting to Know Patients as Peritoneal Programme Director

As time went on, I was asked to manage the SGH-PD programme and served as the Programme Director for SingHealth Nephrology Senior Residency Programme. Directing the PD programme gave me immense pleasure and satisfaction by working with caring nurses, managers, vendors, and patients. In the Singapore setting, in the early days, I learned to be patient's "medical financial adviser", prescribing with the intent to optimise use of their medical savings and sum-limited insurance. This started my venture into business negotiation with vendors and negotiating

Associate Professor Marjorie Foo was one of the judges for the Renal Department year-end party "Renal Got Talent" in 2013.

Associate Professor Marjorie Foo receives the Chapter of Renal Physicians Lectureship in 2016 with Dr Elizabeth Oei (first on the left) giving the citation for her.

prices to make PD more affordable and planning for budget to keep the manpower strong. It was never in my life plan to be an accountant or an insurance broker or a negotiator, but this is learning on the job and has broadened my mind and experience. There were multiple challenges and it was a necessity to overcome them. Strangely, but not surprisingly I can always find help and support around the corner.

Fulfilling Moments: Training for the Future With the Residency

As a Programme Director for senior residency, I cherished the journey to HarvardMacy to learn the ways of teaching. A necessary skill I need to have to venture into the world of the Millennials and to teach in the 21st Century. Though evolution has not change us much in the last millennium, technology has certainly advance mankind more than one can ever imagine. The Residency Programme has put me into a position of needing to juggle between clinical needs and workload with limited manpower expected from residents. I handed over the programme director post to Associate Professor Jason Choo and under his guidance, the programme went from strength to strength. We achieved the Best-Improved Programme in 2017 and Best Programme for the following two consecutive years.

The Day It All Began

April Fool's Day 2014, the day I became Head of Department, started ironically with a sense of seriousness and loneliness. Gone were the frivolous chats and idle gossiping along the corridor or the friendly knock on the door. There was a feeling of being a bubble enclosure. I was assured that things will change, hopefully for the better.

A Season Like No Other Before ... Hepatitis C Outbreak and How We Got Out of It

In the summer of 2015, we experienced one of the world's largest Hepatitis C outbreaks in a renal unit. It did not occur in a dialysis centre as one might have thought but in a transplant unit, a unit which we took pride in especially with our strict infection control practices and advocate of stringent protocols.

The department had been hit with a thunderbolt that jolted everyone out of their deep sleep. We strayed into uncharted waters and were dragged into a whirlpool of emotions; fear, self-doubt, suspicion,

Associate Professor Marjorie Foo as the host of one of the PD regional forum training nephrologists from around the region in 2018.

disbelief, depression, and helplessness. Doctors, nurses, and patients – no one was spared.

We survived the incident with support from Professor Woo Keng Thye, Professor Chow Wan Cheng, Professor Fong Kok Yong and Professor Ang Choong Lai. This incident created a significant dent in our confidence and a permanent scar in our memory. It is a scar that will serve as a constant reminder of the need for us to be humble and never to be complacent when the going is good and a reminder that there is nothing that cannot be fixed as long as we come together and support each other.

We rejoiced with patients who recovered and mourned those whom we have lost. Three whole years were needed to heal and rebuild the unit. The good thing was... Relationships, trust, and support amongst peers were never as strong before. Infection control measures were tightened, and lessons learned were disseminated across the whole institution, providing enhanced focus on patient safety and accelerated quality improvement initiatives.

The Digital Era: The Good, The Bad and the Ugly

Ward rounds used to be not only about physically checking up on patients but also running around looking for X-rays, medication charts, and case notes, while having to ensure that you have an endless supply of ballpoint pens in your white coat pockets, along with your name stamps. Now, gone are those days of ink-stained pockets on shirts and bulky pockets filled with name stamps and pages of patient lists! Who knows if we will ever need to write anything by hand anymore in the future? Isn't this great? The introduction of digital case notes and imaging was a godsend. Just how much time and money have we saved by not needing to run around looking for documents? The quality of life has clearly improved for juniors, maybe for seniors but as for our poor patients. Not really...! For digital native juniors, digitalisation is something that comes naturally, while for seniors (being digital migrants), it is a necessary evil, and as for patients, they simply exclaim, "I cannot get to see my doctors' faces, they just stare at the computer screen all the time!"

A quiet moment for Associate Professor Marjorie Foo in the early morning during the last days as Head of Renal Medicine.

SingHealth was hit by one of the biggest cyberattacks in 2018. That temporarily crippled the way we work with internet separation and secure messaging becoming the norm. Patient data security became an utmost priority, with a heightened awareness on the Personal Data Protection Act and the threat posed by rampant internet phishing. Everyone got help on how not to fall prey to internet hoaxes and scams. The outcome is one of enhance security at all cost and booming of computer sales as separate computers were needed for internet-enabled services.

Building Bridges through Collaboration and Research

Extending a helping hand: Extending knowledge beyond borders was one of our priorities. The Department has been constantly reaching out to regional countries with support from the International Society of Nephrology (ISN), including adopting a sister unit in the Philippines. We advised them on the requirements for building of new centres and for conducting training.

The true test of leadership is how well a leader functions during a crisis. Associate Professor Marjorie Foo had passed the toughest of times with flying colours and brought others up with her like ward 64E when it received the Team Up Award in 2019.

With support from our vendors, the Department also reached out to train physicians and nurses in charge of peritoneal dialysis programmes from neighbouring countries like Thailand and Indonesia. Our support also reached all the way to the shores of Fiji, when the Ministry of Foreign Affairs engaged us to send a team of experts in critical care nephrology and haemodialysis to help the locals establish themselves in these areas of expertise by providing training for their nurses and doctors. The trip turned out to be a mutual learning experience. We observed and discovered the new limits to "leanness", and most importantly, realised how fortunate we are to have high-tech machines at our disposal and how lucky our patients are to be able to enjoy world-class healthcare.

Expanding the Research Frontier

Multipartite collaboration with industry, universities, global networks, and patients

Research is one of the three main pillars in renal medicine in SGH. Over the past six years, there has been a push in this direction by the Ministry of Health, encouraging research innovation in health services, devices, genomics, and data science. With this in mind we re-organised the department structure, allocating lead roles for various subspecialties e.g. academic nephrology, intervention nephrology, critical care nephrology, research, PD, HD and Transplant. Innovative research grants have allowed for more collaboration between healthcare institutions, universities, and industry partners. The foresight of the government has enabled the department to extend the research frontier beyond basic science research to innovative device research in dialysis access and dialysis machines. During this period, we had 2 devices in dialysis arena that attained FDA "breakthrough device" designated; a PD-based wearable artificial kidney and sirolimus coated balloon angioplasty device (Magic touch PTA).

The Department, in collaboration with the university, has focused extensively on the area of Patient Related Outcome Measures (PROMS) research in PD, transplantation, and CKD management. The focus of research in PROMS has allowed patients to be more personally involved in their care and facilitate value in our care.

The renal unit in SGH is made up of highly intellectual, self-motivated, ambitious and compassionate people, who want to excel and do well by our patients. I see my role as a facilitator and a servant. Facilitating empowerment, while aligning with the mission and vision of the institution and the nation. Facilitation accomplished with transparency and impartiality always. Last but not least, we will not be too far wrong if we follow the motto "do to others as we would like others do unto us".

感恩

柔和的灯光抚慰着我的眼脸，
吟唱着的监测仪撩拨着我的耳弦，
忙碌的白衣天使呼唤着我的意识，
我知道！
苦难已经过去！
我获得了新生！

就在昨天，
我还躺在透析机旁
忍受那漫长的四小时：
穿刺的疼痛，
口渴的煎熬，
钾磷的紊乱，
摧残着我的肉体，
消磨着我的意志。
工作泡了汤，
旅游、美食成了梦想，
甚至连水，都成了奢望。
为了家人，
独自在暗洒的泪涛中
苦苦地徘徊。

就在此刻，
这一切都成了过去，
我又可以展开希望的翅膀，
不再纠结、不再忧虑，
珍惜生命和健康，
用爱来拥抱这个世界，
让生命的价值重新绽放！

苏醒的激动，
掩饰不住，
对医护的感恩。
他们是
久旱的甘霖，
黎明的曙光，
他们是
守护的天使，
病患的希望。
他们带走我心灵的创痛，
带来了我对未来的畅想。
感恩！

By Ms. Yu Yang,
a kidney transplant recipient at SGH

Grateful

The gentle lights comfort and rouse me
To the rhythmic beeping of the monitors
And I stir to the hum of the bustling ward,
The chorus of the nurses — the angels in white
I know, now
That I have passed the trials
And crossed the threshold to my new life.

Just yesterday I lay next to the dialysis machine
Enduring those 4 interminable hours
Still, and suffering:
The sting of the needles
The torment of thirst
The salts in shambles
Ravaging my body
And wearing down my mind.
Gone was my job
Travel a mere dream
The pleasure of food and water
Became a luxury I could not afford
I shouldered this alone, away from my family
Weeping in dark, and
Wandering in the uncertainty.

But now, the old has passed
And I unfurl my long-forgotten wings
Leaving the struggle behind
To cherish my life and health,
To embrace this world with love
And let life bloom again.

The unbridled joy upon my awakening
Does nothing to dim my gratitude to the healthcare team
They are:
The first drops of rain after a long drought
The gleam of light at the end of a long night
My guardian angels
The hope for all patients
They have taken away the thorn in my heart
And brought me hope for the future
I am thankful!

Translated by Dr Chin Han Xin

Chapter 2
50 Years of Renal Transplantation at SGH

"But most of all, it will be a place where patients will truly feel that they have a second chance of life and the programme places them at the heart of all it does. And yes, " This is what Hope looks like."

- Associate Professor Terence Kee

History of Renal Transplantation at SGH

Associate Professor Terence Kee
Senior Consultant and Medical Director for Renal Transplantation

Kidney transplantation in Singapore could not have possibly started without a haemodialysis programme and the philanthropic support that SGH, or then called Outram Road General Hospital, received in the 1960s.

In 1961, a generous donation of a Travenol (Kolff) twin coil dialysis machine from Dato Lee Kong Chian ushered in dialysis treatments in Singapore.[1] As a result, there was hope for patients with acute kidney failure as dialysis enabled some 35% of those afflicted then to recover from the illness. However, for those with irreversible end stage renal failure (ESRF), there was no chronic haemodialysis programme then and consequently it was estimated that at that time about 200 Singaporeans died from ESRF ever year. As a result, Professor Khoo Oon Teik, Head of Medical Unit 2 of SGH, recognised the importance of developing a chronic haemodialysis programme because without it, patients would not be able to survive long enough to receive a kidney transplant, which was viewed as a cheaper alternative to haemodialysis. He thus initiated a drive to seek donations for the hospital to procure a chronic haemodialysis machine and successfully started a haemodialysis programme in 1968. By 1970, a 10-bedded dialysis unit was set up at SGH.

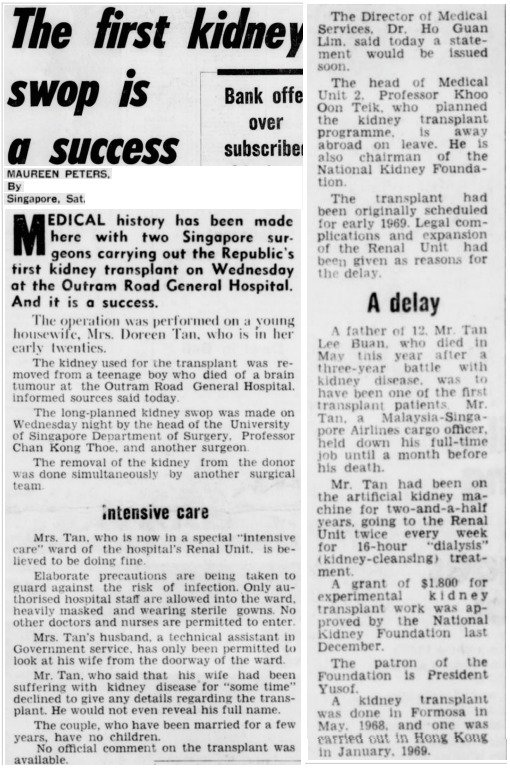
While the haemodialysis programme was developing, visits to overseas transplant centres in the United States (Francis D Moore and Joseph Murray at the Peter Bent Brigham Hospital) and United Kingdom (Roy Calne, Westminster Hospital) were made in 1965 to develop the knowledge base required for setting up a kidney transplant programme. In 1966, a proposal was made to the Ministry of Health to approve and support an organ transplant programme and by 1967, Professor Khoo was able to announce plans for SGH to perform kidney transplantation. As a result, in the following year, a kidney transplant team was formed and included Sister Ling Mei Hean who was a nurse that worked in Adelaide Hospital where Australia's first kidney transplant was performed. In addition, an animal experimental surgery laboratory was set up using donations from Dato Dr Aw Cheng Chye and the China Medical Board. With this laboratory, the kidney transplant team led by Professor Chan Kong Thoe honed their surgical skills by performing one dog renal transplant per week. Simultaneously, protocols were developed at SGH for deceased donor kidney procurement, tissue typing and post-operative management. As there was then no government funding available to drive the initiatives to develop dialysis and transplantation in Singapore, the National Kidney Foundation (NKF) was also set up in 1968 to meet such a need, with Professor Khoo Oon Teik becoming its first chairman. With donations from various individuals and the Lion's Club, two patients one of which was Ms. Doreen Tan were able to receive 16 hours of chronic haemodialysis twice a week and were eventually fit enough to be identified as suitable candidates for kidney transplantation.

Professor Khoo Onn Teik established the first renal dialysis unit at SGH in the 1960s.

By the end of 1969, SGH announced that it was ready to perform its first kidney transplant. However, there was little support from the University of Singapore and objections were voiced over whether this was a priority among many other primary healthcare needs at that time, such as hospital beds and better facilities for patients. A general practitioner even declared that "this move to transplant is both ill-timed and ill-considered. It entails a large sum of money spent on a handful of patients to achieve results which can at best be of short-term success".[2] Nevertheless, the dream of performing a kidney transplantation persisted and it was envisioned that the first donor would be someone who had died in a hospital though those who died from suicide would be excluded from kidney donation.

By the time a deceased donor was available, there were three candidates for transplantation, but one had died while the other was too ill to undergo transplantation. This left Ms. Doreen Tan, who was a clerk at the British Royal Air Force and had been on haemodialysis since October 1969. On 8th July 1970, doctors approached Mdm. Lee Ah Hoe, the mother of Mr. Yee Kwok Chong, a 20-year old national serviceman who died from a brain infection, asking for him to be the first deceased donor in Singapore. Mdm. Yee agreed, saying that "It did not take long to decide. I told myself I might as well do a good thing by saving a life with something my dying son could not take with him."[3] As a result of her altruism, Ms. Doreen Tan received the first kidney transplant in Singapore, performed by a team led by Professor Chan Kong Thoe, Head of the Surgical Department at SGH back then. The transplant was complicated by delayed graft function, but Doreen was eventually discharged by September of 1970. This historic transplant could not have been possible without the NKF, who financed the entire procedure.

Ms. Doreen Tan, the first kidney transplant recipient in Singapore celebrating her 20th transplant anniversary with her surgeon, Dr Chan Kong Thoe, in 1990.



The first kidney swop is a success

Bank offe over subscribe

MAUREEN PETERS,
By
Singapore, Sat.

MEDICAL history has been made here with two Singapore surgeons carrying out the Republic's first kidney transplant on Wednesday at the Outram Road General Hospital. And it is a success.

The operation was performed on a young housewife, Mrs. Doreen Tan, who is in her early twenties.

The kidney used for the transplant was removed from a teenage boy who died of a brain tumour at the Outram Road General Hospital, informed sources said today.

The long-planned kidney swop was made on Wednesday night by the head of the University of Singapore Department of Surgery, Professor Chan Kong Thoe, and another surgeon.

The removal of the kidney from the donor was done simultaneously by another surgical team.

Intensive care

Mrs. Tan, who is now in a special "intensive care" ward of the hospital's Renal Unit, is believed to be doing fine.

Elaborate precautions are being taken to guard against the risk of infection. Only authorised hospital staff are allowed into the ward, heavily masked and wearing sterile gowns. No other doctors and nurses are permitted to enter.

Mrs. Tan's husband, a technical assistant in Government service, has only been permitted to look at his wife from the doorway of the ward.

Mr. Tan, who said that his wife had been suffering with kidney disease for "some time" declined to give any details regarding the transplant. He would not even reveal his full name.

The couple, who have been married for a few years, have no children.

No official comment on the transplant was available.

The Director of Medical Services, Dr. Ho Guan Lim, said today a statement would be issued soon.

The head of Medical Unit 2, Professor Khoo Oon Teik, who planned the kidney transplant programme, is away abroad on leave. He is also chairman of the National Kidney Foundation.

The transplant had been originally scheduled for early 1969. Legal complications and expansion of the Renal Unit had been given as reasons for the delay.

A delay

A father of 12, Mr. Tan Lee Buan, who died in May this year after a three-year battle with kidney disease, was to have been one of the first transplant patients. Mr. Tan, a Malaysia-Singapore Airlines cargo officer, held down his full-time job until a month before his death.

Mr. Tan had been on the artificial kidney machine for two-and-a-half years, going to the Renal Unit twice every week for 16-hour "dialysis" (kidney-cleansing) treatment.

A grant of $1,800 for experimental kidney transplant work was approved by the National Kidney Foundation last December.

The patron of the Foundation is President Yusof.

A kidney transplant was done in Formosa in May, 1968, and one was carried out in Hong Kong in January, 1969.

The significance of this event was that it was a quantum leap in the treatment of ESRF in Singapore and was also the first deceased donor kidney transplant to be performed in South-East Asia. This kick-started the deceased donor kidney transplant programme which eventually led to Singapore being the country with the highest deceased donor kidney transplant rate per million population rate in the South-East Asian region.[4] Another remarkable observation was that Ms. Doreen Tan continued to live for another 22 years before dying at age 52 on 19th March 1992 from an infection related to a hip replacement operation. This was truly a testimony to the skills and care of the healthcare team that were practicing medicine when Singapore was a developing country, and barely five years after it achieved sovereignty.

Unfortunately, there were no further donations for the rest of 1970 despite the availability for Singaporeans to state their wish to donate their organs by signing donor cards. There were difficulties getting consent for kidney donations due to religious superstitions and fears that kidneys may be prematurely removed. The next two deceased donor kidney transplants were subsequently performed only a year later on 16th October 1971 when a 29-year old policeman, Mr. Michael Ray Tex Melson died from a gunshot wound and became a kidney donor to 51-year old Mr. Ang Koen Sim and 25-year Mr. Ho Fong Chan, who were the first males to receive transplants.[5] Unfortunately, Mr. Ang subsequently also became the first patient with graft loss when he underwent transplant nephrectomy for a urinary leak in March 1972.[6]

Kidney donation rates were very poor, with only three further deceased donor kidney transplants being performed even as the annual mortality rate of ESRF patients rose to 400 in 1972. As a result, the Medical Therapy Education and Research Act (MTERA) was introduced in the same year to pave the way for individuals to pledge their kidneys for donation upon their death. Unfortunately, it was subsequently realised that none of the deceased donor kidney transplants performed after the introduction of MTERA were from organ pledgers. The first post-operative mortality was also encountered in 1972 when 36-year old Mr. Wong Kam Wah died on 30th July 1972 from haemorrhage, 17 days following his kidney transplant surgery.[7]

With the passing of the MTERA, the NKF launched a campaign in 1973 to get more Singaporeans to pledge their kidneys by signing donor cards. However, deceased donor kidney transplant rates remained low with only nine transplants being performed between 1973 to 1974, of which 3 were failures. The waiting list had also grown from three in 1970 to 21 in 1974 and included Mrs. Poobalan Naidu, a 30-year old teacher who previously received her first transplant on 16th December 1972, but which subsequently failed due to rejection. She eventually received a second kidney transplant on 26th July 1974, becoming the first re-transplant patient in Singapore.[8]

Deceased kidney donation rates were very poor with only 20 deceased donor kidney transplants performed between 1970 to 1976. As a result, living kidney donation was subsequently legally permitted and resulted in the first living kidney donor transplant being performed in 1976 when Mr. Mani Retnam, a 21-year old man received a kidney from his elder 28-year old brother Krishnan on 31st July 1976. Unfortunately, he died 11 days later from viral myocarditis.[9] However, this legal approval for living kidney donation to take place in Singapore expanded the opportunities for transplantation and allowed other hospitals to consider transplantation. As a result, the first living kidney donor transplant in a private sector hospital was performed on an Indonesian man on 11th December 1978.[10] Between 1976 to 1983, living kidney donors became the predominant source of kidney transplantation at SGH, with 95 kidneys transplants performed from parents and siblings. The criteria then for living kidney donation then was that the potential donor should be willing and have at least a single haplotype match with normal renal function with single renal artery.[11] These criteria have changed significantly over the years, with kidney donation from individuals who are immunologically incompatible or have complex vascular anatomy becoming acceptable in this modern era of transplantation.

In 1981, the current SGH was opened by then Prime Minister Mr. Lee Kuan Yew and ushered in the second decade of significant milestones in kidney transplantation in Singapore. The renal unit in the old attic of the Outram General Hospital shifted to a spanking new ward and dialysis centre on level 2 of the new SGH. Amid the excitement of a new hospital and progress in renal care, there was still not enough

First live kidney donor did it to save brother's life

SHEILA CHEONG

Only one with 'full house' match

By

HOUSING Board labourer Krishnan s/o Retnan, 28, became the first live kidney donor in Singapore four days ago when he donated one of his kidneys to save his younger brother Mani's life.

Doctors — two surgeons and two renal specialists from the Singapore General Hospital — successfully performed the three-hour twin operation in adjoining theatres at the hospital on Saturday.

Concern

Already up and about, Krishnan spoke of his family's concern on learning of Mani's chronic kidney disease.

He said their mother, a brother, sister and himself rallied round to volunteer their kidneys for Mani, 21, when told that a live kidney donor transplant was possible.

But only Mani's and Krishnan's blood and tissues proved a "full house match".

Though married with a three-year-old daughter, Krishnan had no hesitation about the transplant.

"My only thought was to save my brother's life," he added.

One of the surgeons said: "Krishnan will be discharged in a few days and can live as normally as anyone else with one kidney.

"Mani is convalescing and is as well as can be expected."

He said relatives found it hard to donate kidneys to their kin.

'Backed cut'

"Relatives have no more than one occasion agreed to be a live donor but backed out after second thoughts," he said.

Mani's kidney transplant brings the total carried out in Singapore to 20.

About a month ago, doctors at the Singapore General Hospital carried out yet another cadaver transplant (from a dead donor).

Wong Kim Chua, 28, received a kidney from a 17-year-old girl who died in a bus accident.

A reassuring pat on the hand for Krishnan from his mother, Mrs. R. Seetha

kidney donors especially deceased ones to meet the growing demand of patients with ESRF. Between 1970 and 1982, there were only 30 deceased donor kidney transplants performed, which translated to a dismal average rate of 2.5 transplants per year. To alleviate this shortage of deceased donors, unwanted kidneys from other countries were imported into Singapore for kidney transplantation under a trans-Pacific organ sharing programme. On 1st July 1983, Mdm. Sim Tong Lian, a 37-year old woman became the first Singaporean to receive an overseas deceased donor's kidney from the United States.[12] Despite nearly 48 hours of cold ischemia time, Mdm. Sim was successfully taken off dialysis. Subsequently, 10 more kidneys from the United States were imported into Singapore but on 26th October 1983, kidneys also began to be imported from Canada, of which the first was transplanted to 32-year old Mdm. Goh Ah Choo after 38 hours of cold ischemia.[13] Between 1983 to 1987, a total of 33 kidneys (27 from the United States and six from Canada) were imported, all HLA mismatched to their recipients and kept under very long cold ischemia durations of 50 to 73 hours. Although these imported kidneys help to increase the annual transplant rate to 13.8 per year, the outcomes were very poor with 1-year graft survival being only 27.3% compared to the 76.4% 1-year survival rate of local deceased kidney donor transplants. Primary non-function occurred in 15.2% while patient survival was only 72% at six months post-transplantation due to the high rates of sepsis.[14] It was also expensive to import these kidneys and the countries which were providing these eventually needed them for their own transplantation needs. As a result of these factors, the trans-Pacific organ sharing programme was abandoned.

In subsequent years, local newspapers often highlighted stories of patients receiving kidney transplants to raise awareness of transplantation. One remarkable story was when Mdm. Nurain Binte Abdullah became the first kidney transplant recipient to successfully give birth to a baby girl on 15th January in 1984.[15] Despite these stories to encourage kidney transplantation as a preferred alternative to dialysis, donation rates continued to remain very low and there were also insufficient dialysis machines for everyone. As a result, patients who had the financial means turned to commercial kidney transplants from the black markets of India from 1979 and China from 1986. Since then, 553 patients from SGH have received overseas commercial kidney transplants from these countries between the period of 1979 to 2019, a number driven by the unacceptably long waiting time for a deceased donor and the reluctance to accept or become a living kidney donor. Unfortunately, outcomes from these overseas commercial kidney transplants were poor especially due to donor-transmitted infections like fungus, HIV and hepatitis B. Subsequent analysis of these cases revealed that the infection rate from these overseas transplants was high at 47% compared to 5.2% of kidney transplants performed locally. Allograft survival at 10-year follow-up was also numerically inferior among overseas transplants at 66.9% compared to 77.9% for local kidney transplants.[16] Fortunately, commercial kidney transplantation from these countries have been largely eliminated by 2019 due to better local regulation and enforcement, but now, patients instead go to Cambodia for kidney transplantation by a surgical team from China but with unrelated donors from Cambodia, Vietnam and even India.

In 1985, Cyclosporine was introduced into Singapore and by end of 1988 had become the mainstay immunosuppression, leading to dramatic improvements in outcomes. Prior to Cyclosporine, the standard for kidney transplant immunosuppression was Azathioprine and high doses of Prednisolone. However, this regimen was associated with a low 10-year graft survival rate of 32.5% where rejection was responsible for 81.2 % of graft losses.[17] With the introduction of Cyclosporine, 10-year graft survival improved to 67.4% and graft loss due to rejection fell to 42.3%. Similarly, 10-year patient survival also improved from 47.3% to 87.7% following the switch from an Azathioprine- to Cyclosporine-based regimen. When Azathioprine and Prednisone was used, the doses of immunosuppression were very high e.g. 100 mg/d tapering to 10-15 mg/d at six months post-transplant which may be partly responsible for the high rates of infective complications seen during those times. But the introduction of Cyclosporine allowed lower doses of immunosuppression e.g. the starting dose of Cyclosporine was 12 mg/kg/d in combination with Corticosteroids and Azathioprine during the early years, but this was progressively reduced over time to 5 mg/kg/d in combination with Corticosteriods and Mycophenolate. Unfortunately, prior to financial assistance being provided by the government, the costs of using Cyclosporine was high (e.g. $950 per month). Fortunately, both NKF and private companies chipped in to reduce the financial burden of patients on Cyclosporine therapy. In order to reduce drug costs, some patients were converted from Cyclosporine to an Azathioprine-based regimen at the end of the first year of transplantation, but chronic rejection was frequent, leading to the abandonment of this practice.[18]

In spite of the advances in kidney transplantation in Singapore, deceased donation rates remained low. Organ pledgers were few (e.g. only 2,800 in 1981), partly driven by a desire from the Chinese majority to keep a complete body upon death. Between the 16 years from 1970 to 1986, only 69 deceased donor kidney transplants were performed, representing an annualised transplant rate of 4.3 per year. Living kidney donors slightly buffered the burden of low transplant rates as 146 living donor kidney transplants were performed between 1976 to 1986, representing a higher annualised transplant rate of 13.3 per year. Nevertheless, there was an urgency to increase transplant rates in Singapore as haemodialysis was expensive and over 90% of patients on dialysis still died after five years.

As a result, the government had to explore alternative ways to increase the deceased donation rates apart from the existing MTERA. For example, at that time, Israel had an opting out legislation which resulted in an immediate doubling of its transplant rates within 12 months. Thus in 1981, the then Minister of Health, Mr. Goh Chok Tong, proposed to Singapore to consider an opting out or presumed consent legislation to increase the number of organ donations from the deceased. This suggestion was met immediately with various concerns including the perception that not enough was done to improve the organ pledger rate, worries that doctors might give up on patients for the sake of organ donation and that presumed consent to donate did not necessarily imply expressed consent. Nevertheless, over the next five years, the idea of an opting-out legislation was reviewed and debated by many stakeholders including overseas experts, the general public, religious bodies, educators, student unions, trade unions, legal authorities and health-related professional bodies. In order to improve organ donation rates, "kidney persuaders" who were medical social workers trained to persuade families to donate the kidneys of their dying relatives were introduced in 1983 but failed to have a major impact on organ donation.

Eventually, in 1985, the health ministry announced its intention to introduce an opting out legislation. Following this announcement, in 1986 Singaporeans (as many as 58,000 of them) from all walks of life such as patients, taxi drivers, and churchgoers expressed their support for by helping to raise awareness of the proposed opting out legislation. This decision to push through an opting-out legislation was reinforced by the fact that over a period of 13 years, NKF had managed to secure only 24,808 organ donor pledges (out of a target 800,000 organ pledgers estimated to be necessary for the needs of dialysis patients). This small number of organ pledgers was obtained at an astronomical cost of $4 million dollars spent on publicity campaigns via talks, pamphlets, notices on utility bills, filmlets, exhibitions and advertisements targeted at pharmacies, schools, community centres, companies, statutory boards, churches, universities and households. Apart from

NKF, even nurses and college students volunteered to organise their own campaign to get more organ pledgers, but their yield was poor. Furthermore, not a single kidney was procured from pledgers and all kidneys from deceased donors were obtained through securing consent from their next of kin. As a result, it was clear that the then existing framework of relying on MTERA to procure organs was not effective to improve transplantation rates. Between the 17 years from 1970 to 1987, only 85 local deceased donor kidney transplants were performed, producing an average rate of five deceased donor kidney transplants per year. Furthermore, there was also no significant drive to encourage more living kidney donations during this period as there were concerns about the health of living kidney donors after donation.

Interestingly, prior to the introduction of the opting out legislation on 16th July 1987, there was a sudden increase in the number of local deceased donor kidney transplants from just one in 1985 to 15 in 1986. This was attributed to the massive publicity efforts to encourage organ donation in previous years as well as the good work performed by Ms. Sally Kong, the first transplant coordinator appointed in 1986. By 1987, the Human Organ Transplant Act (HOTA) was passed, taking effect in 1988. HOTA was essentially an opting out legislation, permitting the removal of only kidneys for the purpose of transplantation from Singaporean citizens between 21 and 60 years of age who had died from accidents and were otherwise known to be of sound mind. Muslims were excluded at that time as the community was not ready to accept donation and transplantation as part of routine care. This act made Singapore the only country in Asia to have an opting out legislation. HOTA had an immediate effect on the number of deceased donor kidney transplants being performed, which increased from 16 in 1987 to 23 in 1988. In 1989, histocompatibility testing, which was previously performed on site in SGH was shifted into a central laboratory that is currently located at the Health Sciences Authority building in Outram Road.

Over the next two years, deceased donor kidney transplants further increased and 1990 saw a record of 45 deceased donor kidney transplants being performed, the highest achieved over the last two decades. The average annual deceased donor kidney

Celebrating the 500th kidney transplant at SGH in 1994. This event was graced by the presence of Dr Kwa Soon Bee and attended by 150 kidney transplant recipients in SGH.

transplant rate increased to 31 per year between 1988 and 1990 with 58.5% of kidneys donated under HOTA. As a result, SGH hired Singapore's second transplant coordinator, Mr. Peter Soh to assist Ms. Sally Kong. In that same year, SGH celebrated 20 years of kidney transplantation by holding a lunch gathering of patients and released 346 balloons into the air, representing the total number of kidney transplants performed at SGH till then. Another milestone achieved in 1990 was the introduction of government financial assistance for immunosuppression, which was previously fully borne by the patient. The 1990s also saw a policy drive to encourage patients to consider living related donor kidney transplantation if they had suitable related donors (parents or siblings). This was because despite having HOTA in force, the deceased donation rates were still unable to meet the demand of a growing wait list of patients on dialysis. The decade also witnessed further moves to widen access of kidney transplantation to patients with ESRF. In order to further expand the potential living kidney donor pool, spouses were also allowed to be living kidney donors in 1991, and thence the first living spousal kidney donor transplant was performed on 4th March 1991 at SGH. Since then, spouses have become the dominant type of living kidney donors today, accounting for over 80% of living kidney donor transplants being performed over the last five years at SGH. Prior to the 1990s, patients who received kidney transplants had either hypertension or chronic glomerulonephritis but in the 1990s, patients with systemic causes of ESRF, such as systemic lupus erythematosus (1991) and diabetic kidney disease (1992), also started getting transplanted. On 5th March 1994, SGH celebrated

performing 500 kidney transplants at a gathering of more than 100 patients and healthcare providers. As a result of the increasing workload and complexity of evaluating donors and recipients while ensuring that post-transplant follow-up care was being provided, Ms. Lu York Moi, a nurse was employed to be the first dedicated post-transplant coordinator in 1995; and is now the longest serving transplant coordinator in the programme.

By end-1999, the renal transplant programme at SGH accounted for exactly 1000 kidney transplants (761 deceased donor and 239 living kidney donor transplants). Nationally, the introduction of HOTA had significantly increased the annual deceased kidney donor transplant rate to 44 per year during the period from 1988 to 1999, reaffirming the belief held by HOTA champions like Mr. Thambirajah Tharmadurai (Chief Executive Officer of NKF then) and others that an opting out legislation was necessary to increase deceased donor kidney transplant rates in Singapore.

The turn of the 21st century would see rapid advances in renal transplantation and surgery that would transform the renal transplant programme at SGH into a world class transplant centre. In 2002, hand-assisted laparoscopic donor nephrectomy was introduced and evolved to full laparoscopic donor nephrectomy by 2005.[19] This new surgical technique improved the acceptability of living kidney donation as the outcomes were good and hospital stay was short at an average of 3-4 days. New immunosuppressive drugs also started streaming in and are the modern armamentarium of which the renal transplant programme uses to prevent and treat rejection today (Table 1).

Table 1:Timeline of the modern era of immunosuppressive drugs used at SGH

2002	2003	2004	2008	2009
OKT3 Mycophenolate Mofetil	Tacrolimus	Thymoglobulin Sodium Mycophenolate Sirolimus Basiliximab Daclizumab	Everolimus	Rituximab

With the advent of these newer immunosuppressive agents, extra-corporeal therapies like plasma exchange (2003) and the introduction of newer histocompatibility techniques like flow cytometric crossmatch (2007) and solid phase assays to detect anti-HLA donor specific antibodies (2008), the renal transplant programme started planning for HLA and ABO incompatible kidney transplantation, which included an overseas study trip to Japan in 2008. These transplant options would further expand the options for patients wishing to undergo living kidney donor transplantation. As a result, the first HLA incompatible kidney transplantation with preformed donor-specific antibodies in SGH was eventually performed on 9th April 2008, while the first ABO incompatible kidney transplant in SGH was performed on 11th November 2009. With further development of critical care nephrology at SGH, newer antibody removal technologies like double filtration plasmaphresis (2016), Glycosorb© immunoadsorption (2017) and regional citrate anticoagulation (2018) were introduced to improve the versatility and safety of extra-corporeal therapies for high immunological risk antibody positive kidney transplantation. For example, in 2018, patients with very high levels of both HLA and anti-ABO antibodies underwent desensitisation with a hybrid protocol using both immunoadsorption and plasmaphresis to successfully undergo living kidney donor transplantation. Such patients would have been considered ineligible for kidney transplantation barely a decade ago.

As experience grew with the use of modern immunosuppression and extra-corporeal therapies, the renal transplant programme started to share its expertise with others. In 2014, it helped ophthalmologists from the Singapore National Eye Centre to perform high immunological risk corneal transplants using a protocol with Basiliximab and Sirolimus while in 2018, it assisted with immunoadsorption for Singapore's first ABO incompatible liver transplantation at SGH. The programme is now assisting in the development of immunosuppression protocols for proposed transplant programme like uterine transplantation and vascularised composite allograft transplantation.

Despite all these advances in kidney transplantation surgery and medicine, kidney donation rates have not improved significantly. After the introduction of HOTA in 1987, deceased donor kidney transplantation increased significantly from an annual average transplant rate of 4.7 per year during the period from 1970 to 1987 to 47 per year during the period from 1988 to 1999. However, in the first five

Siblings overcome the odds to carry out transplant op

New methods help prevent rejection where donors, patients not a match

By POON CHIAN HUI

WHEN his elder sister's kidneys both failed in 2009, operations manager Yow Kok Kheong wanted to give her one of his.

Then antibody tests showed they were not a match.

But early this year, against all odds, 38-year-old teacher Yow Sok Fun successfully received a kidney from her brother, 35.

This was after Singapore General Hospital (SGH) had devised a way to condition the patient's body to accept an incompatible transplant.

The public hospital now joins two others in offering kidney transplants from patients who have incompatible antibodies, though their methods may differ slightly. National University Hospital has performed 14 such procedures since 2009, while Mount Elizabeth Hospital has had at least seven in the past five years.

For SGH, Ms Yow was their first.

The latest development offers yet another avenue for patients who have trouble finding a suitable donor, said surgeon Terence Kee, who heads SGH's renal transplantation programme.

"We can re-open the transplant option to patients who are on the waiting list for a kidney," he said.

Kidneys from deceased donors are getting harder to come by.

Figures from the National Organ Transplant Unit showed that the number of deceased donors hit a five-year low last year at only 23. This is down from 36 in the preceding year.

But the waiting list for kidneys is many times longer, with more than 400 requiring one each year.

The average wait is about nine years.

"Chances are bleak for these patients," said Dr Kee, who operated on the siblings in January. "Still, we always try to find a compatible donor first. The new protocol is the last resort."

About two years ago, the Yow siblings had failed the "T-cell cross match" test that determines if there are antibodies that will cause rejection.

Ms Yow, who is married with two school-going children, had very high levels of problematic antibodies due to previous pregnancies and blood transfusions.

In such situations, doctors normally will not proceed with the transplant due to the high risk of rejection – more than 80 per cent.

But the hospital, for the first time, tried an approach in which she received regular infusions of a blood product in the months leading up to the surgery, to reduce the amount of "bad antibodies".

The blood product, called intravenous immunoglobulin, is extracted from donated blood. One of its functions is to help "switch off" the production of the bad antibodies. After this, Ms Yow's blood was filtered through a machine to remove the antibodies.

Dr Kee said not everyone is suitable for the latest approach. For instance, they have to be healthy enough for the blood filtering procedure, which may cause low blood pressure. This can in turn trigger a heart attack or stroke in vulnerable patients.

Since the surgery, Ms Yow has recovered without complications. Initially, she had hesitated due to the higher risks involved.

Ms Yow Sok Fun, 38, has since recovered without complications after she received a kidney from her brother Kok Kheong, 35, in January. Antibody tests had shown he was an unsuitable donor. ST PHOTO: NEO XIAOBIN

Hospital's approach

- Patient receives regular infusions of a blood product, called intravenous immunoglobulin, to reduce "bad antibodies" in months leading up to surgery
- Blood is filtered to remove antibodies
- Patients have to be healthy enough as procedure may cause low blood pressure

"With surgery, there is always the chance that you will die on the operating table," she said.

"But there was also a very high risk that the transplant will fail – which meant my brother's kidney would be wasted."

But they decided to go ahead, said her brother, partly because dialysis had not been easy on his sister. The thrice-weekly sessions tired her out, plus there were strict dietary limits – only four cups of water were allowed a day.

The constant use of needles meant her veins got blocked, so regular ballooning procedures were needed to re-open the vessels. "It was worth taking the risk, a no-brainer," he said, adding that there was also the "mental torture" of waiting for a transplant to take place.

Today, Ms Yow is looking forward to returning to full-time work. "I was touched that my brother was willing to take the risk, sacrifice his career, and go through the pain of surgery."

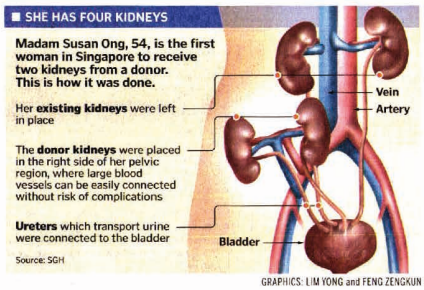
chpoon@sph.com.sg

years of the 21st century (2000 to 2004), the annual average rate of deceased donor kidney transplants fell to 34 per year. At the same time, the number of patients requiring kidney transplants grew from 208 in 1988 to 673 by end 2003. As a result, HOTA was reviewed and amended to allow deceased kidney donation from any cause of death in 2004.[20] At the same time, HOTA was also revised to include a regulatory framework for living kidney donation that mandated that all living donor kidney transplant candidates and their donors undergo review and approval from a Transplant Ethics Committee. Following the amendments, the annual average rate of deceased donor transplants increased to 44 per year during the period from 2004 to 2009 but that was still not enough as 460 patients remained on the kidney transplant waiting list in 2009. As a result, further amendments to HOTA was made to include Muslims (2008) and to lift the age cap of 60 years (2009) in an attempt to further expand the pool of potential deceased donors. With the lifting of the age cap, kidney transplantation from elderly deceased donors increased with kidneys allocated as single or dual based on explant biopsy assessments. Indeed, the first dual kidney transplantation from an elderly donor was successfully performed in 2009 at SGH. Since then, 24 dual kidney transplants have been performed with good 1-year 100% patient and 95.8% graft survival rates. Apart from elderly deceased donors, elderly living kidney donors were also increasingly accepted and Mdm. Chee Leng Yin, a 75 year-old lady, became SGH's oldest living kidney donor when she donated a kidney to her daughter, Shirley Lau in 2009.[21] The use of elderly donors is becoming more acceptable and the proportion of donors older than 60 years have increased from 2% in the 1970s to 7.4% in the period between 2000 and 2019. The amendment of HOTA in 2009 also permitted paired kidney donor exchange and led to the first paired kidney donor exchange in 2015 with a second one being performed in 2018.

With over 800 patients under its follow-up and facing challenging complications such as BK virus nephropathy and antibody mediated rejection, the care of transplant patients has become more complex and demanded that healthcare professionals be dedicated to transplantation. Prior to 2005, Professor Vathsala Anantharaman was the only trained transplant nephrologist in 1989 after returning from fellowship training under the renowned Professor

Two get kidneys from dead donors above 60

They receive two kidneys each from stroke victims aged 62, 70



GRAPHICS: LIM YONG and FENG ZENGKUN

Madam Susan Ong received the kidneys of a 62-year-old donor. Five people on the waiting list before her rejected the organs. ST PHOTO: STEPHANIE YEOW

By Judith Tan

TWO women have become the first recipients of kidneys from dead people aged over 60, since the age limit for such organ donations was lifted last November.

They scored another first – each received two kidneys.

Their operations at the Singapore General Hospital (SGH) were on Dec 21 and Feb 12, after the donors died from strokes.

The first recipient was housewife Susan Ong, 54, who received the kidneys of a 62-year-old.

The second recipient, who declined to be named, was a 37-year-old petrol-station cashier, whose life-saver was a 70-year-old.

Given the age of the donors, doctors transplanted both kidneys into each of the recipients. Usually, only one is transplanted.

Dr Terence Kee, a consultant with SGH's department of renal medicine, said a kidney from an older dead donor works at one third less capacity than that from a young donor.

Two older kidneys will work as well as, if not better than, a single younger organ, he said.

The kidneys are usually transplanted to one side of the patient's body to lower the risk of complications from having to re-route several blood vessels.

The world's first such double-kidney transplant was carried out at Columbia University Medical Centre in New York in 1993.

Here, the move last year to change the Human Organ Transplant Act (Hota) to allow organs of donors aged above 60 to be used in transplants has yielded another 10 to 12 donors of various organs each year.

This puts about 70 patients with various failed organs on track for a new lease of life.

If the age limit for donors had not been raised, the two women recipients would have had to continue dialysis treatment and would have remained on the waiting list for kidneys from younger dead donors.

The alternative would have been to go abroad for a donor.

Dr Kee explained, however, that organs from older dead donors have to be tested, as not everyone is fit to be a donor.

Tissue samples have to be drawn from potential transplant organs to test for tissue compatibility, function and for signs of infections or cancers.

Once the organs are cleared for use, the surgeons must work fast, as older kidneys lose their function more quickly, said Dr Tan Yeh Hong, a consultant urologist at SGH.

The race is then on to find a suitable recipient who is willing to accept older organs, he added.

Madam Ong, on dialysis since 2001, was the sixth patient on the waiting list to be offered the kidneys. The five before her did not want the older organs and also did not want to be the first to have a dual-kidney transplant here.

The mother of two children in their 20s recalled: "When I got the call at 5pm on Dec 21, I was anxious and, at the same time, hesitant. It took me half an hour to ponder at home and another two hours at the hospital to make up my mind."

Her son and daughter convinced her to accept the offer.

"They said the doctors here are careful and well-trained and that Singapore's medical technology is modern," she said.

Surgery began at 11pm that same day.

She told reporters yesterday that her first thought on regaining consciousness was that she was done with dialysis.

She said: "I was going for it three days a week, for four hours each time, for almost eight years, and each time I would feel sick – faint or tingling in my legs. I am glad it is now over."

Her nightmare began with a urinary tract infection and cysts in her bladder in the late 1990s. By 2001, she was in end-stage kidney failure.

"I hope my experience will help convince others on the waiting list that there is nothing wrong with accepting older cadaveric kidneys," said Madam Ong, who now can drink up to 13 glasses of water a day, up from the half a cup a day previously.

The waiting list for kidney transplants now has 460 names on it.

juditht@sph.com.sg

SGH performed the first dual kidney transplant from an expanded criteria donor in Singapore in 2009.

Managing a kidney transplant recipient is a complex process and involves multiple healthcare providers from various disciplines such as nursing staff, pharmacist, dietician, physiotherapist, medical social worker and transplant coordinator. Even before COVID-19, it was mandatory for staff to wear masks before entering a patient room.

Barry Kahan at the Vanderbilt University School of Medicine in the United States. Professor Vathsala drove many initiatives that led to the foundations of a modern renal transplant programme at SGH. She also provided transplant leadership in transplant advisory committees at the Ministry of Health and spearheaded many of the policy changes that has improved access of Singaporeans to kidney transplantation. As a result of her efforts, she is recognized as a global key opinion leader and has led not only as President of the Society of Transplantation (Singapore) but also the Asian Transplantation Society. To many, she is regarded as the Mother of Modern Kidney Transplantation in Singapore. Subsequently, Dr Terence Kee became the 2nd transplant nephrologist for SGH in 2005 after receiving transplant training in Australia under Professor Jeremy Chapman, another internationally renowned transplant nephrologist. Since then, the renal transplant programme has boasted a bigger team of passionate transplant nephrologists and surgeons, all of whom have received training in other

The transplant centre provided a one-stop service centre for transplant recipients to see the physicians including dermatologists and endocrinologists, surgeons, pharmacists, dietician, physiotherapists and transplant coordinators in one place.

world-renowned transplant centres in the United States, United Kingdom and Canada. These doctors are supported by transplant coordinators, with the numbers growing from two in the early 1990s to its current complement of twelve, some of whom have also gone for preceptorships in transplant centres in the United States, Canada and Spain. There are also dedicated medical social workers, dieticians, physiotherapists and pharmacists who are given time to focus on transplantation and meet weekly in a multidisciplinary meeting to discuss care with the nephrologists and transplant coordinators. Transplant nursing also established its roots following the ringfencing of kidney transplant beds in one ward in 2003 while the introduction of transplant advance practice nurses such as Sister Maslinna Binte Abdul Rahman in 2016 provided an important nursing liaison and added to the clinician assets of the team. Following the HCV outbreak in 2017, Dr Jasmine Chung, a transplant infectious disease physician from the Department of Infectious Diseases became "embedded" in the programme to provide guidance and advice on transplant infection control, diagnosis and therapies. There are also 6-monthly meetings with the Infection Control Unit to review infection control practices and data on contagious infections that the kidney transplant programme had encountered. These initiatives are especially important, given that

The first outpatient kidney transplant biopsy was performed in the transplant centre in 2014.

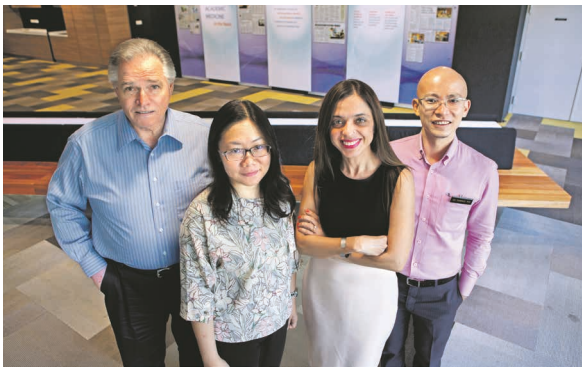
infections are the most common cause of hospital admissions among kidney transplant recipients. With these investments in dedicated transplant personnel among other improvements in transplant care, 3-year graft survival has improved from 87.6% (2000 to 2008) to 90% (2008 to 2016) while 3-year patient survival has improved from 94.4% (2000 to 2008) to 96% (2008 to 2016).

Infrastructure had also improved over the last 50 years. Previously, kidney transplant recipients were seen in the general nephrology outpatient clinics and had to travel to different areas to see other healthcare professionals like dieticians and physiotherapists.

There was also a risk of exposure to contagious infections and it was difficult for kidney transplant recipients to socialise with one another. However, with the establishment of SingHealth Transplant in 2009 (now called the SingHealth-Duke NUS Transplant Centre) and philanthropic support from the Lee Foundation, the previous health screening centre in Level 1 of Block 7 at SGH was renovated to become a Transplant Centre in 2013, serving patients and healthcare providers from the kidney, liver and haematopoietic stem cell transplant programme. The transplant centre is a one-stop facility for patients who will be able to see their clinicians, pharmacists, dieticians and physiotherapists in one place while having more options for outpatient treatments. For example, there is an outpatient procedure room where transplant biopsies and treatments for rejection can now be performed to avoid the need for admission. Indeed, the first outpatient kidney transplant biopsy was performed on 4th June 2015 right there in the transplant centre. The centre also saw patients developing friendships with one another while they wait together for their appointments and led to the development of a Facebook-based patient community called "A New Sprout of Life" in 2016, thanks to the initiatives of transplant coordinators and nurses like Ms. Eleanor Ng and Ms. Chan Yee Fong. With greater patient socialisation and desire to learn more about self-care, the kidney transplant programme started an annual end-of-the-year dinner symposium in 2016 which is well attended by patients and their families.

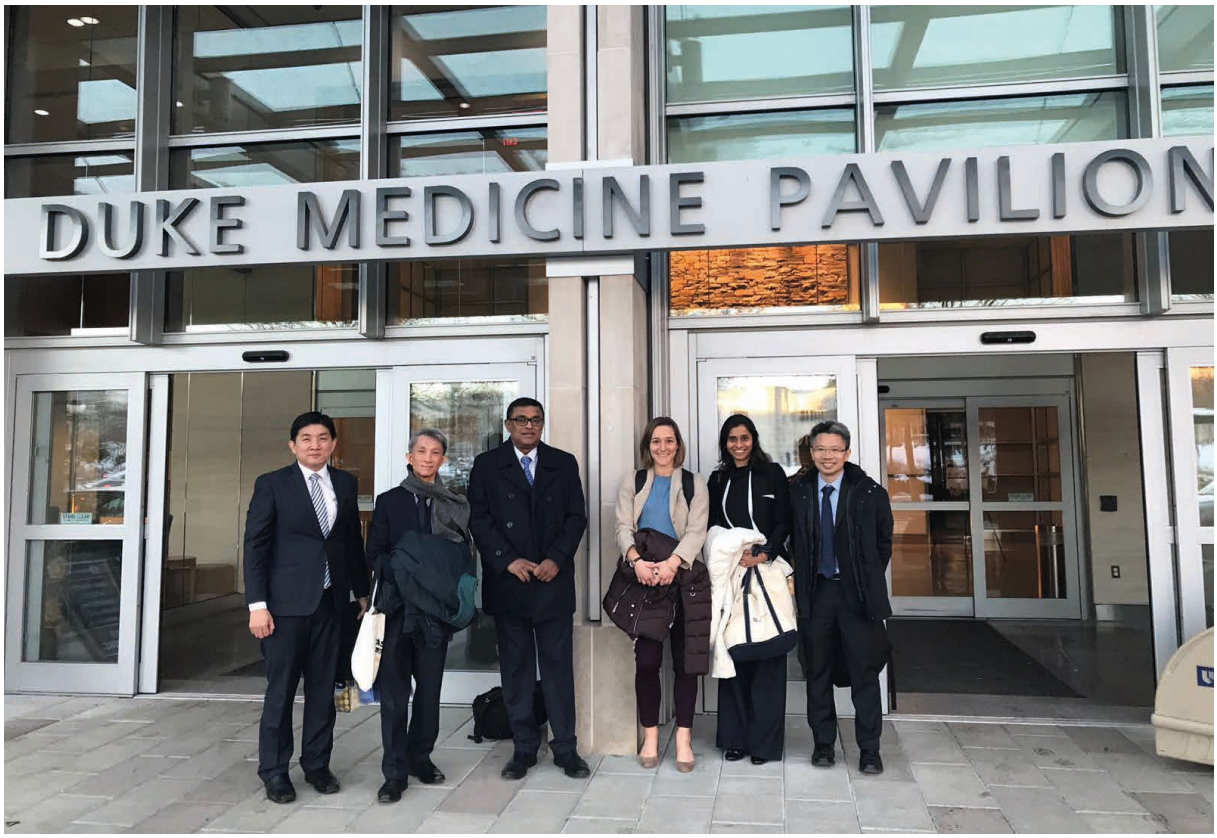
Quality improvement has become a major focus in the renal transplant programme, with doctors and transplant coordinators required to undertake quality improvement projects. Staff are encouraged to keep their minds open to change and take the initiative to question, innovate and create. They are told that "everything is man-made and subject to dismantling for improvement". As a result, many of the quality improvement projects have become integrated into daily work life and improved the safety and efficiency of care provided. Some of these projects led by transplant coordinators Ms. Tee Ping Sing, Ms. Yong Jin Hua and Ms. He Xia have in fact received accolades as SGH Quality Improvement Project of the Year (2015), Gold Illumination Award at the International Convention on Quality Control Circles in Korea (2015), Gold Award in the In-House Innovation and Quality Circle Assessment (2016) and voted among the top five SGH Quality Improvement Projects (2019).

In 2005, a landmark collaboration between Duke University in the United States and the National University of Singapore was established, leading to the formation of Singapore's only graduate medical school called the Duke Medical School at the Outram campus. Under a SingHealth Academic partnership, of which SGH is a member, signature research programmes were established to herald a renaissance of academic excellence. The kidney transplant programme has benefited from this transformation by performing research not only with renowned faculty from the Duke Medical School such as Professor Tazeen Jafar and Professor John Allen but also with its sister American transplant centre at the Duke University in Durham, North Carolina under Professor Stuart Knechtle. As a result of the latter collaboration, both centre are participating in joint immunology research and the renal transplant programme hope to send a nephrologist there for transplant training in the future.



Since the formation of the Duke Medical School in 2005, the renal transplant programme has benefited from the academic partnership with several papers published with the collaboration of Professor Tazeen Jafar and Professor John Allen from Duke Medical School.

However, there continue to be major challenges to the renal transplant programmes. Over its recent history, the transplant programme has been suspended three times due to viral outbreaks in 2003 (the SARS epidemic), 2015 (the HCV outbreak) and now the SARS-CoV2 epidemic in 2020. These infections pose a major threat to the patients who are extremely vulnerable as was seen during the HCV outbreak where the mortality rate was high at 42%. Though having an embedded transplant infectious disease physician in the programme has significantly



Dr Sobhana D/O Thangaraju with the SingHealth Duke-NUS Transplant Team on a visit to Duke Transplant Centre at North Carolina in the United States of America in 2018.

improved the surveillance and management of infectious diseases in the kidney transplant unit, more needs to be done to improve defences against infectious diseases. Thence, there are plans to build a dedicated transplant ward to ring fence all solid organ transplant recipients, as well as develop a transplant infectious disease registry that will facilitate research and better understanding of infectious disease complications among transplant recipients.

Another challenge is retaining and attracting transplant talent. Over the last 10 years, the programme has had difficulty retaining experienced transplant talent and recruiting younger nephrologists and surgeons to take up a career in transplantation. Barriers to a career in transplantation such as long hours, after office hours call back and high stakes in caring for kidney transplant recipients are factors that are unavoidable. Thence, there is a need to appeal to younger professionals to become a part of the life changing experience which transplantation offers. This alone could be good enough reason for one to devote his or her life to transplantation. Fortunately, since 2013, there has been more interest in this field with two more nephrologists now being part of the transplant team. They are Dr Sobhana D/O Thanagaraju (joined in 2013) who completed her transplant fellowship in British Columbia (Canada) under Professor John Gill, Dr Ho Quan Yao (joined in 2018) and Dr Liew Ian Tatt (joined in 2020) who were both previously from Tan Tock Seng Hospital but got inspired following their transplant rotation at SGH as Senior Residents. Transplant coordinators were also previously difficult to retain but this has somewhat improved following the separation of deceased donor coordination from pre-transplant and post-transplant recipient coordination in 2009, allowing for improved work-life balance and better focus. Another factor that may help improve retention and development of transplant coordinators is the recent assimilation into the Division of Allied Health in 2019, which will help better structure career progression and development.

Finally, despite half a decade of changing organ donation legislation, expanding potential donor pools and introducing state-of-the-art immunosuppressive

regimens and technologies, it continues to be a struggle to find enough kidney donors for an ever-increasing prevalent population of patients with ESRF in Singapore. Since the last amendment to HOTA in 2009, the average annual rate of deceased donor kidney transplant has not increased in Singapore over the subsequent 10 years. In fact, it has dropped from 44 per year (2004-2009) to 32 per year (2010-2019). This has been compensated somewhat by an increase in living donor kidney transplants from an annual average rate of 33 per year (2004-2009) to 37 per year (2010-2019). At SGH, we have also seen similar trends and feel the same policy of advocating living kidney donor transplantation in the 1990s continues to be relevant in this era of low deceased donation rates. There is good reason for this when living kidney donation in Singapore appears to be safe while 41.6% of patients on the SGH wait-list either die or become medically unsuitable for transplantation[22-24]. As a result, there is a need to invest more effort into encouraging living kidney donor transplantation. Since 2018, the programme at SGH has ran outreach programmes to its sister hospitals at Changi and Sengkang with transplant coordinators conducting satellite counselling and education services for living kidney donor transplantation. This outreach programme has proven to be very effective, producing a doubling of referrals for living kidney donor transplantation from these hospitals. We have also reached out to NKF and has started a pilot programme to educate their nurses and SGH patients dialysing with them about kidney transplantation and living kidney donation. As a result of this outreach to NKF, one patient self-referred herself for living kidney donor transplantation and underwent the procedure in 2019. Another area that will also need further development and focus is the adequate provision of educational resources for patients and their potential donors to allow them to make an informed decision and correct any misperception on their part. At the moment, patients and their potential donors each receive a pack of information materials in the form of a book, pamphlet and CD. However, this will be further expanded into an online education hub where testimonies, learning videos and self-assessment quizzes can be posted for patients to refer to at their own convenience and hopefully this will help capture a wider audience. It will also explore advances in video conferencing where transplant coordinators can offer counselling for patients and their families in the convenience of their own home or workplace so they will not have to take time off to come to the hospital.

The birth of the kidney transplant programme 50 years ago at SGH was a miracle. This was because a successful kidney transplant was performed just five years after Singapore achieved the status of a sovereign developing nation. What was more amazing was that this medical milestone was reached while our young nation was still struggling with basic public healthcare needs. In contrast, many nations around the world today have only begun to start their transplantation programmes despite having the infrastructure and funding to do so earlier. Ever since then, the kidney transplant programme at SGH has progressed by leaps and bounds and is now a modern state-of-the--art unit. It is also paying it forward as a sister International Society of Nephrology regional training centre to the Southern Philippines Medical Centre since 2017. All these would not have been possible without the selfless contributions of medical leaders, NKF and charities over the years (Table 2).

Table 2: Pioneers and Leaders of Kidney Transplantation in Singapore

Physicians	Surgeons	Pathologists	Charitable Businesses and Foundations
Khoo Oon Teik	Chan Kong Thoe	Tan Kheng Khoo	Dato Aw Cheng Chye
Lee Guat Siew	Ong Siew Chey	Gilbert Chiang	China Medical Board
Lim Cheng Hong	Foon Weng Cheong	Tan Puay Hoon	Lion's Club
Lim Pin	Abu Rauff	Alwin Loh	Dato Lee Kong Chian
Beatrice Chen	Foo Keong Tatt		Dato Loke Wan Tho
Pwee Hock Swee	Li Man Kay		Dato Lee Chee San
Woo Keng Thye	Susan Lim		Sri Rumme Shaw
Vathsala Anantharaman	Sydney Yip		Lee Foundation
Terence Kee	Christopher Cheng		
Sobhana DO Thanagaraju	Ng Lay Guat		
	Lee Fang Jann		
	Valerie Gan		

As of 31st December 2018, the renal transplant programme at SGH has performed 501 living kidney donor transplants and 1,028 deceased kidney donor transplants. The progress made in transplant medicine and surgery over half a century has witnessed significant improvement in short-term graft and patient survival rates (Table 3, while long-term survival rates are comparable to those seen in other countries (Table 4).

Table 3: 10-year outcomes of kidney transplantation performed at SGH (as of 31st Jan 2020)

Graft Survival (%)	1970 - 1979	1980 - 1989	1990 - 1999	2000 - 2008	2009 - 2018
Deceased Donor					
1-year	59.1	68.3	89.4	90.0	93.5
5-year	40.9	54.9	83.0	79.5	78.3
10-year	22.7	45.8	66.3	65.2	-
Living Donor					
1-year	68.0	89.8	97.8	97.1	99.0
5-year	60.0	74.5	93.6	95.6	97.0
10-year	52.0	62.2	86.1	84.0	-
Patient Survival (%)	**1970 - 1979**	**1980 - 1989**	**1990 - 1999**	**2000 - 2008**	**2009 - 2018**
Deceased Donor					
1-year	81.2	86.7	96.3	95.8	96.6
5-year	64.2	77.2	93.4	89.1	90.3
10-year	41.7	71.4	83	79.8	-
Living Donor					
1-year	80.9	94.6	100	98.5	100
5-year	71.4	84.9	98.9	98.5	98.5
10-year	65.0	77.2	96.4	89.2	-

Table 4: International comparisons of post-transplant outcomes

Graft Survival (%)	Singapore (2000 – 2008)	Australia and New Zealand (2005 – 2009)	United Kingdom (2005 – 2007)	United States (2000 – 2006)
Deceased Donor				
1-year	90.0	92	93	93
5-year	79.5	81	85	75
10-year	65.2	65	76	48
Living Donor				
1-year	97.1	97	96	98
5-year	95.6	90	91	85
10-year	84.0	75	82	65
Patient Survival (%)	**Singapore (2000 – 2008)**	**Australia and New Zealand (2005 – 2009)**	**United Kingdom (2005 – 2007)**	**United States (1999 – 2015)**
Deceased Donor				
1-year	95.8	97	97	96
5-year	89.1	90	89	85
10-year	79.8	75	77	64
Living Donor				
1-year	98.5	99	99	99
5-year	98.5	95	96	92
10-year	89.2	88	90	79

Note:

Australia and New Zealand data taken from the ANZDATA 41ST Annual Report 2018 (https://www.anzdata.org.au/report/anzdata-41st-annual-report-2018-anzdata/), United Kingdom data taken from the NHS Organ Donation and Transplantation Activity Report 2018/2019 (https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/16537/organ-donation-and-transplantation-activity-report-2018-2019.pdf) and United States data taken from the USRDS Annual Report 2018 (https://www.usrds.org/2018/view/v2_06.aspx).

The future of the kidney transplant programme at SGH is promising as it continues to build a succession pipeline of future transplant healthcare professionals that will lead the programme into the years ahead. The journey has witnessed historical cycles of growth and decline that were sometimes marked by tragedies, but with each cycle, the experiences and lessons earned has strengthened the foundations of the programme so that it will be better able to face future challenges. With the capabilities built up over the decades, the dream to be fulfilled over the next 50 years is for the kidney transplant programme to be recognised as a first class global centre, attracting the best talents to come train and work, while being also a key opinion leader in niche areas of clinical practice and research. But most of all, it will be a place where patients will truly feel that they have a second chance at life and the programme places them at the heart of all it does. And yes, "This is what Hope looks like!"

Acknowledgements

The author gratefully acknowledges the review of this article from Professor Woo Keng Thye, Emeritus Consultant from the Department of Renal Medicine. It also acknowledges assistance from Dr Chan Kong Thoe, the National Library of Singapore and the SGH Library services in the retrieval of photos, newspaper and publications that have contributed to the content of this article.

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Associate Professor Terence Kee and Dr Angeline Goh from SGH undertook a preceptorship in Japan where they learned how to set up a ABO-incompatible kidney transplant programme in 2008. The first ABO-incompatible kidney transplant was subsequently successfully performed in SGH in 2009.

Associate Professor Terence Kee was in Brunei during 2014 to visit renal centres and advise on further development of renal transplantation in Brunei.

Dr Chan Kong Thoe, the surgeon who performed the first kidney transplant surgery in Singapore at the Singapore Society of Nephrology 40th Year Anniversary Meeting in 2012.

Minister Gan Kim Yong attended the launch of the inaugural Transplant Awareness Week organised by SingHealth Transplant in 2011. At this inaugural event, staff from the various transplant programmes went to the heartlands all around Singapore to raise awareness to the public on organ donation and transplantation.

The Singapore Transplant Games was an effort contributed by all members of the Department. Here are the nurses from the peritoneal dialysis programme who volunteered their services during the Singapore Transplant Games in 2013.

SingHealth Transplant TRUE fund dedicated to supporting needy transplant recipients was a beneficiary of the OCBC cycling fund raising event which patients and staff from SingHealth Transplant participated to raise money. This photo was taken in the 2015 event which saw the biggest turn out of patients cycling for a cause.

The programme organised its first transplant ambassador programme with NKF in 2019 where it trained NKF nurses to counsel SGH patients about transplantation at NKF dialysis centres. Through this programme, one patient from the NKF dialysis centre self-referred herself for transplantation and eventually underwent transplantation the same year.

In 2016, the renal transplant programme started an annual Transplant Advocacy Award in recognition for nephrologists who supported kidney transplantation with the most referrals to the programme each year. Dr Irene Mok was its first recipient.

In 2015, Ms. Tee Ping Sing represented the renal transplant programme at the 40th International Convention on Quality Control Circle in Korea where she received the Gold Illumination award for the project on improving efficiency in living kidney donor transplantation processes.

In 2015, the renal transplant programme won its first SGH's Quality Improvement Project of the Year Award in improving time efficiency in evaluating candidates for living kidney donor transplantation.

The renal transplant programme supports activities organised by the National Organ Transplant Unit such as the Donor Appreciation Ceremony in 2017.

Renal Transplant Team

(Left to right)
First row standing: *Ms. Fiona Foo (Clinical Transplant Coordinator), Ms. He Xia (Living Kidney Donor Transplant Coordinator), Ms. Allie Tan Wen-Li (Wait-List Transplant Coordinator), Ms. Yong Jinhua (Clinical Transplant Coordinator), Ms. Sophia Cheah (Senior Physiotherapist), Ms. Looi Bee Hong (Dietitian), Ms. Jenny Leong (Senior Associate), Ms. Lu York Moi (Manager in Clinical Quality, Education and Research), Dr Lim Rou Wei (Senior Clinical Pharmacist), Ms. Natelie Kwan (Clinical Transplant Coordinator), Dr Lee Puay Hoon (Senior Principal Clinical Pharmacist)*

Seated: *NC Siti Nurhidayah Binte Mohamed Rofi, NC (APN) Maslinna Bine Abdul Rahman, Dr Ho Quan Yao, Dr Jasmine Chung (Department of Infectious Diseases), Associate Professor Terence Kee, Dr Sobhana D/O Thangaraju, Ms. Goh Soo Cheng (Master MSW Clinical Educator), Dr Goh Li Fang (Senior Clinical Pharmacist), Ms. Diana Foo (Senior Associate), ADN Leong Siew Teing*

Ward 64E is currently the home of the renal transplant programme at SGH and gone through thick and thin together, bonding us closer together as a family. The nursing staff are well liked by patients and has received numerous compliments for the excellent care given.
(Left to right)
Seated on sofa: *Ms. Tee Ping Sing (Manager for Operations), Ms. Low Wai Yan (Physiotherapist), Dr Riece Koniman, Dr Sobhana D/O Thangaraju, Dr Ho Quan Yao, Associate Professor Terence Kee.*
Standing first row: *ADN Leong Siew Teing, NC (APN) Maslinna Binte Abdul Rahman, Dr Lee Puay Hoon (Senior Principal Clinical Pharmacist), SN Yang Wen-Ru, Ms. Allie Tan Wen-Li (Wait-List Transplant Coordinator), SSN Yan Shuxia, SN Carol Jiani Li Dealo, SSN Siti Nadiah Binte Masnor, SSN Li Mengnan, SN Ms. Yong Pay Wen, SSN Siti Aisyah Binte Dolmat, SSN Masulanga Sandra, PEN Siti Ruzaimah Binte Haron, SN Wu Ting, NC Li Yang, Ms. Yong Jinhua (Clinical Transplant Coordinator), EN Nur Raffhanah, SSN Mary Antonette, Ms. Natelie Kwan (Clinical Transplant Coordinator).*
Standing second row: *Ms. Fiona Foo (Clinical Transplant Coordinator), ANC Jamaliah Binte Jamali, ANC Seri Rahayu Binte Safie.*

Renal Transplant Surgery

Dr Valerie Gan, Consultant and Surgical Director for Renal Transplantation, Department of Urology

The first successful renal transplant between identical twins was performed on 23 December 1954 by Joseph E. Murray. In retrospect, the success of this transplant was not significant in itself, for the surgical technique used was nothing new, and the knowledge that skin grafts between identical twins were not rejected was there for decades. He went on to perform the first successful renal allotransplant in 1959 and in 1962, the first successful deceased donor renal transplant.

In his 1990 Nobel Prize lecture, he said *'The full story of successful organ transplantation in man weaves together three separate pathways: the study of renal disease, skin grafting in twins, and surgical determination. A leitmotif permeates each of these pathways, i.e., a single event or report was critical for medical progress.'*

The study of renal disease led to the creation of the Kolff-Brigham 'artificial kidney' and later, chronic dialysis by Schribner in Seattle. The successes and failures in skin grafting, reported in the 1930s, lent to the certainty of permanent survival of skin grafts between monozygotic twins. The dizygotic twin story culminated in the successful skin grafting by Sir Michael Woodruff, a transplant surgeon in Edinburgh, between a pair of twins, one male and the other female.

Surgical determination can be attributed to many a surgeon who have sealed their names in the history of transplantation. Alexis Carrel is best known for pioneering vascular anastomosis techniques, and later for his work with Charles Lindbergh on the perfusion pump for organ transplantation.

Soviet surgeon Yu Yu Voronoy of Kiev made the first known attempt at human-to-human renal allotransplantation in 1933. In the 1940s and early 1950s, experimental dog kidney transplantation was actively conducted by surgeons in Paris, Boston, Denmark and London.

In 1951, David Hume from Boston performed transplants placed in the anterior thigh with the ureter brought out to the skin. Concurrently, in Paris, René Küss and Charles Dubost, as well as Marceau Servelle of Strasbourg, performed allotransplantations using donor kidneys from guillotined criminals. The kidneys were placed retroperitoneally in the pelvis revascularised by iliac vessels with the ureter anastomosed to the bladder - Küss' method that has since been refined by other Parisian surgeons and is still the standard performed today.

These three pathways merged at Peter Bent Brigham Hospital, culminating in a series of successful renal transplantations and widespread attempts to overcome the immunological barrier that was limiting transplant success to identical twins. Experimental protocols including total body X-ray treatment and marrow infusions finally gave way to the breakthrough of immunosuppressive drugs.

It is no small feat then, that 5 years after achieving independence as a sovereign nation, Singapore performed its first kidney transplant from a deceased donor in 1970. Dr Chan Kong Thoe, then head of the University of Singapore Department of Surgery, performed the first deceased donor kidney transplant on Doreen Tan, a 30-year-old housewife, on 8 July 1970 at Bowyer Block of Singapore General Hospital (SGH). The donor, Mr. Yee Kwok Chong, 20, died of a presumed brain tumour after only 4 days of hospitalisation (he was later found to have had an infection).

The stage was set in 1961, when the Department of Clinical Medicine at the then Outram Road General Hospital acquired its first haemodialysis machine. Initially used primarily for the treatment of acute renal failure, pioneering nephrologists gained experience in its use for maintenance treatment of end stage renal failure. However, with nearly 200 patients dying annually from end stage renal failure, the cost was prohibitive, at an estimated $15 000 per patient per

Our transplant surgeons
From left to right: *Dr Ng Lay Guat, Dr Valerie Gan and Dr Edwin Jonathan Aslim.*

year. Renal transplantation thus became a more attractive option and ideal goal of renal replacement therapy in Singapore.

A proposal was made to the Ministry of Health in 1966 to establish an Organ Transplantation Programme. Visits were made to various transplant centres around the world to assess the feasibility of starting a programme in Singapore. Exactly one year prior to the first transplant, animal experimental surgery began, allowing Dr Chan and his team of surgeons including Drs Ong Siew Chey, M Sridharan, and R Sundarason to gain surgical experience on canine models. A $75,000 donation from an American foundation enabled the setup of an experimental animal laboratory where one dog renal transplant was performed each week. Simultaneously, various protocols were established for the retrieval of cadaveric kidneys, tissue typing and post-operative management of the recipient.

These efforts culminated in Doreen's surgery which took 3 hours, and within 10 days, the kidney started producing urine. She went on to live another 22 years before succumbing to sepsis, albeit with a functioning graft.

In 1972, the legal framework for retrieval of cadaveric kidneys was passed with the introduction of the Medical Therapy, Education and Research Act (MTERA). This opt-in legislation gave a low yield of deceased donor kidneys (average of 3 a year), leading to the development of a living donor kidney transplant programme in SGH. In the early years, this was restricted to parents and siblings of the patient, with a minimum requirement of a single haplotype match on Human Leucocyte Antigen (HLA) testing.

The first recipient received a kidney from his brother on 31 July 1976. With the introduction of Cyclosporine A in the 1980s, living donation was eventually extended to spouses and second-degree relatives. The first spousal kidney transplant was performed in 1991.

Despite this, transplant volumes remained low. A trans-Pacific organ-sharing programme between 1983 to 1987 provided 33 additional deceased kidneys from America and Canada to Singaporeans. However, graft survival was extremely poor, likely attributable to the prolonged cold ischemia times (50-73 hours) and the high degree of HLA mismatches. This prompted the introduction of the Human Organ Transplant Act (HOTA) in 1987 which was an opt-out, presumed consent legislation.

In the following decades, with new drugs and improvement in immunosuppression regimes, kidney transplant recipients at SGH became more complicated, having more comorbidities and/

Dr Valerie Gan, Surgical Director of Renal Transplantation performing benchwork surgery prior to allograft implantation.

or higher immunological risks. At the same time, advancements in surgical techniques and technology were being explored at transplant centres elsewhere. One area of concern was the morbidity from traditional open donor nephrectomy. The flank incision caused significant trauma to the thoracoabdominal wall with potential complications like pleural injury and long-term wound issues (pseudo-hernia, hypoesthesia and chronic pain). A relatively long convalescence was required for an otherwise healthy donor.

The turning point in donor nephrectomy began with the first laparoscopic nephrectomy for a renal tumour performed by Ralph V. Clayman at Washington University in St Lois in 1991. Subsequent reports on the benefits of this approach, including less wound pain, improved cosmesis and rapid recovery times compared to open nephrectomy, led to the first laparoscopic living donor nephrectomy being performed by Louis Kavoussi and Lloyd Ratner at the Johns Hopkins Bayview Medical Centre, Baltimore, USA on 8 February 1995.

In 1988, Urology became a recognised specialty in Singapore, and Professor Foo Keong Tatt, who is widely recognised locally as the Father of Urology, was naturally appointed as Head of the newly established Department of Urology in SGH. Renal transplant surgery became entrenched as a urological domain, as it was in Europe, and Professor Foo was subsequently appointed as Head of the MOH renal transplant team in 1990.

He was succeeded by Professor Li Man Kay in 2001, with Professor Christopher Cheng as deputy head. This was the era where laparoscopy was booming in urology, and thus the duo embarked on efforts to introduce laparoscopic donor nephrectomy. As the norm, when learning new skills, practice began with performing nephrectomies on animal models. As a prelude to donor nephrectomy, the team performed the first hand-assisted laparoscopic (HAL) nephrectomy under the mentorship of Dr David Albala from Loyola University Medical Centre in Chicago on September 11, 2001. Unfortunately, the most memorable part of that day to the surgeons was watching horrific events unfold before their eyes on TV in the operating theatre after performing the surgery!

Professor Christopher Cheng, then Head of Department with the renal transplant team and nursing staff from ward 55B after successfully performing a HLA incompatible kidney transplant in 2009.

Having gained experience performing HAL nephrectomy, the team then proceeded to perform the first HAL donor nephrectomy, again under the mentorship of an expert, Dr Michael Stifelman from NYU Medical Centre in March 2002. From then on, HAL donor nephrectomy became the norm at SGH. Following that, the transition to full laparoscopy was made in 2005 and has remained the standard procedure offered to the majority of living kidney donors today. In 2009, a 75-year old lady underwent a laparoscopic donor nephrectomy to become our oldest kidney donor to her daughter.

In deceased kidney procurement, minor changes were made over the years, for example the switch in organ perfusion solutions from Eurocollins and UW to HTK in 2005 following literature reviews and cost considerations to the multiorgan transplant teams. That year, procurement surgeons also ceased having to transport the kidneys in the back of their

own vehicles, as new processes were put in place and organs were couriered to their destinations professionally.

In November 2009, HOTA was amended to remove the donor upper age limit of 60 years. This was meant to increase the deceased kidney donor pool by including donors who might have been considered marginal previously. Kidneys from these extended criteria donors (ECD) were biopsied before being allocated for transplant. Those deemed of intermediate quality (based on the Remuzzi histological scoring system) were allocated together to a single recipient to increase nephron mass. This presented uncharted territory to our surgeons. Various approaches have been reported, including bilateral extraperitoneal implants using two Gibson incisions and vertical midline transperitoneal implants, in the earlier days. In 1998, Douglas Masson and Thomas Hefty from Virginia Mason Medical Centre in Washington described a new technique – essentially extending the usual Gibson incision and placing both kidneys in the same iliac fossa, one superiorly to the other. This decreased the operative time and left the other iliac fossa untouched for future transplants. Using this technique, Professor Cheng and Dr Tan Yeh Hong performed the first dual kidney transplantation in Singapore in December 2009.

Over the years, as the programme matured and workflow became more streamlined, Surgical Directors were appointed. They ensured oversight over the surgical aspects of the programme and worked in tandem with the Medical Director. Dr Sidney Yip succeeded Professor Cheng in 2002, then Dr Ng Lay Guat took over in 2007, followed by Dr Lee Fang Jann in 2013. Dr Lee was the first urologist from SGH to take up a HMDP fellowship in kidney and pancreas transplantation at Oxford Transplant Centre, UK.

My predecessors laid the groundwork and paved the way for transplant to grow as an important subspecialty within Urology. Inspired by them, I became the first locally trained female urologist to veer from tradition, pursuing a kidney and pancreas transplant fellowship at Cleveland Clinic and taking over the directorship from my mentor in 2017. Since then, I have started a dedicated Urotransplant Clinic, striving to provide more wholistic surgical care throughout a kidney patient's transplant journey. This allows me to see waitlist patients and ensure they have no active surgical issues precluding them from transplant when they get called up for a kidney, evaluate potential living kidney transplant donors and recipients, as well as manage kidney donors and transplant recipients post-operatively, some of whom may go on to develop urological malignancies, stones or voiding issues.

The first combined urology and nephrology transplant meeting in 2018 which would be then held annually to update both departments on process and clinical outcomes in transplant nephrology and surgery.

In reality, kidney transplant surgery has not changed radically since the early days. The introduction of laparoscopy for donor nephrectomy was the highlight of transplant surgical landmarks. Other techniques described in laparoscopic donor nephrectomy were essentially variations on a theme – retroperitoneal laparoscopy, single site laparoscopy and natural orifice transluminal endoscopic surgery (NOTES) to name a few.

In this day of minimally invasive surgery (MIS), one cannot fail to mention robotic kidney transplant and donor nephrectomy, already touted as the standard of care at some transplant centres. Urologists are very familiar and comfortable with robotic surgery, using it routinely for prostatectomies and partial nephrectomies. In countries where kidney transplants were mainly performed by vascular surgeons, this presented a way for urologists to regain a foothold in transplant. There were doubts in my mind as to the advantage of robotic surgery in this instance, so I embarked on training, performing robotic transplant in pigs, to decide if the hype was true. The main advantage is decreasing wound infection rates in very obese transplant recipients – a problem we face infrequently, compared to our Caucasian counterparts. There are still issues

to overcome, mainly a prolonged ischemia time and operative time (in most hands), and of course, prohibitive costs, including specialised tools and resources. Till then, I foresee laparoscopic donor nephrectomy and traditional open kidney transplant techniques remaining at the forefront for some time.

I started this piece by quoting from Murray's Nobel Prize lecture and will end with more of the same. He describes the moments before performing the first living kidney transplant: *'The only remaining problem was the ethical decision concerning the removal of a healthy organ from a normal person for the benefit of someone else. For the first time in medical history a normal healthy person was to be subjected to a major surgical operation not for his own benefit.'*

His thoughts sum up the most essential part of transplant surgery – not the surgical technique, rather the drive to adhere to transplantation principles and ethics, ensuring that the patient's safety is at the forefront when they are giving or receiving the 'gift of life'.

A rare moment for renal transplant surgeons and physicians enjoying themselves together at the Department of Urology 30th Anniversary Dinner in 2018.
From Left to Right: *Dr Edwin Jonathan Aslim, Dr Valerie Gan, Dr Ng Lay Guat, Associate Professor Terence Kee, Ms. Tee Ping Sing*

Our urologists being deployed for COVID-19 operations outside of SGH.

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Transplant Coordination

Ms. Sally Kong, Assistant Director
National Organ Transplant Unit, Ministry of Health

By March of 1964, 342 non twin kidney transplantations had been performed worldwide. The same group of surgeons who recovered, preserved and shared the organs were also responsible for the transplantation and post-operative care of the recipient.[1] Though surgeons made it technically possible to perform the transplant, it was imperative that an organised system was put into place to support the grand scheme.

The role of the transplant coordinator (TC) was an American invention. It was recognised early in the USA that paramedical personnel could provide substantial support in the procurement of kidneys and subsequently in the process of machine preservation and transplantation. Hence, TCs have been at work in the USA since the 1960s. In Europe, these procedures were performed by the hands of the doctors till the TCs took over their role in the 1970s.[1] There were TCs in existence in Belgium, Germany and Netherlands by the 1970s, Sweden and Australia in 1983, Spain in 1984, Japan in 1985 and Singapore in 1986.[1]

In Singapore, the first deceased kidney donation was performed in 1970, with much of the coordination undertaken by renal physicians and surgeons. Deceased donations occurred at irregular intervals during 1970-1982, with an average of one deceased donor per year. This translated to two kidney transplants performed a year during that period of time.

Approaching Grieving Families on Organ Donation

In 1983, there were three haemodialysis centres in Singapore – SGH (SGH), Alexandra Hospital (AH) and Tan Tock Seng Hospital (TTSH) – providing dialysis for 164 patients.[2] As transplant remained the best option of treatment of modality for patients suffering from end-stage renal disease, the National Kidney Foundation (NKF), dedicated to improving the lives of renal failure patients, recognised the importance of having a sustained deceased organ donation programme to supplement the dialysis service in Singapore.

Ms. Sally Kong with kidney transplant coordinators from SGH, preparing flowers to distribute during organ donation awareness week in 1996.

NKF together with Ministry of Health (MOH) Singapore began a concerted effort to improve the deceased organ donation rates in Singapore. Apart from increased publicity on organ donation, families of brain-dead patients were also approached to consider donating the kidneys of the deceased. Medical Social Workers (MSWs) who were trained counsellors were deemed to have the skills necessary to undertake this arduous task.

NKF invited Dr Gene Pierce, Executive Director of the South Eastern Organ Procurement Foundation, USA, to educate our MSWs on the sensitive issue of "when to ask for kidney donation".[3] In March 1983, the MSWs of all government hospitals were assigned to undertake the role of persuading families to donate their loved ones' kidneys and were called "Kidney Persuaders" (KP).[4] A workshop was conducted to train MSWs to approach individual families and equip them for this role. NKF also sponsored five MSWs to travel to USA and Europe for attachment to organ procurement agencies. I was one among the five, visiting the organ procurement agencies and hospitals in Richmond, Baltimore, Houston and Tampa.[5]

Transplant coordinators come of age as a transplant team is divided into smaller teams for living kidney donor coordination, wait-list management and post-transplant clinical coordination. At SingHealth, a dedicated pool of procurement transplant coordinators assist the National Transplant Organ Transplant Unit in organ procurement.

Though all 27 MSWs were tasked with this new role, many were very apprehensive and uncomfortable in having to deal with the very emotionally charged situations, believing that approaching families during their most difficult hour was highly inappropriate and this only served to exacerbate their grief. MSWs were also required to be on-call after office hours to respond to such referrals, which proved to be daunting for some.

Most deceased organ donor referrals originate from potentially brain-dead patients. Hence, being then an MSW in TTSH where the only neurosurgical unit in Singapore was located meant I had several opportunities to be involved in deceased organ donation cases. Experiencing the value and the challenge of the work further spurred my interest in that area.

Role of "Kidney Persuaders (KP)"

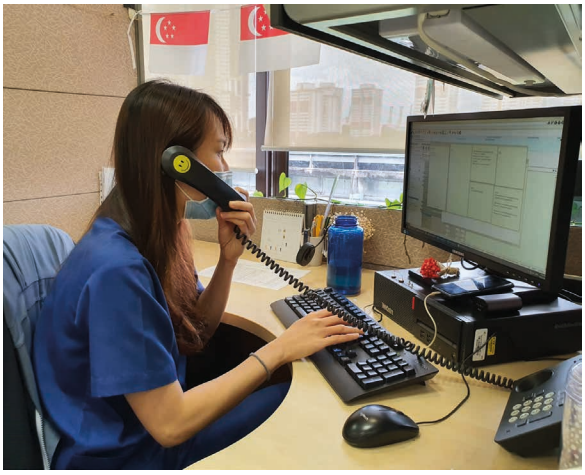
The role of a KP was very specific. They were only called in to speak to the families of a potential deceased donor in order to obtain consent for kidney donation. The process of organ donation was undertaken by a series of individuals, with none specifically assigned to oversee the whole process. There was a need to ensure timely attention to each of the various tasks such as brain death certification, assessment of the donor for suitability, activation of "kidney persuaders", assembling of surgical team, arranging for operating theatre and obtaining coroner's consent. Team effort was of imperative importance, however, due to the truncated manner in which the whole process was handled, led to delays at times and often found the individuals involved trying to compartmentalise their area of work.

With the introduction of KPs, the number of deceased donor kidneys transplants (DDKT) increased to 16 in 1984 but subsequently fell sharply to just one in 1985. This sharp decline was attributed to the lack of a continued impulse to drive the programme and sustain the interest and momentum of all the parties involved in the organ donation process. Much of the logistics on the ground were also handled by senior doctors who were already very busy managing their patient load.

Appointment of Full-Time Transplant Coordinator (TC)

Concerned with the decline in the number of transplants in 1985, both NKF and MOH, were of the view that the appointment of a full-time TC to look after organ donation activities was crucial in sustaining the momentum. Emulating the USA where TCs were either intensive care nurses or paramedics, a search was made to second an intensive care nursing sister to become a TC. In the USA, TCs were fully responsible for the medical management of the deceased donor once a referral had been made, thus making it essential for them to come from a medical / nursing background. Apart from being engaged in a whole new area of work with uncertain prospects for the future, being a TC meant being on-call 24 hours a day. Hence, it was no surprise that the job drew little interest.

Transplant coordinators are the driving force of the renal transplant programme. It is now impossible to run a transplant programme without a well-staffed team of transplant coordinators.



Transplant coordinators play a vital liaison role between physician and patient, providing the vital communication link to deliver care plans to patients.

It was then that I approached Dr Pwee Hock Swee, a renal physician in SGH and Chairman of the Government-appointed National Kidney Task Force, on my interest in the position. In April 1986, I was appointed as the first TC in Singapore[7]. I was a MSW seconded to the post of TC, an uncharted territory.

Organ Procurement Unit (OPU)

With the appointment of a full-time TC, a single-staff unit, the OPU, was established.[6] OPU's aim was to increase organ donation rates in Singapore. It came under the Department of Renal Medicine, SGH, since at that time the focus was on kidney donation with other solid organ transplant programmes yet to be established. However, OPU was rightfully sited in TTSH, being the only hospital in Singapore with a neurosurgical unit and hence a high likelihood of having potential deceased organ donors.

Whatever I learned from my attachments in the USA were immediately implemented. Daily visits were made to intensive care units in TTSH and this was gradually extended to such units in the other acute care hospitals. It was a long journey of building rapport with the doctors and nurses with my constant presence reminding them to refer suitable cases, if any. The morning visits were initially not warmly received. Nevertheless, I persevered, chatting with nurses, doctors and the administrative staff that was supporting the functions of OPU. I only attended the monthly departmental meeting at SGH to report on the progress of my work and highlight operational issues experienced by donor hospitals in the organ donation process so they could be resolved.

In 1986, the DDKT numbers jumped to 15 from the miserable number of only one in 1985.[7] Having a full-time staff dedicated to organ donation proved to be the key. After just a couple of months, it was no longer necessary to remind the doctors to refer cases - their response had become spontaneous. The ICU staff helped looked out for cases for me and the moment I stepped into their unit, it would be identifying the possible cases or letting me know that there was "no business today". We developed a strong friendship and even when we do meet today, we still reminisce about the times we worked together, building an organ donation culture from scratch and the kind of hardships we encountered in our work.

In 1987, with the pending implementation of the Human Organ Transplant Act (HOTA)[8], an opt-out legislation for the donation of kidneys, another MSW was seconded to OPU as a TC. I finally had a colleague, and it was such a joy to have someone with whom I could share the daily happenings and challenges of the job, while also supporting each other emotionally

Transplant coordinators often lead in quality improvement projects undertaken every year to improve delivery of care and services to patients and stakeholders.

through difficult situations. We worked relentlessly. There was no on-call allowance or overtime pay but that never deterred us in giving our all and best to the programme.

In 1988, with the enactment of HOTA, OPU was closed in TTSH and the TCs were pulled back to SGH to provide support to the Department of Renal Medicine in the administrative duties of HOTA, wait-listing of kidney patients for transplant, development of kidney allocation criteria, selection and counselling of recipients for transplant, and post-transplant follow up. The role of TCs had therefore expanded from dealing with organ donation and nothing else.

Post of Transplant Coordinator (TC)

With the restructuring of SGH in 1990, the post of TC became established officially. Similarly, not long after, the same post was also created in National University Hospital (NUH). From just a handful of TCs, our numbers grew with the establishment of the various transplant programmes and recognition of the importance of the TCs as the backbone of any efficient transplant programme.

Formation of the International Transplant Coordinators Society (ITCS)

A TC's practice and profession is built on education, clinical work and also sharing and networking with other TCs, even though the scope of work may vary between different countries. In 1994, ITCS was formed in Kyoto after a lengthy discussion amongst like-minded individuals on the need for an international TC group which could provide a platform

to gather, foster communication and collaboration amongst TCs, provide professional education and promote research. The founding officers of ITCS were Seigo Hiraga – MD (Japan); Greg Armstrong – TC (Australia), Sally Kong – TC (Singapore), Teresa Schafer – TC (USA) and Leo Roels – TC (Belgium)[1].

National Organ Transplant Unit

With the increase in patients needing transplant and growth of transplant programmes, it was recognised that there was a need for an agency to oversee organ donation and transplant activities at the national level. Hence, in 2005, the National Organ Transplant Unit (NOTU) was established as the operational and planning arm of MOH on organ donation and transplantation matters. The Organ Donor Registry and OPU, previously under SGH, were also consolidated under NOTU's ambit. In recognition of their important role as the central node of this intricate network, NOTU was also staffed by TCs.

Conclusions

Transplantation has come a long way since the first successful transplant but so has transplant coordination. Today in Singapore, there are about 50 TCs spread across the various organ and tissue transplant programmes in SGH, NUH and NOTU. They are highly motivated and driven individuals with a very unique and specialised skill set that enables them to drive and coordinate organ donation and transplant processes, care for patients pre- and post-transplant, and assist transplant teams to ensure the programme functions effectively. As a result, TCs are valued in all organ donation and transplant programmes. The role of the TC in Singapore has evolved much over the last 30 years, but their tenacity and perseverance in improving the lives of organ-failure patients will always remain the same.

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Ms. Sally Kong with transplant coordinators and physicians from both SGH and NUH during an appreciation dinner for Professor Amy Waterman who was a HMPD visiting expert to improve living kidney donor transplant rates in Singapore.

Ms Sally Kong is now the assistant director of the National Transplant Organ Unit and is seen here with her team of coordinators.

(Left to right)
Seated: *Dr Jeff Guo (Assistant Director), Mr. Benjamin Ho (Assistant Manager), Mr. Samsudin Bin Nordin (Assistant Manager)*
Standing (First Row): *Ms. Esther Ng (Senior Associate), Ms. Audrey Ngau (Transplant Coordinator), Ms. Stella Agustin (Transplant Coordinator), Ms. Karen Lim (Senior Transplant Coordinator), Ms. Sally Kong (Assistant Director), Ms. Jasmine Boh (Transplant Coordinator), Ms. Koh Xiu Xian (Manager), Ms. Gena Fong (Transplant Coordinator), Ms. Tin Tin Khiang (Registry Officer), Ms. Felicia Tan (Executive)*
Standing (Second Row): *Ms. Rachel Leung (Transplant Coordinator), Ms. Debby Arsita Thong (Transplant Coordinator), Ms. Chow Yee Ling (Transplant Coordinator)*

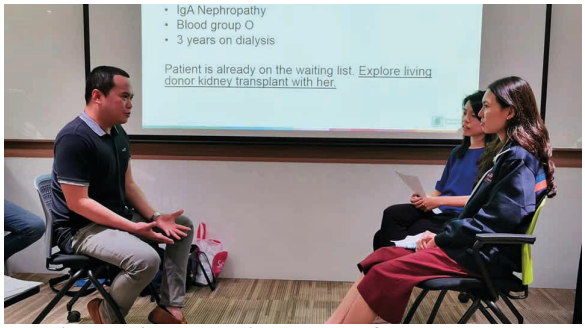
The programme holds an annual end of year lecture and dinner gathering for all kidney transplant recipients since 2016. It is organised by the transplant coordinators and is an event enjoyed by the patients and their families.

In 2011, the clinical transplant coordinators led a multidisciplinary effort to produce the first edition of " My Lifebook ", a book to guide patients in their new journey with a kidney transplant.

The National Organ Transplant unit holds an annual Wellness Carnival (this picture from 2018) in the heartlands under the leadership of Ms. Sally Kong. This is a family-friendly event whereby visitors are able to participate in informative and interactive games to learn about healthy living as well as about organ and tissue donation.

Transplant coordinators play an important role in providing input for the medical team during their daily rounds.

Transplant coordinators support the National Organ Transplant Unit's annual public fair to raise awareness of organ and tissue donation in the heartlands.



Transplant coordinators simulating patients for NKF nurses to practice their counselling skills during the transplant ambassador course held in 2019.

Transplant coordinators in their previous office location at Block 4 next to the renal dialysis centre in SGH.

Chapter 3
Past, Present and Future of Renal Medicine

"The Department of Renal Medicine has come a long way over the past 50 years and in many ways, its progress has been one of the success stories of healthcare in Singapore."

- Associate Professor Ruban Poopalalingam

Haemodialysis

Dr Liu Peiyun, Consultant
Dr Phang Chee Chin, Consultant
Ms. Ng Li Choo, Advanced Practice Nurse
Associate Professor Lina Choong, Senior Consultant
Dr Sheryl Gan, Consultant and Director of Haemodialysis

Our Humble Beginnings

Singapore's haemodialysis journey began on 5 July 1961 in SGH when the first artificial kidney machine – a Travenol (Kolff) Twin Coil Artificial Kidney was used to treat a British soldier with acute renal failure due to trauma incurred while preparing for a motorcycle grand prix (Figure 1). This pioneering machine was donated by Dato Lee Kong Chian to the Department of Clinical Medicine (Medical Unit II in SGH) of the then University of Singapore. The haemodialysis was performed with the assistance of Professor David Kerr together with a dialysis team from the Royal Air Force (RAF). Local pioneering doctors who were involved in that historic first treatment in Singapore included Professor Khoo Oon Teik, Dr Lim Cheng Hong, Dr Lim Pin, Dr Lee Guat Siew and Dr Beatrice Chen.

Figure 1
The Travenol (Kolff) Twin Coil Artificial Kidney provided the first dialysis treatment to a patient with acute renal failure in 1961.

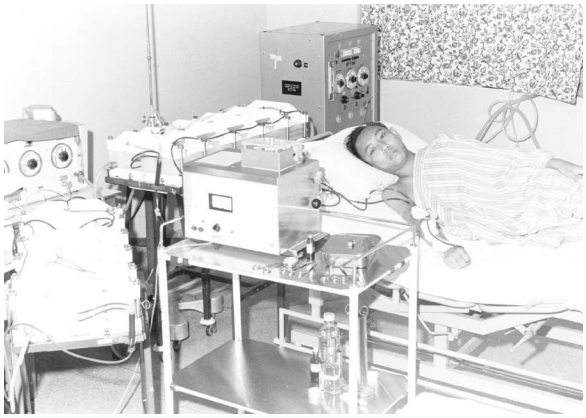


Figure 2
A patient undergoing dialysis in the first haemodialysis centre located in an attic at the old Bowyer's Block of SGH.

The early haemodialysis centre was housed in the old Bowyer Block and humbly located in a side-room adjacent to Ward 21 (Figure 2). The veranda served as a preparatory area and doctors were responsible for performing the dialysis sessions from start to end. Treatment was offered only to patients with acute renal failure in the hope that they would recover. In an effort to groom haemodialysis trained nurses, Sister Ling Mie Hean was sent on a two-year scholarship to Professor Jim Lawrence's unit in Adelaide and later to Melbourne for a Sister Tutor's course in 1967. She subsequently became the first Sister Tutor in Renal and Coronary care.

The Travenol twin coil artificial kidney required 8 to 10 pints of blood to be primed for each dialysis session. This was soon replaced by Heppell Kiil dialysers donated by Malaysia Dairy Industries Ltd in 1968. However, the treatment time remained lengthy at about 12 hours per session. In the same year, a chronic haemodialysis programme was established in SGH where patients were accepted for chronic maintenance haemodialysis and a chronic dialysis unit was also established with funds obtained from

Figure 3
A nurse starting dialysis for a patient using the kiil dialyser at the dialysis centre in the attic of Bowyer's Block in 1970.

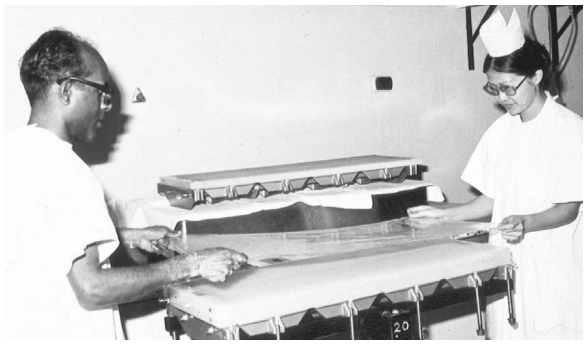


Figure 4
Dialysis nurses laying cellophane onto the kiil dialyser.

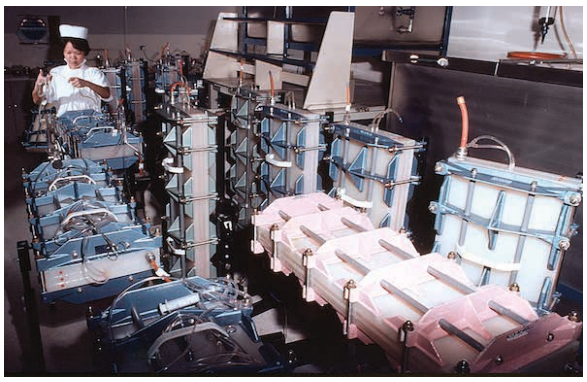


Figure 5
A nurse is testing a Kiil dialyser membrane for any leakage by filling with formalin before use. Each dialyser was designated to a patient and thence had a name label stuck to it.

the Shaw Foundation. The attic above Ward 16 (Surgery A unit) of the old SGH was converted into a dialysis centre with eight beds (Figure 3). Dialysis was performed then using Cuprophane membranes in a standard Kiil dialyser (Figure 4 and 5). Dialysate was mixed either manually in a large tank or a central proportioning system and pumped out to Watson Marlow monitors. Ultrafiltration was achieved by dropping the dialysate outflow line two stories down from the attic. Patients were dialysed twice a week for 15 hours per session from 1968 to August 1975. With the introduction of Meltec Multipoint Dialysers, the treatment time for dialysis was reduced to eight hours. Thereafter, shifts were reduced to 6-8 hours, but frequency of dialysis was increased to 3 times a week, allowing the centre to run two shifts a day.

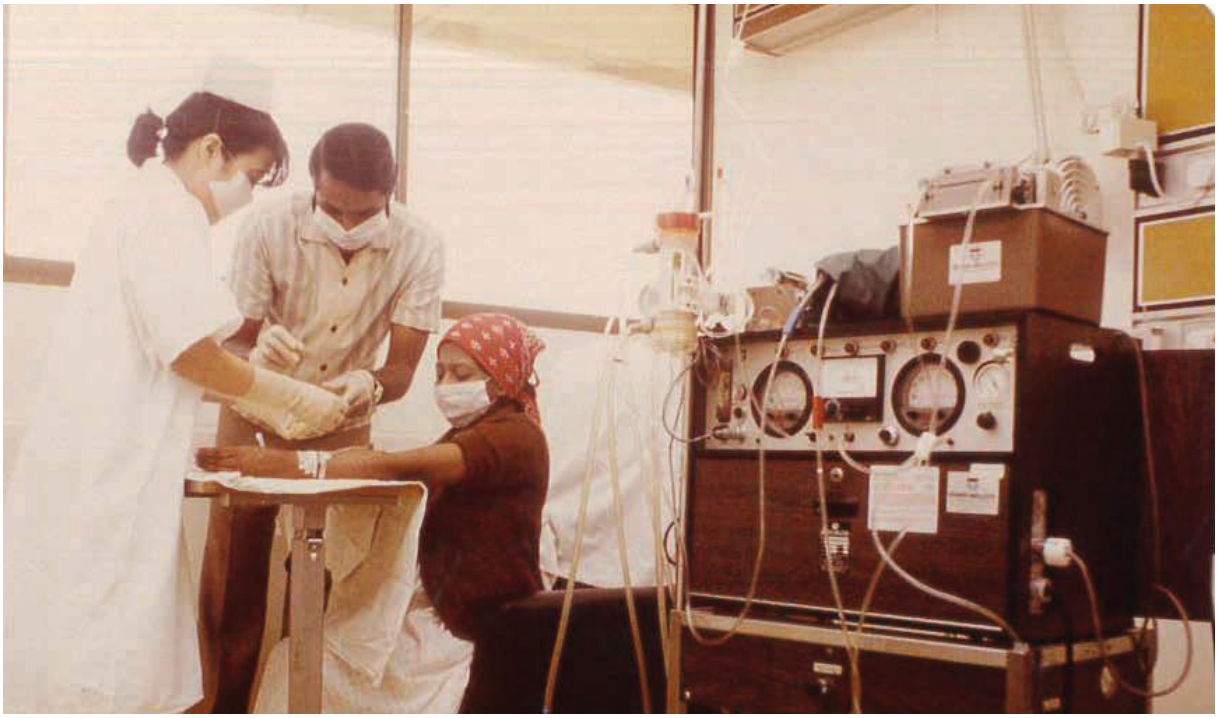


Figure 6
When Sister Susan Quek was a staff nurse, she taught relatives of patients to cannulate a fistula at the self-dependency dialysis unit.

Figure 7
The second self-dependency dialysis unit at Tan Tock Seng Hospital in 1983 with a capacity for 80 patients.

The home haemodialysis programme was launched in 1970 in Singapore. Patients were trained at SGH together with their helpers who would usually be their spouse or a close relative before they were sent home to perform dialysis themselves. This programme was not subsidised and patients had to bear the full cost of dialysis. In 1974, the National Kidney Foundation of Singapore sponsored a self-dependency dialysis programme to cope with the increasing number of patients on haemodialysis. This programme involved training patients and their helpers for two months in SGH to perform their own dialysis before they were allowed to dialyse themselves at a satellite centre (Figure 6). The idea was to have a minimum of staff and patients had to be self-reliant. In 1975, the first self-dependency dialysis unit (SDDU) with a capacity for 44 patients was set up in Alexandra Hospital in an abandoned old Gurkha kitchen. In 1983, the second SDDU which could take up to 80 patients was established in Tan Tock Seng Hospital (Figure 7). The first SDDU started operations in July 1975 and was officially opened by President Benjamin Sheares on 6 September 1975. The self-assist haemodialysis programme allowed one single nursing staff to supervise up to 20 patients during haemodialysis. Heavily subsidised, these state-supported programmes allowed patients to be dialysed with the help of their own spouses or relatives. Patients paid only $10 per dialysis and were selected based on medical and socio-economic considerations. These programmes were cost saving due to the reduction in manpower needs since staff salaries could account for up to half of the total cost of dialysis then.

Moving with the Times

With the opening of the new SGH in 1981 (Figure 8), a dialysis centre was set up in the new premises using new generation dialysers made from hollow fibres (Figure 9). These new dialysers further shortened dialysis treatment time to four hours. The 10-bedded, fully nurse-assisted centre was able to run two shifts of 10 patients per day. The new centre was also equipped with a water treatment system that included reverse osmosis facilities to improve water quality for haemodialysis. Reverse osmosis water treatment technology has allowed the elimination of aluminium toxicity, which can occur in vintage dialysis patients resulting in slurred speech, facial grimacing, and seizures with severe wasting and osteomalacia. Aluminium present in tap water which is used to produce dialysate solution can result in aluminium toxicity after years of dialysis leading to a condition coined "dialysis dementia", which was the commonest cause of death in dialysis patients then accounting for up to 43.5% of the deaths before 1981 as compared to 3.3% after 1980. Over at the SDDU in Alexandra Hospital, a deioniser was already installed in 1979 while the other unit at Tan Tock Seng Hospital was built with a deioniser unit included. Acetate buffered dialysate was used throughout all three centres. The five-year survival of haemodialysis patients admitted into our haemodialysis programme was 46.9% from 1968 to 1980 as compared to 82.8% among the intake from 1981 to 1987. After the introduction of erythropoietin in 1989 in Singapore, management of anaemia in dialysis patients has improved, allowing most patients to maintain a haemoglobin of about 10g/dL or more. In addition, new dialysers usually feature a smaller blood compartment volume and hence reduces blood loss in the event of dialyser clotting. Microcytic anaemia resulting from aluminium toxicity has also declined with use of reverse osmosis facilities. Occurrence of aluminium bone disease has declined with the replacement of aluminium containing phosphate binders for calcium containing phosphate binders and with the use of treated water for haemodialysis. All patients are also vaccinated against hepatitis B prior to entry to the dialysis programme but about one-third of existing patients were already admitted into the programme before vaccination became available.

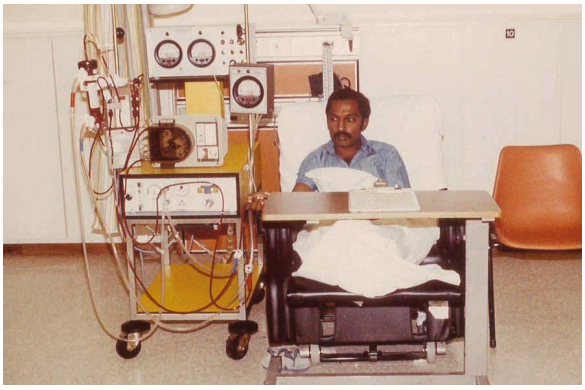


Figure 9
Patient receiving dialysis, using the Travenol dialysis machine.

Figure 8
In 1981, SGH had a new haemodialysis centre which was a 10 bedded fully nurse-assisted unit, able to run two shifts of 10 patients per day for 4 hours.

Figure 10
The haemodialysis centre in the 1990s expanded into a 20-bedded centre.

Figure 11a
The modern haemodialysis centre at SGH in 2020.

Figure 11b
The modern haemodialysis centre at SGH in 2020.

The SGH dialysis centre provided dialysis treatment for patients with acute kidney injury, patients on interim dialysis while awaiting renal transplant work-up or during transition to peritoneal dialysis, as well as patients who failed peritoneal dialysis and were converted back to haemodialysis. The centre also had an additional four single-bedded stations for training patients for home dialysis or self-dependency dialysis, and also served as a site to help manage patients with dialysis-related problems from the National Kidney Foundation dialysis centres and other centres. The SGH Dialysis Centre underwent major upgrades in 1992 with 25 stations and again in 2011 to meet increasing patient load and advancing medical techniques and technology (Figure 10). Today, the renal dialysis centre comprises of a 20-station unit, offers isolation stations and runs three shifts a day (Figure 11a & 11b). It also provides overnight dialysis support for urgent cases. The centre continues to rise to the challenge to provide timely haemodialysis for the inpatients in SGH. The dialysis programme in SGH as well as nationwide has also moved from self-assisted haemodialysis prevalent in the old days back to fully nurse-assisted haemodialysis at the present time.

Directors of the SGH Haemodialysis Centre include: Associate Professor Lina Choong (2002 to 2018) and Dr Sheryl Gan (2018 to present). The current nursing managers in the dialysis centre include Senior Nurse Clinician (Advanced Practice Nurse) Michelle Ng, Sister Liang Wen Qian and Sister Sumathi D/O Siva Thore. We currently have around 60 haemodialysis nurses and one renal dialysis technician and we are also supported by administrative staff and clerks.

Over the past decade, new haemodialysis techniques that were introduced include High Flux Dialysis (HFD) as well as haemodiafiltration (HDF). With the advancement of technology in haemodialysis, we have transitioned from acetate-based dialysis to bicarbonate-based dialysate which reduces the incidence of low blood pressure during dialysis. In addition, newer dialysers with larger sieving coefficients and surface areas allow more fluid to be drawn from dialysis patients, which helps to improve blood pressure disorders related to poor compliance with salt and fluid restriction. Current haemodialysis machines (Figure 12) are also equipped with the capability for volumetric fluid removal and sodium

Gambro AK96

Fresenius 5008

Fresenius 4008S

Figure 12
Modern haemodialysis machines

modelling. The dialysis centre in SGH is able to cater to standard bicarbonate haemodialysis as well as heparin free haemodialysis, dialysis with sodium modelling and isolated ultrafiltration for inpatients with special needs. In addition, sustained low efficiency haemodialysis as well as HDF can also be performed for patients with haemodynamic instability or are critically ill. Low flux haemodialysis membranes were routinely used till 2018, subsequent to which all patients were dialysed via high flux membranes unless otherwise specified. As a result, the incidence of dialysis related amyloidosis has declined with the use of high flux dialyser membranes which are associated with increased clearance of beta-2 microglobulin. With improved biocompatibility of dialyser membranes, there is also less blood-membrane interaction and patients experience less intradialytic symptoms.

Haemodialysis prescription in SGH has evolved over the years with the introduction of an electronic medical record system. Prescriptions used to be ordered manually on a paper form, but now can be ordered online since 2011. With the use of information technology, we have benefited from reducing our carbon footprint, improved manpower efficiency and reduced errors.

We continue to invest heavily in supporting, training and improving our people and in our work processes. Our staff have been sent for training under the Human Manpower Development Programme in areas such as the management of the chronic haemodialysis patient, nocturnal haemodialysis and home haemodialysis. Our teams have embarked on and completed many quality improvement projects such as reducing turn-around time between patients, reducing haemodialysis machine downtime and reducing haemodialysis catheter related infections. Projects such as the latter have been done in collaboration with our community partners. We are and continue to be grateful and honoured to work with our colleagues such as National Kidney Foundation, Kidney Dialysis Foundation, Renal Health Private Limited and other restructured hospitals. Our fellow doctors in Vascular Surgery, Interventional Radiology and Nephrology have also help made the excellent care of our haemodialysis patients possible.

We also acknowledge that our success would not be possible without our colleagues in the SGH family, such as the Biomedical Engineers, Facilities, Laboratory Services, Finance and Business Office. Our haemodialysis vendors and service providers also play a key role in ensuring our continued service and progress.

The Future

We will continue to increase our service capacity by increasing trained staff and dialysis stations. This includes the opening of the haemodiaysis centre in SingHealth Tower in 2020. In addition, the centre will continue to provide dialysis support for future SGH clinical service expansions such as the Acute Medical Ward and Elective Care Centre.

We will continue in our endeavour to utilise automation and leverage on artificial intelligence in the dialysis centre to facilitate better day-to-day running. With the integration of medical devices with electronic medical records, we hope to be able to download patients' parameters recorded in dialysis machines directly onto Citrix. This will do away with the need to key these parameters manually into the electronic system and thus reduce the workload of the dialysis nurses. We have grown from strength to strength since our humble beginnings in 1961. Our vision is to continue providing state of the art haemodialysis as a major renal replacement therapy for the end stage renal failure patients in SGH and our country.

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Peritoneal Dialysis

Dr Htay Htay, Consultant and Deputy Director of the Peritoneal Dialysis Programme
Associate Professor Marjorie Foo, Senior Consultant and Director of the Peritoneal Dialysis Programme

History of the Peritoneal Dialysis Programme at SGH

Peritoneal dialysis (PD) was first introduced in Singapore, as a form of continuous ambulatory PD (CAPD) at SGH by Dr Akira Wu in 1980, when five patients were first enrolled in the programme. The number of PD patients subsequently increased to 66 in 1985, 94 in 1986, and 109 in 1987.[1] CAPD provided a less expensive mode of dialysis and had comparable survival to haemodialysis (HD). Furthermore, the PD programme permitted the entry of patients over 50 years of age, who would then have been precluded from HD programme during the 1980s.[1] The first CAPD unit in SGH (Figure 1) was established in April 1987 by Dr Grace Lee with Ms. Florence Fan Fung Yin as the PD nurse-in-charge and provide comprehensive care to patients such as patient training, education, and management. The number of patients continued to increase to 128 in 1992 and all PD patients were looked after by two PD nurses (1:60 nurse-to-patient ratio) during that time. Dr Lee and the team also provided an individualised training programme for visiting doctors, workshops on dialysis therapy for general practitioners and patient education programmes such as in-house refresher courses and annual PD patient education seminars (Figure 2).

Figure 1
Senior Staff Nurse Florence Fan at the CAPD Centre located at Block 4 Level 2 of SGH where the current Interventional Nephrology Suite is located now.

Initially, the PD solution was prepared in glass bottles. (Figure 3) The conventional spike system

Figure 2
Dr Grace Lee with Professor Evan Lee, Dr Steven Chew and SSN Thanaletchumi Krishnasamy at the first peritoneal dialysis patient education seminar.

was used for CAPD and the ultraviolet irradiation connection box set was subsequently introduced in the 1980s to reduce PD-related infection. The peritonitis rate was high at one in 13 patient months (0.92 episodes per patient-year) in 1983 but after the introduction of the O-set disconnect system in 1993, the peritonitis rate improved to one in 24.1 patient months (0.50 episodes per patient-year). Newer technologies and solutions were then introduced over the years. The ultrabag system was introduced in Singapore in the late 1990s while the glucose-based polymer, Icodextrin (Extraneal) PD solution became available in SGH in the early 2000s. Additional types of solutions such as the amino acid-based PD solution (Nutrineal) and biocompatible solutions (Physioneal) were introduced in the middle of the 2000s but their use was low due to their high costs. As a result, these solutions became no longer available during the 2010s. Initially, only PD products from Baxter Healthcare were available in SGH but products from Fresenius Medical Care (FMC) such as Stay Safe® and Sleep Safe® systems were later introduced to SGH in the middle of the 2000s. The neutral pH, low glucose-degradation products solution (Balance® solution) were also available for PD patients using the FMC systems since the middle of the 2010s.

Figure 3
In the 1980s, peritoneal dialysis solutions were contained in glass bottles.

In the past, straight double cuffed Tenckhoff catheters for PD were inserted by urologists and general surgeons in the operating theatre. However, due to complications including catheter migration, the straight catheter was replaced with Swan Neck catheters for a short period of time before eventually being replaced by the coiled double cuffed Tenckhoff catheters in the early 2000s. In the early days, acute PD was practiced in SGH using a rigid catheter inserted by nephrologists (Figure 4). However, the practice of using a rigid catheter was abandoned in the early 2000s.

Automated PD (APD) was introduced in 1990 using Pac-X cycler (Figure 5) and enrolled 13 APD patients in the same year.[1] The Pac-X cycler was later replaced with the Baxter healthcare Homechoice® APD machine in the late 1990s (Figure 6). Homechoice Claria Sharesource® from Baxter Healthcare has been recently introduced which allows remote monitoring and adjusting of PD regimen for patients on APD therapy. In SGH, there are over 50 PD patients on Claria Sharesource® (a remote monitoring platform for home-based treatment monitoring) as of June 2020.

Currently, patients with chronic kidney disease who are deemed suitable and keen for PD are referred to PD care coordinators and PD nurses for further education and counselling on PD. Patients who decide to choose PD as a modality of renal replacement therapy are referred to surgeons for insertion of PD catheters. In our centre, PD catheter insertion is performed by a team of vascular surgeons led by Associate Professor Chong Tze Tec and Associate Professor Tan Seck Guan. We practice prescribing prophylactic intravenous antibiotics before PD catheter insertion to prevent early peritonitis in PD patients.[5,6] We also practice daily application of topical antibiotic cream at the catheter exit-site to prevent catheter-related infections.

Figure 4
Rigid peritoneal dialysis catheters.

The topical application antimicrobial agent (mupirocin) for catheter exit site antimicrobial prophylaxis was introduced in 2000 and reduced peritonitis rate from 0.44 episodes per patient-year in the period between 1998 and 1999 to 0.34 episodes per patient-year in the period between 2000 and 2004.[3] However, in 2013, mupirocin cream was replaced with 1% chlorhexidine gluconate cream for the period of 2014 to 2015 as there was a concern of the development of drug-resistant organisms with daily mupirocin use. Unfortunately, subsequent monitoring of exit-site infections suggested a higher

Figure 5
One of the earliest automated peritoneal dialysis machine introduced in the early 1990s.

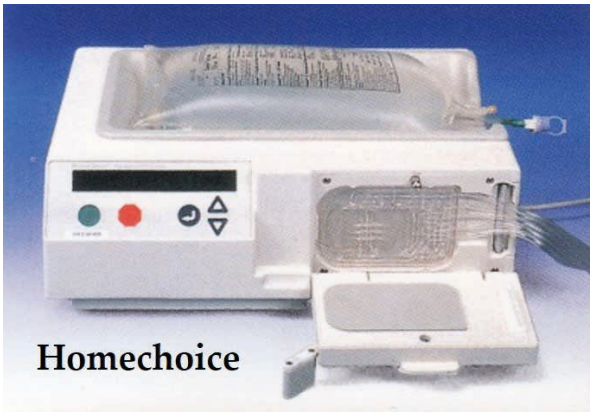

Figure 6
Baxter Healthcare's Homechoice automated peritoneal dialysis machine.

rate of exit-site infections with chlorhexidine cream compared with mupirocin cream (0.22 versus 0.12 episodes per patient-year).[4] As a result, the use of chlorhexidine cream was replaced with topical 0.1% gentamicin cream since 2016.

The initial CAPD unit also provided PD training to doctors and nurses from Indonesia, Malaysia, Thailand and the Philippines. This led to the unit being designated a Regional Reference Centre in 1990 by Baxter Healthcare in recognition of the high standard of PD practice it set. Over time, the unit evolved into a PD centre providing one-stop training and outpatient treatment for PD patients. Thence, it became the PD Centre and was officially opened by Dr Lee Suan Yew, Director of SGH on 27 June 1993 (Figure 7). To meet the demands of the growing PD population, MOH organised a meeting between SGH and Singapore Children's Society to provide financial and social support for needy PD patients. The new PD Centre was jointly set up by the Singapore Children's Society and SGH and was relocated away from the main hospital building nearer to the former School of Nursing at Block C (Figure 8). This new PD Centre was officially opened by Dr Balaji Sadasivan, then Senior Minister of State for Health on 21 October 2004. However, this facility was later closed, and the PD centre had to be temporarily relocated to SGH block 4, where it was co-sited with Renal Health Dialysis Centre in 2013 before finally being moved to its current location in Diabetes & Metabolic Centre in 2015 (Figure 9).

In 1998, Dr Stephen Chew succeeded Dr Grace Lee as Director of the PD programme. Ms. Thanaletchumi Krishnasamy (Figure 10 and 11) was one of the chief PD nurses for the programme during that time and she was actively involved in assisting Dr Chew in patient education and PD training. During Dr Chew's tenure as PD director, he was instrumental in developing an electronic PD database system which tracks data for PD population demographics, infectious complications, hospitalisations and PD solute clearance. This made it easier for the PD team to perform audits and monitoring of key performance indicators of the programme.

The cost of PD was lower than of HD - the estimated cost of HD was US$1,500 to 2,500 per month and the cost of PD was only US$860 per month in the 1980s.[1] The price of CAPD increased to S$1,290 per month in 1998 when the ultrabag system came into use. Professor Woo Keng Thye, then Head

Figure 7
The CAPD unit evolved into the CAPD centre, which was officially opened by Dr Lee Suan Yew, Director of SGH in 27 June 1993. In the background are Mr. T. T. Durai, Ms. Susan Tan from Baxter, Professor Woo Keng Thye, CEO Mr. Lawrence Lim, Ms. Chen Ai Ju (DMS), Dr Phyllis Liauw and Associate Professor Lina Choong with S/N Florence Fan.

Figure 9
The PD centre in its current location at level 1 of the Diabetes Metabolism Centre.

Figure 8
The CAPD centre moved to a bigger location at the former School of Nursing Building. It had a larger waiting area including a place for patients to exercise.

of Department of Renal Medicine, subsequently negotiated with the Baxter Healthcare team to bring the cost of CAPD down to S$1,100 per month in 1999. Furthermore, in 1998, eligible CAPD patients also received additional subsidies from the National Kidney Foundation (NKF). In December 2001, the government announced additional subsidies for both CAPD and APD patients to minimise out-of-pocket payments by patients. This was driven by a national policy to promote PD, which was more cost-effective than HD. As a result, the proportion of kidney failure patients on PD increased to 20.7% in 2004 compared with 16.4% in 2000 as a result of the government's financial incentives that were in favour of PD.[2]

Current Status of SGH-PD Programme

The current PD Programme Director is Associate Professor Marjorie Foo (Figure 12), who took over from Dr Stephen Chew when the latter left for private practice in 2004. Dr Htay Htay is the Deputy Director for programme, while the PD nurse-in-charge is Ms. Wu Sin Yan. The proportion of patients choosing PD as a modality for renal replacement therapy increased with the introduction of an urgent-start PD programme to SGH in 2016 (Figure 13). By 2019, 30% of all incident patients needing dialysis were placed on PD at SGH. There are now over 500 prevalent patients on PD in SGH as of the year 2019. Outcomes are also excellent with the peritonitis and exit/tunnel infection rates being 0.18 episodes per patient-year and 0.15 episodes per patient-year respectively during the year 2019 (Figure 14 and 15). The current 1-year patient and technique survival rates are 92.8% and 86.3% respectively while 5-year patient and technique survival rates are 49.7% and 36.1% respectively (Table 1). The current 1-year and 5-year death-censored technique survival rates are 93.0% and 72.8% respectively (Table 1).

Figure 10
SSN Thanaletchumi Krishnasamy became one of the most senior PD nurses and was a resource person for many renal registrars rotated to the PD programme.

Figure 11
Dr Stephen Chew took over as Director of the PD programme in 1998. (pictured 2nd person from the left in the back row).

Table 1. Patient survival, technique survival, and death-censored technique survival of peritoneal dialysis patients followed up in SGH between 2005 to 2019

Variables	2005-2009	2010-2014	2015-2019
Patient survival			
1-year	85.5	88.1	92.8
3-year	59.6	64.9	71.5
5-year	39.9	46.5	49.7
Technique survival			
1-year	80.0	82.4	86.3
3-year	48.6	54.6	59.0
5-year	29.7	33.8	36.1
Death-censored technique survival			
1-year	93.6	93.6	93.0
3-year	81.7	84.4	82.5
5-year	74.6	65.6	72.8

Data are presented in %

Figure 12
Dr Marjorie Foo took over the PD programme in 2004 when Dr Stephen Chew left for private practice.

PD Training

The PD centre train patients and caregivers to perform PD exchanges safely and monitor for PD-related complications. It is one of a few centres in Singapore which provides PD training for different systems (Baxter or Fresenius) depending on the patients' choice or need. Furthermore, training for both CAPD and APD is provided. Most patients (70%) are on APD but they are also taught CAPD during their training to prepare them for a situation where they might need to use CAPD, for example, during an overseas trip. In addition, the PD team works closely with voluntary welfare organisations including National Kidney Foundation (NKF) and Kidney Dialysis Foundation to provide additional community and financial support to needy patients.

PD Initiation Clinic

The PD initiation clinic was established in 2017 by Dr Htay Htay. In this clinic, patients with end-stage renal failure initiated on PD are reviewed and followed up by a dedicated PD team for up to six months. Patients are then transferred back to their primary renal physicians to continue long term follow-up once stable on PD. Our centre practices incremental PD for all incident PD patients who still have significant residual renal function. This is because there is evidence that the outcomes of incremental PD are comparable to those of the full-dose PD approach.[7] Incremental PD also reduces costs and burden of PD exchanges as well as lower peritoneal exposure of glucose and its toxic degradation products.

PD Disease Management Clinic

Our PD programme runs a weekly disease management clinic (DMC) manned by a dedicated PD team including PD physicians, Senior Residents on PD training, PD nurses, a dietician, and a pharmacist. PD patients with complicated PD issues are reviewed and followed up by the PD team in this DMC. As a result, holistic care is provided by a multidisciplinary team and provide a platform for Senior Residents to receive dedicated PD exposure and training.

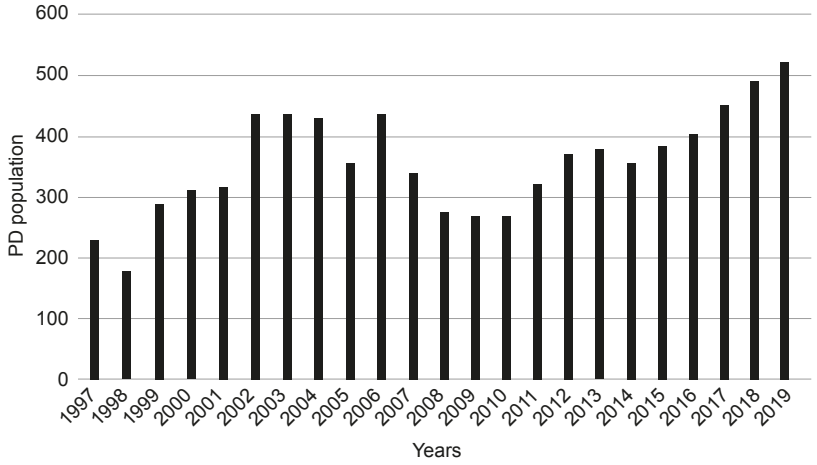

Figure 13
Prevalent population of PD patients followed up at SGH during the period of 1997 to 2019.

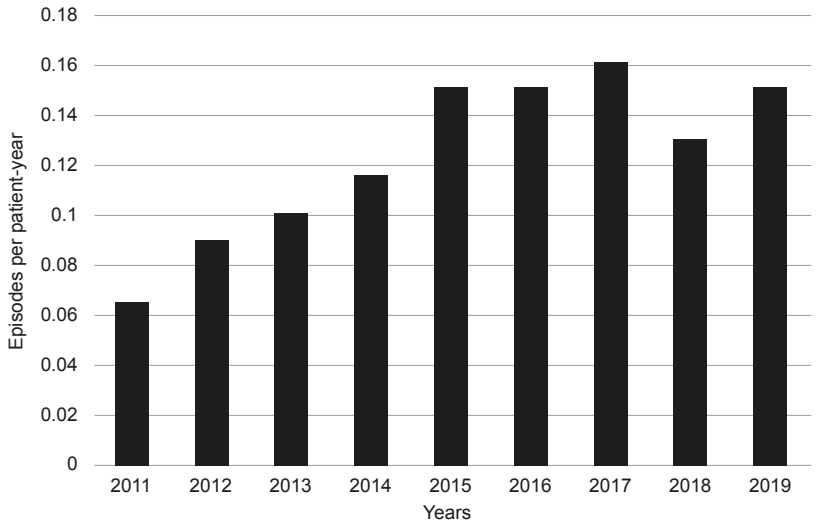

Figure 14
Exit-site or tunnel infection rates of the PD programme at SGH during the period of 2011 to 2019.

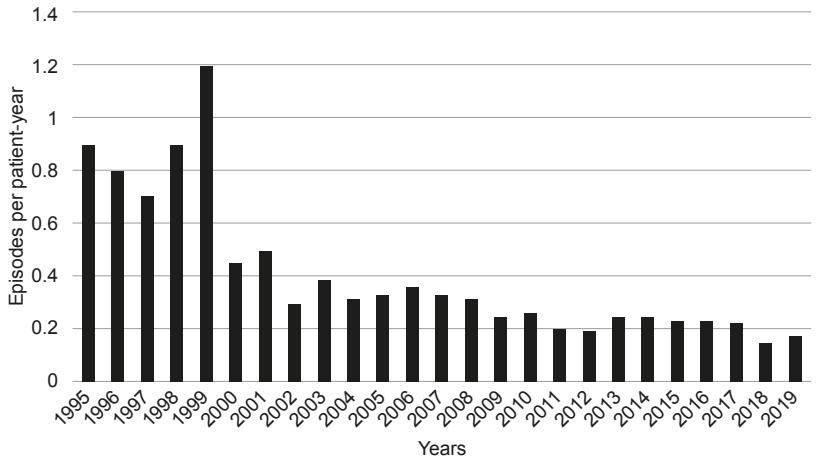

Figure 15
Peritoneal dialysis-related peritonitis rates of the PD programme at SGH during the period of 1995 to 2019.

PD Walk-in Clinic

In addition to the routine PD clinic, our PD programme also provides a walk-in clinic for patients who seek urgent medical attention for PD-related issues including PD exit-site infection, peritonitis and fluid overload. This walk-in clinic is open during office hours to review patients with PD-related issues and manage them in a timely manner to prevent any unnecessary hospital admission.

PD In-patient Services

Our PD programme also provides in-patient PD support for PD patients who are admitted to the hospital. In addition, there is also a PD nurse on call who provide urgent in-patient PD support outside of office hours e.g. urgent PD exchange for fluid overload or urgent intra-peritoneal antibiotics for PD-related peritonitis. There are also fortnightly PD ward rounds to optimise management of patients in hospital with complicated PD issues. This PD ward round is conducted by a PD physician and attended by PD nurses, a pharmacist, and Senior Residents. All complicated PD problems are brought up for discussion during the ward round and results in an appropriate management plan being laid out.

PD Home Visit Meetings

The PD programme conducts monthly PD home visit meetings that are attended by PD physicians, PD nurses, medical social worker, PD coordinator and PD nurses from various external organisations, such as NKF, Baxter Healthcare and FMC. These organisations conduct home visits for PD patients in the community. During home visits, the medical, psychosocial, financial and home conditions of PD patients are noted and are subsequently discussed during the PD home visit meetings. These home visits provide additional support for patients in the community and also allow the PD team to ensure adherence to safe-PD related procedures and intervene when there are deviations.

Support for Patients and Caregivers

SGH-PD Centre organised its first patient-family outing to the Singapore Zoological Gardens in 1988. Subsequently, several overseas trips have been organised for PD patients to countries including Korea, Thailand, and Australia. PD forums have also been held in SGH since 2003. This was later expanded into a national PD educational forum, of which the first one was held in Khoo Teck Puat Hospital in April 2019 (Figure 16). It was a concerted effort from nurses, patients and all other PD care providers to set up this PD Forum together, where everyone could have fun, interact and learn at the same time. For the first time, patients were included in the programme committee, making it a more relevant forum that targeted their needs.

Figure 16
A PD Forum held in SGH in 2018.

Urgent-Start PD Programme

The PD programme also supports urgent initiation of PD in patients who require urgent dialysis but have yet to establish permanent dialysis access and are keen to consider PD. The urgent-start PD programme was implemented in 2016 and involves collaboration with vascular surgeons to provide timely PD catheter insertion, prompt education by PD Care Coordinator and psychosocial/financial support by the medical social workers. PD nurses also have to perform intermittent PD on patients before they or their caregivers could be taught how to perform PD exchanges. Low volume APD in a supine position was used during urgent PD initiation to minimise mechanical complications during urgent PD initiation such as leaks.

PD Multidisciplinary Meetings

PD multidisciplinary team meetings begun in 2017 to regularly review key performance indicators and outcomes while discussing ways to improve them further. These meetings are conducted once every four months and are attended by PD physicians, PD nurses, nurse clinicians, pharmacists, dieticians, medical social workers, renal, and PD care coordinators.

Multidisciplinary PD team

A. Nephrologists

There are 29 nephrologists and one visiting nephrologist providing care of PD patients in SGH. Of these, four nephrologists are accredited as PD physicians (Figure 17) and are involved in running different PD specialty clinics, managing patients with complicated PD-related issues and participating in PD ward rounds, home visit meetings and multidisciplinary meetings. The PD physicians also provide educational activities for Senior Residents as well as participate in quality improvement and research projects to improve the outcomes of the PD patient population.

B. PD nurses

PD nurses play a crucial role in the success of the PD programme. They are responsible for PD education and assessment of patients who might be keen on PD as a renal replacement therapy option. Once the PD catheter is inserted, a PD nurse will take care of PD exit-site dressing till patients or caregivers have been trained to do so. PD nurses also provide PD training to patients and caregivers during which they will assess their techniques and perform re-training for patients who need it. PD nurses also perform intermittent PD for patients who need PD urgently, provide 24-hour hotline support and support outpatient/inpatient services of the PD programme.

C. Renal Coordinators

Pre-dialysis counselling has been associated with a reduction in the use of central venous catheters for dialysis initiation in patients with end-stage renal failure. The Renal Coordinator Unit in SGH provides education and counselling on various renal replacement therapy options as well as offer information regarding dialysis subsidies to help patients navigate the complex funding schemes and programmes offered by voluntary welfare organisations. In order to support the growing needs of the PD programme, a dedicated renal coordinator for PD (PD Care Coordinator) was appointed in 2017. The PD Care Coordinator provides pre-dialysis counselling and reinforces education for chronic kidney disease patients who are potential candidates for PD, giving them more in-depth information on PD therapy, answering any queries and reduce their anxieties about the therapy. As a result, there has been less frequent last-minute modality changes and patient uptake of PD has increased.

D. Pharmacists

Pharmacists participate in the care for PD patients at the beginning of their PD journey. Upon PD initiation, pharmacists educate patients about changes in their medications and the importance of medication adherence in optimising their outcomes

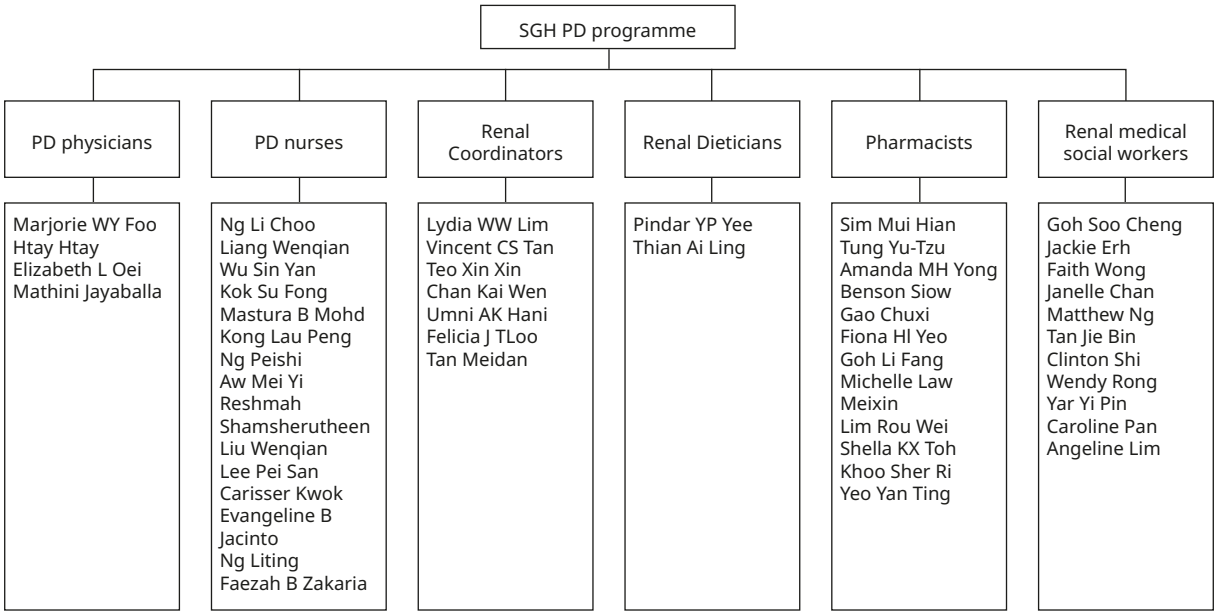

Figure 17
Peritoneal dialysis service is run by a multidisciplinary team of healthcare professionals.

on PD. The PD pharmacists are also actively involved in research and quality improvement projects, annual auditing of antibiotics sensitivity of causative micro-organisms for PD-related infections and ensuring that the centre's empiric antibiotic regimens for peritonitis and exit-site/tunnel infection are appropriate to allow timely resolution of infections and thus improve the overall outcomes of our patients.

E. Medical Social Workers

Renal medical social workers (MSWs) assist the PD team in the psychosocial care of patients on PD. Recognising that an illness does not impact just the individual, MSWs provide holistic care by engaging and working with the families of patients too. MSWs provide psychoeducation, financial assistance, counselling, and referral to community resources to support patients on their journey. They also participate in the multidisciplinary PD home visit meetings to provide psychosocial input and conduct home visits with PD nurses to support PD patients and caregivers in their home.

F. Dietitians

Malnutrition is a common complication in PD patients. Dietary counselling plays an important role in the management of the nutrition status of PD patients. Under the SGH PD programme, all new PD patients are reviewed by a dietitian at the point of PD initiation and subsequently in follow-up visits to ensure dietary adherence and adequate nutrition, providing nutritional supplements when needed.

Quality Improvement Projects

Our centre is continuously striving to improve the clinical outcomes of PD patients through quality improvement (QI) initiatives. For example, the culture-negative peritonitis rate in our centre was previously more than 20%, which was higher than required in international guidelines. However, after a QI project undertaken during the period of 2014 to 2015, the rate reduced to less than 20%. The centre also started a QI project on improving vaccination rates for influenza and pneumococcal infections. Before the QI project started, the proportion of PD patients receiving vaccinations for influenza, pneumococcal 13, and 23 was 63%, 54%, and 14% respectively. However, through the QI project, the programme offered vaccination upfront during the PD training period as well as inform physicians to vaccinate their PD patients. After the QI initiative, the vaccination rates for influenza, pneumococcal 13 and 23 improved to 84%, 84%, and 65% respectively.

Education & Research

SGH hosts the SingHealth Renal Medicine Senior Residency Programme and the PD curriculum is aligned with ACGME-I standards. Our PD Centre is the main training centre for Senior Residents when it comes to nephrology training within SingHealth. The PD team actively participates in the Singapore Annual PD (SAPD) Meeting which is a platform to educate and update renal physicians, trainees and nurses in Singapore. In addition, the centre had previously provided PD training courses for nephrologists and PD nurses from the region in 2014 and 2015.

Research plays a major role in improving the quality of life and clinical outcomes of patients. Our PD team actively participates in clinical trials for PD patients. Our centre is also the first in the world to successfully conduct the first-in-human trial for the safety and efficacy of the Automated Wearable Artificial Kidney (AWAK) PD device. This trial was sponsored by a grant from the National Medical Research Council (NMRC) and AWAK Technologies, led by Associate Professor Marjorie Foo and Dr Htay Htay. In addition, a pilot study of the weekly use of chlorhexidine impregnated sponge dressing at the PD catheter exit-site in the prevention of catheter-related infection in PD patients has been completed. The centre is currently conducting the study of the point-of-care test strip in the diagnosis of peritonitis in peritoneal dialysis patients. Such ongoing research is vital for the betterment of patient care and for us to become a global leader in PD research.

The SGH PD Centre is the first and largest PD centre in Singapore. It is also one of the few centres providing holistic care to patients, including full outpatient and inpatient PD support and a 24-hour support hotline for patients who are homebased. In terms of education, we not only provide PD training for future nephrologists but also strive to improve outcomes for PD patients through state-of-the-art clinical research including the AWAK in-human trial, with hopefully many more such breakthroughs to come.

Acknowledgments

The authors greatly acknowledge the contributions of Professor Woo Keng Thye, Dr Grace Lee, Dr Stephen Chew, Dr Sim Mui Hian, Ms. Wu Sin Yan, Ms. Lydia Lim, and Ms. Faith Wong for this article.

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General Nephrology and Glomerulonephritis

Dr Cynthia Lim, Consultant and Director of Research

Associate Professor Jason Choo, Senior Consultant and Director of the Glomerulonephritis, Chronic Kidney Disease and Academic Nephrology Programme

Associate Professor Jason Choo (left) with Dr Cynthia Lim (centre) and Dr Irene Mok (right) from the Glomerulonephritis Team.

Nephrology in SGH was pioneered by Dr Lim Cheng Hong, who led the fledgling department between 1973 and 1989. Clinical Nephrology formed the bulk of the clinical service work then, thus generating early observations on the local glomerulonephritides and especially Immunoglobulin A (IgA) Nephropathy.[1-3] These observations laid the groundwork for trials that, for many years, guided management of IgA nephropathy internationally.[4-6] It was under the leadership of Dr Lim, also the founding president of the Singapore Society of Nephrology, that SGH contributed several papers in the field of glomerulonephritis to the First Asian Colloquium in Nephrology that was held in Singapore in 1974.

Renal physicians attending one of the monthly renal histopathology meetings which is always a very educational and interactive session between histopathologists and nephrologists.

Professor Woo Keng Thye, current Emeritus Consultant and previously Head of Department, continued to encourage and foster translational and clinical research in the department. He set up the renal laboratory and started systematic documentation of kidney biopsies performed in SGH in the late 1970s. This was done with the help of Professor Gilbert Chiang who was the only pathologist at the time with a special interest in nephrological diseases. Over the years, the programme has grown and the spectrum of primary glomerulonephritis changed as the nation's socioeconomic landscape altered.[7] An ageing population and prevalent metabolic diseases have gradually shifted the focus to diabetic nephropathy and chronic kidney disease retardation, leading to translational and clinical studies in the use of renin-angiotensin-aldosterone system blockade to reduce proteinuria and slow kidney disease progression.[8-9]

In the early 2010s, it was recognised that patients with primary and systemic glomerular, vascular and interstitial diseases needed a more focused effort to streamline immunosuppression regimens used and patient care. With the support of Professor Woo Keng Thye and Professor Chan Choong Meng, the dedicated Glomerulonephritis Disease Management Clinic (GNDMC) was started in 2012 to manage patients with complex glomerular, vascular and interstitial disease.

The introduction of new media technologies allowed teaching of histopathology to take a new level.

SGH's first Renal Biopsy Clinicopathological Workshop was held in 2018 with participants from both locally and around the region.

In the initial stages, this clinic served to start induction immunosuppression according to best medical evidence for patients with glomerulonephritis as well as a referral clinic for patients who were refractory to standard immunosuppressive therapies. It also served as a subspecialty teaching clinic to allow trainees to experience the entire spectrum of glomerular diseases and spur case discussions to supplement didactic lectures in the core curriculum. Later in 2018, this clinic was augmented by pharmacists who provided medication counselling for patients newly initiated on immunosuppressants.

In addition to the GNDMC, the Nephritis Clinic was also set up in 2015 at the Autoimmunity and Rheumatology Centre to provide complex rheumatology patients with Systemic Lupus Erythematosus and systemic vasculitis a convenient referral clinic in the event of renal involvement.

The glomerulonephritis team now consists of multigenerational nephrologists, having started off with Professor Woo Keng Thye, Associate Professor Jason Choo, Dr Cynthia Lim and Dr Irene Mok, and with the latest new addition in 2019 in the person of Dr Tan Hui Zhuan. This team forms the core group for referrals with complex glomerular and interstitial diseases, and renal vasculitis as well as oncological patients who develop nephrological complications due to immunotherapy. The team also went on to conduct the oversubscribed first SGH Renal Biopsy Clinicopathological Workshop in 2018 under the auspices of the Medicine and Pathology SingHealth-Duke NUS Academic Clinical Programme with Professor Tan Puay Hoon and Associate Professor Jason Choo as Co-Course Directors.

In addition to clinical service, research and education in glomerulonephritis, diabetic nephropathy had over the years become the number one cause of end stage kidney disease. Recognising this important impact on patient care and in concert with the 'War on Diabetes' waged by the Ministry of Health, a core team was formed to target diabetic nephropathy research in 2016. This team includes Professor Chan Choong Meng, Associate Professor Jason Choo, Dr Kwek Jia Liang who leads the SGH HALT-CKD programme and Dr Cynthia Lim.

Today, our nephrologists continue to improve patient care by using up-to-date evidence-based therapies, participate actively in both under- and post-graduate medical education, and conduct research in the areas of chronic kidney disease, epidemiology, diabetic nephropathy, prognostic biomarkers and glomerulonephritis clinical outcomes.[10-19] In addition to conducting and being national leads of multinational industry sponsored clinical trials in glomerulonephritis and diabetes nephropathy that seek to improve patient outcomes, our investigator initiated studies receive funding from national and institutional competitive grants for collaborations

that include the Singapore Eye Research Institute and Duke-National University of Singapore Medical School. One such ongoing study is the Diabetes study in Nephropathy And other Microvascular Complications (DYNAMO) that is funded by the National Medical Research Council. The department will continue to strive in our research efforts to better understand the kidney conditions and disease progression in our local cohort and evaluate clinical practices and treatments that seek to improve patient care and outcomes.

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Renal Nursing

Ms. Michelle Ng Li Choo, Senior Nurse Clinician (APN)
Ms. Maslinna Binte Abdul Rahman, Nurse Clinician (APN)
Ms. Susan Quek Hwee Koon, Senior Patient Experience Manager

Renal Nursing has been recognised as a specialty since the early 1960s and over the years, Renal Nurses have taken on more responsibilities and autonomy in delivering dialysis treatments while expanding their roles beyond the dialysis centre. Today, Renal Nurses are the cornerstone on which all aspects of renal care are delivered.

Nurses from the Renal Unit celebrating Christmas with the first dialysis patient at SGH in 1968.

Nurses attending to a young patient at the renal ward in the old SGH.

Haemodialysis Nursing

Haemodialysis in Singapore begin in 1961 when a patient with acute renal failure was dialysed using the twin coil artificial kidney.[1,2] It started with a single machine in a side room of a ward and later expanded into a fully-fledged unit.[3] By 1968, a chronic haemodialysis programme was set up at SGH and led to the first haemodialysis centre being established in Singapore in the same year.[1] Initially, patients were dialysed in a hospital based unit housed in a converted attic at the Bowyer Block of the old SGH, which was fully manned by senior nurses. This eight-bedded dialysis centre provided fully assisted inpatient haemodialysis thrice weekly per patient for six to eight hours each time using Cuprophane membranes in a standard Kiil dialyser.[4] Back then, haemodialysis treatment was reserved for patients who were young and were the sole breadwinner of the family. The indications for acute haemodialysis then were for leptospirosis infection and poisoning such as salicylate or paraquet poisoining.[1]

In 1970, the home haemodialysis programme was introduced for patients who could afford to purchase a haemodialysis machine.[1] These patients and their caregivers were trained for eight weeks to perform their own haemodialysis at the haemodialysis centre in SGH. Each class was limited to a maximum of four patients as the dialysis unit was only able to accommodate four additional chairs on top of the eight inpatient dialysis beds. Apart from training, the dialysis nurses would perform home visits to examine their home environment and coordinate logistics for home-based haemodialysis.[5] Following the establishment of the haemodialysis centre at SGH, two other satellite dialysis centres were set up as self-dependency dialysis units (SDDU) at Alexandra Hospital in 1975 and another one at Tan Tock Seng Hospital in 1983.[1,2] These were state supported haemodialysis centres where fees for dialysis were heavily subsidised. However, these SDDUs provided only self-dependency dialysis where the patients were dialysed with the help of their spouses or other family members. In these self-help centres, only one nursing officer was assigned to supervise the dialysis treatment of 20 patients which turned out to be cost-effective.

When the old SGH was redeveloped in 1981, the dialysis unit in the attic was shifted to its present location at Level 2 of Block 4 in the current SGH. Till today, this facility remains SGH's main dialysis centre. This new in-hospital, fully nurse-assisted dialysis unit was named the Renal Dialysis Centre (RDC). At that time, it provided interim dialysis of patients who were receiving training to eventually transit into the satellite dialysis centres or were patients awaiting peritoneal dialysis/kidney transplantation. The RDC also provided dialysis of patients admitted to SGH who were from NKF and private dialysis centers. The standard dialysis treatment evolved to a 4-hour session scheduled three times a week. Nurses were present to assist patients to initiate and terminate dialysis treatments as well as manage complications that arose during dialysis sessions. The majority of patients then in the dialysis unit were outpatients (60%) while the remaining 40% were inpatients.[1] However, the dialysis landscape changed over time eventually leading to the RDC catering only to inpatients by 2004.

When the new SGH opened in 1981, one area on Level 2 of Block 4 was allocated as the renal ward and functions till this day as Ward 42. Since then, patients with renal conditions are admitted to this ward and are cared for by renal-trained nurses. In 2004, a second renal ward was opened at ward 64 and include one side of the ward dedicated to the care of kidney transplant inpatients. There are eventually plans for a dedicated transplant ward to house kidney and other solid organ transplant recipients.

Renal Transplant Nursing

The history of renal transplant nursing in Singapore began with the success of the first local deceased donor renal transplant in July 1970.[6,7] Nurses from the surgical ward of the Bowyer Block at the old SGH were tasked with managing transplant patients pre- and post-operatively. Over time, the special needs for kidney transplant recipients drove the development of a new nursing specialty called transplant nursing where the nurses were trained in both the use of immunosuppression and the post-operative care of kidney transplant recipients and living kidney donors.

Nurse Clinician Amy Lim providing a clinic consult as a renal specialty nurse.

Some of our Renal Nurses receiving awards for Sponsorship for Master of Nursing.
From left to right: *ADN Associate Professor Tan Siok Bee, ADN Ms. Lim Fong Chee, Chief Nurse Dr Tracy Carol Ayre, SSN Zileen Peng Ya, ANC Huang Zhi Hua, SSN Wang Wez, SSN Leong Ee Won, ADN Ms. Nohayati Binte Ahmad*

Peritoneal Dialysis Nursing

Peritoneal dialysis (PD) was first introduced to Singapore in 1980. Patients were taught by Renal Nurses to perform PD manually using glucose-based dialysate, a process which is currently known as continuous ambulatory peritoneal dialysis (CAPD).[8] In April 1987, a CAPD unit was established in SGH. CAPD was a nurse-led programme, supported by nephrologists and nurses provided an integrated approach to patient training, management and education.[8] Since 1 Dec 2011, both CAPD and automated peritoneal dialysis (APD) are subsidised by the government, with no out-of-pocket payment for patients covered by Medishield. The model of care for patients on PD is primarily nursing-based, with nurses caring for PD patients in the programme for their lifetime unless they switch to haemodialysis or undergo kidney transplantation.

In October 2004, the SGH PD Centre was relocated to the old School of Nursing (SON) with support from the Singapore Children's Society. The programme was subsequently expanded to deliver outpatient and inpatient PD services by PD nurses. The SGH PD Centre subsequently shifted to the Diabetes and Metabolism Centre located at Bowyer Block of SGH in May of 2015. The model of nursing care remained the same but this time, the PD Centre also provided clinical attachment and training for healthcare providers from community nursing homes, the Home Nursing Foundation and overseas hospitals.

Academic Development in Renal Nursing

The role of a Renal Nurse has evolved from a multitasking nurse to one sub-specialising in various renal subspecialties over the years. Historically, in the 1960s, nurses received their basic training in the School of Nursing (SON) situated on the Outram Campus. Senior nurses who desired to enhance their knowledge could attend a post-basic nursing course in SON according to their area of interest. One of the post-basic nursing courses available then was the Intensive Care Course (ICU Course), which had a nephrology component. In those days, majority of Renal Nurses were either local ICU-trained or gone overseas for nephrology training.

With the rapid expansion of responsibilities in renal care, it became of monumental importance for nurses to diversify their practice and adequately manage renal patients across multiple facets of nephrology. These included preventing disease progression, ensuring dialysis adequacy/access patency, addressing complications and educating on lifestyle modifications such as diet and fluid restrictions. Improvements in renal replacement therapies also became an impetus to advance nephrology nursing knowledge. As a result, the Ministry of Health supported the formalisation of specialised nephrology nursing skills and knowledge through the development of a dedicated renal nursing course in 1973. This renal nursing course continued to train Renal Nurses over the years but by 1992, SON ceased operations. From then on, individuals who were interested to become a registered nurse had to enrol in the Diploma of Nursing course at the Nanyang Polytechnic. In 2000, an advanced diploma in Nephro-Urology was introduced where only registered nurses with clinical experience in caring for renal patients were eligible to undergo.

Prior to the introduction of the advanced diploma course, fresh diploma graduates in nursing were equipped with only basic nephrology nursing knowledge through institutional-based training in SGH. They underwent on-the-job training, and each was paired with a preceptor who was a senior nurse in the renal unit. This programme spanned over three to six months before a new nurse was deemed competent to work independently. To aid with the theoretical aspects of renal nursing, a renal induction programme was initiated in 2010 for new nurses posted to the renal ward. The course provided basic renal knowledge on the management of renal patients with acute clinical problems. It began as a one-and a-half day training programme but evolved into a mandatory three-day course running three times a year.

Advancement in Renal Nursing

Renal Nursing developed further with the further specialisation of renal medicine. With the introduction of continuous renal replacement therapy (CRRT) in the ICU, it was clear that ICU nurses had to be trained in CRRT on top of their other competencies such as caring of patients on mechanical ventilation and inotropic therapy. As a result, the CRRT nursing course for ICU nurses was developed in 2000 under the SingHealth Alice Lee Institute of Advanced Nursing (IAN). Trainers and assessors for the annual course were drawn from the ranks of nephrologists and senior Renal Nurses from SGH. Over the years, the course has received numerous positive feedbacks and is conducted twice a year to ICU nurses.

Besides CRRT, the renal transplant programme also recognised the need to enhance the knowledge of nurses who were caring for kidney transplant recipients. In 2009, a nursing study at SGH revealed that Renal Nurses required more knowledge on immunosuppressive drugs. As a result, this prompted the development of a dedicated renal transplant nursing curriculum.[6] As a result, the first renal transplantation nursing course was initiated by Associate Professor Terence Kee in collaboration with IAN to empower nurses caring for kidney transplant recipients with the requisite knowledge in 2010. In 2017, the curriculum was subsequently expanded to include other transplant areas and was thence renamed as the Solid Organ Transplant Nursing Course under the auspices of the SingHealth Duke-NUS Transplant Centre. In the future, nurses who have a special interest in transplantation would be able to enrol themselves into a post-graduate diploma in solid organ transplantation from 2021 onwards.

In collaboration with IAN, senior Renal Nurses pay it forward by participating in curriculum planning, revision and teaching of various renal related courses in SGH. These include the CRRT Nursing Course, PD Initiative Course and PD Refresher Course, Intermediate Care Area Course, Care Giver Training

Programme and production of voice annotated renal teaching presentations to educate nurses, medical students and renal residents. In addition, renal senior nurses have also accepted academic appointments with SingHealth, renowned nursing schools and universities in Singapore such as IAN, Nanyang Polytechnic, Singapore Institute of Technology and the National University of Singapore.

Current Developments in Renal Nursing

With the advancement of nursing education over the last 5 decades, it is not surprising that this has translated to improvements in clinical nursing as well. The first nursing-led clinical service was started in the early 2000s, where the department appointed an experienced specialised nurse clinician to assume the responsibility of managing haemodialysis patients with vascular access issues. Subsequently, in 2012, specialised renal nursing service was incorporated into patient management on total parathyroidectomy, a result of an interdisciplinary collaborative effort with head and neck surgeons and the nephrologists.

Advanced Practice Nursing has emerged as a dynamic and exciting aspect of Renal Nursing. The first intake for the Master of Nursing for Advanced Practice Nurse (APN) was in 2003 and was a milestone for what clinical Renal Nursing could become. In 2011, the first Renal APN was minted in SGH and the profession has since achieved enormous progress. The APNs and specialised Renal Nurses have spearheaded several nurse-led services and projects to enhance Renal Nursing in SGH. These services included transplant clinics for new kidney transplant recipients and living kidney donor follow-up, interventional nephrology services in collaboration with interventional nephrologists, radiologists and vascular surgeons to manage patients with malfunctioning renal vascular access, telemedicine services with NKF community dialysis providers to provide consultation for patients with vascular access issues, low clearance clinics to retard and facilitate long-term renal replacement therapy for chronic kidney disease patients, critical nephrology services to deliver acute extracorporeal blood purification therapies and initiatives to prevent acute kidney injury.

SGH nurses receiving training in continuous renal replacement therapy from Dr Manish Kaushik.

NC (APN) Maslinna Binte Abdul Rahman conducting pre-ward rounds before the consultant rounds.

By 2014, the clinical roles of the Renal APN was complemented with the introduction of specialised Renal Resident Nurses trained to manage various complications encountered in renal patients. Renal Resident Nurses are able to assess and provide medical consultation to certain groups of renal patients as they are trained to practice in accordance with strict protocols.

The development of end-stage renal failure for conservative management can be stressful for patients and their families. In 2018, the renal supportive care service was launched to bring specialised nurses together with palliative care physicians, nephrologists, medical social workers and pharmacists. As a team, they provide holistic patient assessment to promote early palliation and link up with the appropriate hospice services in the community to help reduce unnecessary hospital admissions and promote patients' dignity by giving them the choice of dying at home.

Singapore Haemodialysis Workgroup with SNC (APN) Michelle Ng (Chairperson) and nursing representatives from SGH, NUH, KTPH, CGH, TTSH, NKF, KDF, FMC and Advance Renal Care.

Under the leadership of the renal APNs, Renal Nurses have participated in several innovations and re-engineering of current workflows to improve care and work processes. These include the dialysis mover to reduce work-related musculoskeletal strain, peristaltic pump system for dialysis waste disposal from PD patients, renal nursing up-skilling for nurses working in SGH wards and polyclinics, and delivering extracorporeal therapy such as immunoadsorption therapy using the Glycosorb® column for the 1st ABO incompatible living related kidney transplant in 2009 and subsequently ABO-incompatible liver transplantation in 2017. The environment of diverse professional practice led to a growth in nursing research activities. Renal Nurses participated in research collaborations with medical and allied healthcare workers to improve nursing practices and contribute to career fulfillment. This is evident by the numerous scientific presentations at various nursing and medical conferences as well as peer reviewed publications.

Committee & Community Involvement

Renal Nurses have led several workgroups at various levels of SingHealth, community and the nation. This include leadership positions in the SingHealth Duke-NUS Transplant Centre, the SingHealth Steering Committee for Advanced Care Planning Programme and the Committee of the Singapore Haemodialysis Workgroup for dialysis nurses. Renal Nurses have also played the roles of Infection and Prevention Control Liaison Officer as well as Environment Health & Safety Coordinator for dialysis practices in SGH.

Renal Nurses also display immense altruistic spirit of volunteerism with their active contribution to charitable work. The renal supportive group led by senior Renal Nurses was inaugurated in January 2019. The group has participated in many events such as the SGH Bazaar to raise fund for the needy patients, Project Groom Over to perform spring cleaning for patients' homes, patient educational forums and overseas missions to under-developed nations such as Cambodia, Myanmar and Nepal. In the community, the Renal Nursing leaders in SGH also hold various positions to increase the scientific standing of Renal Nursing as they are chairpersons and members of the Singapore Society of Nursing Chapter and the Renal Nurse Chapter of the Singapore Nurses' Association. They facilitate and organise renal related conferences and symposiums such as The State of Art Nephrology Course (Nursing), Kidney Care Conference and Asian Nephrology Nursing Symposium.

Future Development of Renal Nursing in SGH

The development of specialised and advanced nursing roles in Singapore offers a clinical career pathway for nurses and at the same time, prepares them to care for our ageing population with their greater healthcare needs. Currently, in the pipeline, there are two renal APN interns who are undergoing their internship and are projected to be fully-pledge APNs by year 2021. With the graduation of these two Renal APN interns, there have been projections to develop more APN-led services for the Renal Transplant Programme such as telemedicine for living kidney donors follow-up, rapid access services to respond to ad hoc outpatient kidney transplant and peritoneal dialysis consults and APN participation in acute renal disease clinic and the transition clinic which smoothen the transition of paediatric patients to adult renal services in SGH. As the future of renal

Renal nurses at a training session to perform the 1st immunoadsorption therapy using Glycosorb in 2018.

nursing continues to evolve, further refinement in the APN-led, specialised Renal Nursing services and other subspecialised nursing roles such as interventional nephrology nursing will continue to develop further.

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Renal nurses from SGH have provided national leadership in the development of renal nursing in Singapore. Senior Nurse Clinician (APN) Ms. Michelle Ng in her capacity as chairperson of the Singapore Society of Nephrology (SSN) Nursing Chapter welcomed participants of the SSN Nurses' Renal Update Seminar in 2015.

NC (APN) Maslinna Binte Abdul Rahman moderating a session at the State-of-art-Nephrology Nursing Course (SOTANC) organised by the Singapore Society of Nephrology in 2017.

Nurse clinician Amy Lim and other nurses from the Singapore Nursing Association on a mission trip to provide community health screening in Myanmar in 2018.

Renal Clinical Nurses in 2018.

Renal Coordination

Ms. Lydia Lim Wei Wei, Manager
SGH Renal Registry and Coordinator Unit

Ms. Lydia Lim counselling a patient on the various renal replacement therapy options.

With the increase in the number of patients with end-stage renal failure (ESRF) each year, renal coordination of care has become essential for providing an optimal start to dialysis. The spectrum of renal coordination include early identification of chronic kidney disease (CKD) patients to undergo treatment to retard progression of CKD as well as prepare patients in the later stages of CKD for dialysis if transplant was not an option. It is also critical for patients to be able to provide informed consent on the various options of replacement therapy and to ensure that patients' access is created in a timely manner prior to initiation of dialysis.

Role of the Dialysis Coordinator

During his headship, Professor Woo Keng Thye obtained hospital funding for the post of a dialysis coordinator in 1996. As a result. Ms. Connie Yong was the first dialysis coordinator employed to educate patients with ESRF on their options for renal replacement therapies such as haemodialysis (HD) and peritoneal dialysis (PD). The dialysis coordinator also helped with referrals to the vascular surgeon for arteriovenous fistula creation or PD catheter insertion as well as facilitate applications for dialysis subsidies. The renal coordinator reported to Associate Professor Lina Choong who was then Director of Haemodialysis as well as to the Head of Department.

The number of patients with ESRF continued to increase with HD as the main modality of renal replacement. As a result, MOH provided additional government subsidies for PD in 2002 to encourage PD as an alternative to HD. This triggered the hiring of another dialysis coordinator with funding from Baxter to assist in improving education and uptake on PD. An anaemia coordinator was subsequently added to the team in 2000 to improve patient's knowledge of renal anaemia and its therapies. Eventually, SGH took over the responsibility for funding of these manpower.

The Renal Disease Retardation Programme (RDRP)

In 2002, the Renal Disease Retardation Programme (RDRP) funded by MOH was implemented. Ms. Lydia Lim was recruited to kickstart the programme with the RDRP Programme Director, Professor Chan Choong Meng. Under this programme, patients with proteinuria were closely monitored and had their reno-protective treatment titrated. The success of this programme resulted in the establishment of angiotensin receptor blockers as the mainstay drug treatment of patients with early stages of CKD.

During my first four years of service, the dialysis coordinator's office was situated in the old Housemen Quarter. This was previously a hostel used by housemen and nurses, and those who had worked in that building would remember that the only lift in the building tended to break down frequently. Nevertheless, one of the key highlights of working in the Houseman Quarter was that the Housemen Cafeteria was at the ground floor. The five stalls in the cafeteria were always very crowded during lunchtime because the food was both cheap and delicious. Unfortunately, the building was demolished to make way for the building of the current Academia building in 2006. Subsequently, the dialysis coordinator office was moved to its current location at Level 2 of Block 4 at SGH.

Ms. Lydia Lim underwent a 6-week HMDP attachment with the team from the DaVita Vascular Access Centre in 2012. During her attachment, she studied the setup and expanded the role of the renal coordinators.

Setting up of Renal Coordinator Unit

When the funding for the RDRP programme ceased in 2006, the coordinator positions under it was subsequently taken up by the Renal Coordinator Unit. With expanded roles to provide greater breadths in CKD education such as nutrition, lifestyle modification, renal retardation and prevention of CKD complications across the spectrum of CKD as well as counselling on renal replacement therapy options, the dialysis coordinators were redesignated as Renal Coordinators. As Renal Coordinators, they were tasked with educating patients throughout the entire CKD journey and introduce transplantation as a preferred option.

Under the leadership of my predecessor, Mr. Yong Koh Ming, standards and policies for renal coordination were drawn up and frequent revisions were made as work processes changed. This led to the unit being awarded ISO accreditation in 2009. Over time, posts for clerks and administrative assistants were added as the workload grew.

Development of a Department Renal Registry

When the Department of Renal Medicine at SGH was the only renal unit in Singapore, a registry of ESRF cases was set up for the purpose of policy planning. The duty of maintaining the registry fell on the Renal Coordinator Unit which was appropriately renamed 'Renal Registry and Coordinator Unit'. This unit also served to feed information to the National Registry of Disease Office from the Ministry of Health

Ambulatory Blood Pressure Testing

As outpatient management of blood pressure is crucial to retarding progression to ESRF, the unit set up a service to provide 24-hour monitoring of blood pressure upon request. This has been useful not only to improving blood pressure management of patients with CKD but also to confirm the presence of hypertension in potential living kidney donors and other patients.

Ms. Lydia Lim with her team of renal coordinators in 2019.

Vascular Access Coordination

In 2012, Ms. Lydia Lim was given the opportunity to go on a six-week HMDP attachment to DaVita Vascular Access Centre in Los Angeles to study their set up and expand the role of the Renal Coordinator. As a result, collaboration with satellite dialysis centres was set up to fast track malfunctioning vascular access cases for early intervention and helped avoid unexpected admissions through the Department of Emergency Medicine. Work processes for thrombosed vascular access were also improved to reduce the duration of hospital stay from five to two days in uncomplicated cases.

Low Clearance Clinic Coordination

In 2015, the Low Clearance Clinic (LCC) programme was set up in SGH as a multicomponent intervention programme to enhance patient decision-making processes and satisfaction level, as well as to improve patient clinical outcomes and adherence to CKD management. The aim of this clinic is to reduce unplanned dialysis for patients with ESRF by ensuring early referral to nephrologists, better coordination of medical care, management of CKD complications, and timely pre-dialysis education to improve patient outcomes.

The LCC clinic is a one-stop clinic visit for patients where they can be attended to by renal physicians and various allied healthcare teams (Renal Coordinators, Advanced Practice Nurses, Medical Social Workers, Pharmacists and Dietitians), as well as receive appropriate referrals to the renal supportive care team. The aim is to provide timely access for patients to comprehensive CKD management including CKD education, medication reconciliation, and dietary, financial and psychosocial assessment. Regular multidisciplinary meetings are conducted to coordinate care for the patients. Patients' adherence to the programme and timely referrals to vascular surgeons, peritoneal dialysis nurses and renal transplant teams are monitored by the renal coordinator.

These measures have been shown to improve care. For example, compared to patients receiving standard CKD care in general nephrology clinics, a higher proportion of patients under the LCC programme started dialysis using the desired permanent dialysis access (18.2% vs 50%). Encouraged by these positive findings, the LCC clinic has expanded to include all CKD patients with eGFR less than 20 ml/min/1.73m^2 in the department.

Peritoneal Dialysis Coordination

In 2017, the PD Preferred strategy was implemented by the Ministry of Health (MOH) to counter the ever-increasing number of patients being placed on HD. The national target of this strategy is to increase PD uptake to 30%. A workgroup was formed by MOH to review, create and standardise pre-ESRF education and PD training materials. Renal Coordinators were tasked to ensure that patients made an informed choice in selecting a renal replacement modality. As a result, the uptake for PD at SGH has increased to 30.4% in 2019.

Conclusions

The Renal Coordinator Unit in SGH has grown in strength from a staff of just one in 1996 to currently a team of nine coordinators to meet the growing needs of patients for renal support. The role of Renal Coordinators has evolved over the last 20 years, but their tenacity and perseverance to provide an optimal start to dialysis remains the same.

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I would like to express my gratitude to various Head of Department - Associate Professor Wong Kok Seng, Professor Chan Choong Meng, Associate Professor Marjorie Foo and my immediate supervisor - Associate Professor Lina Choong for their support and guidance during my years of service in the department and look forward to many more years in leading the team and contributing to the organisation.

Renal Social Work: 50 Years and Beyond

Dr Crystal Lim, Master Medical Social Worker (Clinical)
Department of Medical Social Services, SGH

Singapore General Hospital (SGH) was the birthplace of renal social work in Singapore, since it was here that Singapore's first renal medicine department was established. In the last 50 years, renal social work has, naturally, expanded in scope and specialisation, even while core functions remain unchanged. This essay chronicles the salient features of SGH renal social work in supporting patients and families cope with end stage renal disease (ESRD).

A catastrophic chronic disease, ESRD affects various spheres of a patient's life, including financial coping, psychological well-being, self-esteem, employment, lifestyle changes, family, social functioning and intimate relationships. Living with ESRD requires coping with its myriad impact, with access to dialysis as the foremost issue. In helping patients cope with ESRD, renal medical social workers (MSWs) procure financial aid for patients, provide supportive counselling and family intervention, and participate in social and health policies to improve care for patients. MSWs also performed the role of renal coordinators (previously known as dialysis coordinators) in educating patients and families on renal replacement therapy (RRT) options and cost, as well as linking patients to dialysis programmes - this was before renal coordinators became part of the renal multidisciplinary team in the late 1990s. MSWs still play a part in RRT education today, with focus on the psychosocial aspects of RRT and its impact on patients and their families. As dialysis programmes expanded and admission criteria were liberalised to include older patients with medical conditions previously considered as disqualifiers for subsidised dialysis, the demographic profile of patients transformed. The renal MSW role evolved correspondingly to include discharge care planning for patients with medical and physical decline through the dialysis trajectory, and transportation support so that dialysis treatment can continue undisrupted.

Ms. Long Chew May was the first renal medical social worker, seen here discussing a patient's case with Dr Lee Wan Tin, one of the department's renal physicians.

Master Medical Social Worker Goh Soo Cheng and Principal Medical Social Worker Jackie Erh discussing potential living kidney donor transplant cases with the transplant coordinators and transplant nephrologists at their weekly living kidney donor transplant meetings.

Medical Social Services did not have an MSW assigned exclusively to support renal medicine until April 1992 and this was in response to the increase in ESRD patient load. Long Chey May became the first dedicated renal MSW. In 1994, SGH managed about 80 per cent of the nation's ESRD load, with the remaining portion shared between NUH and the private sector[1]. That year, Crystal Lim became the new addition to renal social work to manage the multiplied work volume, with work distributed between the two MSWs along male-female patient lines. In 1996, Chey May received a Health Manpower Development Programme (HMDP) award that supported her for three months of nephrology social work training at The Cleveland Clinic, USA. This training added to the specialisation of renal social work in SGH.

The growth in voluntary welfare organisation (VWO) dialysis programmes led to a rise in the demand for renal MSW services. With Kidney Dialysis Foundation (KDF) as an exception, VWO dialysis programmes did not have in-house MSWs until about the mid-2000s. Instead, they relied on SGH renal MSWs to provide psychosocial assessments and support for their patients. To meet this need, VWOs began funding renal MSW positions in SGH, beginning with the National Kidney Foundation (NKF) in 1998; KDF in 2001; the Khoo Foundation's People Dialysis Centre in 2002; and a jointly-funded position by KDF and the Singapore Children's Society (which established the SCS-SGH Peritoneal Dialysis Centre in SGH). When these VWOs revamped their programmes in the mid-2000s and employed their own social workers, funding for SGH renal MSW positions ceased and the hospital absorbed the incumbents into its organisational headcount. Today, there are nearly ten renal MSWs supporting the Renal Medicine Department. We will look back at how their predecessors supported renal medicine.

1970 to 1995

The Reality of Healthcare Rationing

When the University of Washington Medical Centre, Seattle, USA, established the world's first dialysis unit in 1962, a committee comprising individuals from different backgrounds was formed to deliberate dialysis treatment allocation. A Time Magazine article published in the same year infamously (and unfairly) dubbed it the "Death Squad", since its decisions determined who would have a survival opportunity. In fact, the birth of bioethics is associated with the development of dialysis when technological advancements that enabled life-extending treatment introduced ethical quandary on how scarce and valuable treatment resources should be distributed. Similarly, when renal medicine was established in SGH the team had to wrestle with decisions on who should be offered dialysis.

In the early years of SGH renal medicine, the MSW along with a nephrologist and a psychologist, formed a three-person committee to evaluate patients for subsidised candidacy based on medical, social and psychological criteria. Patients were scored on these dimensions and the ones with the higher aggregate points obtained priority for dialysis, while those with lower points were placed on a waiting list until a vacancy became available. Waitlist mortality was common. In those days of early national independence when our nation was struggling economically, the people understood and demonstrated a form of acceptance that healthcare resources were severely deficient.

Renal Medical Social Workers and the Advance Care Planning Team at the Advance Care Planning booth during a SingHealth Community Health event at Telok Blangah.

Some relief came when SGH set up the Self-Dependency Dialysis Unit (SDDU) in 1975 at Alexandra Hospital — in a centre built by NKF — with capacity for 44 patients[2]. In 1983, a ward at Tan Tock Seng Hospital was converted to become the second SDDU, with capacity for 80 patients[1]. As the name suggested, the concept behind SDDU was that of self-reliance where each patient had to provide a "helper", who had to be a family member or a close relative, to assist with the dialysis. This arrangement allowed for one nursing officer to supervise some ten patients and resulted in manpower cost-savings. The programme was heavily subsidised: at its inception it was $10 and by the time the programme was terminated in 1997, it was $45 per haemodialysis session. The MSW applied for financial aid for patients who still could not afford the treatment fee.

The Elderly Poor

In the earlier years, dialysis was a bridge to transplantation, in that only those who were fit enough to be transplanted and met other medical and non-medical criteria were offered subsidised dialysis. This included an age criterion of 55 years old at the point of application, which was then the retirement and CPF withdrawal age. Patients above 55 years old were considered "elderly" and ineligible for subsidised dialysis, even if they were of good performance status or without disease co-morbidity. Private haemodialysis or continuous ambulatory peritoneal dialysis (CAPD) — introduced in 1980 — were offered as renal replacement therapy (RRT) options[1]. CAPD, costing about $900 per month was more affordable than private haemodialysis that ranged between $1,500 and 2,500 per month. With Medishield claims of $700 per month, CAPD presented an affordable alternative for many patients who could not qualify for subsidised programmes. Patients who were Civil Service employees or retirees were fortunate to enjoy financial coverage for their haemodialysis at the hospitals.

Enrolment in personal or government health insurance was not a common practice in those days.

However, patients who were civil servant retirees were fortunate to enjoy financial coverage for their haemodialysis at the hospitals. With Medisave introduced in 1984 and Medishield in 1990, it was not uncommon for individuals of retirement age and older to have parsimonious Medisave and/or not have Medishield coverage. This was particularly true for women, who often were homemakers, and for daily-waged manual labourers — because they did not have a CPF account. Then, there were instances of low-income and low literacy patients who opted out of Medishield because they did not comprehend the scheme, or were misled by their friends or families to distrust insurance programmes. Barriers to affordable dialysis for older persons, particularly the elderly poor, were significant issues during this time phase. Low-income families or those whose adult children earned just enough to get by had difficulty affording dialysis treatment for their loved ones above 55 years of age. For patients above 55 years old, with dependent children and financial hardship, MSWs appealed to philanthropic foundations for aid to tide them through dialysis so as to enable their continuity of the parental role. Therefore, while age categorically barred those above 55 from receiving subsidised dialysis, it did not translate to preclusion of financial support for all cases because of MSW interventions.

Disclosures and Collusion Requests

Paternalism in medicine was a norm in those days. In renal medicine, paternalism was not intended to deny the patient of autonomy — although this would result — but to protect the patient from pain and distress resulting from the realisation that poverty stood in his or her way for life extending treatment. Typically, in cases where there was doubt about an elderly patient's ability to afford private dialysis, a renal physician would typically not broach the issue of dialysis treatment until the renal MSW had assessed the patient's situation. Renal MSWs engaged both patient and family to assess the adequacy of financial resources and family support for the patient to undergo dialysis. In cases where patients did not have the means for dialysis treatment, renal physicians made a judgement call regarding the extent of disclosure to the patient about his or her ESRF and need for dialysis. For patients who were placed on conservative management because they had no means for dialysis, they might not be told about their need for dialysis and would be advised to take their medications. At times, families requested collusions or non-disclosures to patients so as not to cause the latter anger, hurt and distress, which would then intensify the children's sense of guilt or even worthlessness that they could not place their parent on chronic dialysis.

In some families which maintained open communication, patients and their adult children would discuss their means and options. For example, they might jointly decide that there was enough savings to provide for a certain duration of dialysis and this would then "buy some time" for the patient. Having the patient go on twice-weekly haemodialysis instead of the standard thrice-weekly was another way some families negotiated their financial constraints. There were the occasional cases where patients blamed their children for being unable to provide them dialysis, making it painful for children to face the sick parent and to face themselves for failing to provide for the parent's dialysis. For patients and families who could not afford chronic dialysis, sadness, guilt, sorrow, grief and tears were common companions in the clinical conversations. These clinical encounters — assessing patients' eligibility for subsidised dialysis and ostensibly functioning as a gatekeeper to dialysis — made renal social work unsavoury; it was thus hard to attract MSWs to renal work.

Barriers from Non-medical Criterion

Among the non-medical criteria for subsidised dialysis was a requirement that in the two years preceding ESRD, a non-Muslim patient was not an objector to kidney donation, or that a Muslim was a kidney pledger. The rationale behind this was to provide incentive for individuals who supported kidney donation, vis-à-vis the Human Organ Transplant Act (HOTA), and conversely, disincentives if one did not support it. Because Muslims were not automatically kidney pledgers, it meant that even for patients younger than 55 years, they only had the private dialysis option. This imposed financial hardship for the majority in this group, and especially so for those with young children and/or parents to support. Renal MSWs collaborated with the social worker from Muslim Kidney Action Committee, which played a critical role in procuring aid for Muslim patients. Patients would be advised to register as a kidney pledger so that after a two-year period, the patient could apply to a subsidised programme. The challenge then was to

successfully tide the patient over two years before he or she became eligible for a subsidised programme. When resources still fell short in spite of collaborative intervention, it exacted an emotional toll on the social workers, particularly when it involved patients with young children.

The First 25 years

Clearly, the renal MSWs' varied roles were directed towards optimising the patient's dialysis treatment access and mitigating the impact of ESRD on the patient and family system. ESRD can put a strain on marital relationships and impoverish sexual intimacy between couples. Therefore, providing marital counselling and emotional support to patients was a regular part of being a renal MSW. Because eligibility for subsidised dialysis was contingent on the patient's candidacy for kidney transplant, it meant that only able-bodied and younger patients (below 55 years old) could be on government or VWO-based haemodialysis. Therefore in those days, discharge care was not a problem renal MSWs had to dealt with. Instead, financial hardship consequent to treatment cost, loss of employment and reduction in earning capability were the main problems. Compared to today, there was more homogeneity in the patient profile in that patients under MSWs long-term management were "non-old": patients in the prime of their life and eking a living to support young dependents and/or elderly parents. The financial burden of treatment and supporting family dependents meant that financial hardship was a common denominator for patients receiving long-term support from MSWs. When patients had difficulty with the dialysis fees, they would approach renal MSWs in the hospitals for assistance, since VWOs did not have MSWs then. Renal MSWs also functioned as patients' advocate negotiating for lower dialysis fees, where possible.

The promulgation of Medifund by Prime Minister Goh Chok Tong on 1 April 1993 was a critical milestone in healthcare funding. Subsidised class patients who were financially needy could apply to Medifund for assistance with their dialysis fees at SGH or SDDU, hospitalisation charges and outpatient treatment fees, bringing huge relief to patients. Since Medifund is administered by MSWs, that led to a significant role expansion of renal MSWs, considering that renal patients are consistently the highest utilisers of Medifund.

1996 to 2020

Dialysis Resource Surge

Near the mid-1990s, there was an unprecedented increase in VWO-subsidised dialysis programmes, with NKF leading the growth spurt. Under the leadership of its CEO, Mr Thambirajah Tharmadurai or T.T. Durai, NKF conceptualised the use of void deck space at HDB flats for satellite dialysis centres, with the first one in Toa Payoh in 1987. As NKF bolstered its fund raising, from the mid-1990s its centres steadily multiplied resulting in more lives saved on dialysis and easing of patients' financial burden. Its presence island-wide was critical in enhancing treatment proximity for patients.

Another key development during this phase was the establishment of KDF in February 1996 by Dr Gordon Ku, a nephrologist in private practice who was spurred by a desire and commitment to alleviate the financial hardship of dialysis-dependent patients. KDF assimilated and revamped the SDDU at Alexandra Hospital and in the following year, it absorbed the remaining SDDU at Tan Tock Seng Hospital and relocated it to Bishan, hence concluding the era of SDDUs.

Prior to this, from an economic standpoint, the SDDU with its heavily subsidised dialysis and further possibility of Medifund assistance had been the most viable option for financially needy patients. On the other hand, the requirement that each patient provide a committed helper — an immediate family member or a close relative — meant role disruption to another adult in the patient's family. Dialysis helpers who were employed often found themselves having to find alternative jobs or switch to part-time employment in order to commit to the dialysis helper's hours. This created financial strain. Those with homemaker and caregiving responsibilities had to relegate these roles. The high frequency and long-term commitment of an SDDU helper's role strained marital relationships, and disrupted many spheres in the family system. The SDDU programme imposed a different nature of disease burden on the patient and his family. Renal MSWs would provide marital counselling or family intervention to enhance a patient and his helper's coping. The arrival of KDF was important in this regard since it emancipated SDDU patients' helpers from the restrictive dialysis helper role.

The year 1996 saw the entry of a new subsidised dialysis provider, the People Dialysis Centre (PDC) set up by the Khoo Foundation. Its founder, Khoo Teck Puat, was himself on dialysis and this stirred his concerns about access to affordable dialysis among the poor, especially the elderly poor. PDC filled a critical gap in dialysis accessibility for this group in its only satellite dialysis centre at Holland Drive. The practice in SGH renal social work was to refer the poorest patients to PDC because of its generous aid.

A few policy changes during this phase of renal medicine history were highly significant. After SDDU increased the admission ceiling age from 55 to 60 years old, all subsidised programmes followed suit. Eventually, when more VWO satellite dialysis centres became available, age was no longer a criterion for dialysis subsidy. Muslim patients who were not kidney pledgers no longer had to face a two-year debarment from VWO dialysis programmes if they would pledge support for kidney donation and recruit five other Muslims to do so as well. KDF introduced this scheme that was devised by Majlis Ugama Islam Singapura (MUIS). In 2005, MOH rescinded the requirement for kidney pledger status for a patient to be eligibility for dialysis subsidies. These affirmative improvements reduced resource access barriers to subsidised dialysis treatment.

Master Medical Social Worker Dr Crystal Lim at one of the brown bag lunch symposiums on ethics of organ donation, organised by the SingHealth Duke-NUS Transplant Centre.

This phase also witnessed developments in peritoneal dialysis programmes. Up till 1995, CAPD had been offered as private class treatment. In 1997, after a two-year pilot scheme, MOH introduced the Government-subsidised CAPD programme in SGH and the National University Hospital (NUH). As a hospital-based subsidised programme, eligible patients could therefore apply to Medifund for additional assistance. Subsequently, automated peritoneal dialysis (APD) also became available under this scheme. Then in July 2002, the Singapore Children's Society (SCS) jointly established the SCS-SGH Peritoneal Dialysis Centre that operated for six years.

New Service: Kidney Transplant Social Work

Amendments to The Human Organ Transplant Act (HOTA) in 2004 paved the way for unrelated living organ donation, and all living donor organ donation and transplant must be approved by a Transplant Ethics Committee (TEC). This defined a new role for renal MSWs: to evaluate the donor and recipient's psychosocial fitness for living donor organ transplant, and provide a comprehensive report and recommendation to the TEC. Transplant social work therefore became a new sub-specialisation competency for renal MSWs. Kidney transplant social workers began supporting the National Organ Transplant Unit (NOTU) in assessing non-directed kidney donors, often referred to as altruistic donors, for donation candidacy. Prior to this, renal MSWs' role in kidney transplant was mainly that of providing financial support and supportive counselling for transplanted patients experiencing graft failure.

Expansion of Dialysis Resources

The proliferation of subsidised dialysis programmes corresponded with Singapore's economic advancement in that our nation, as well as the community, became better resourced to support the patients on chronic dialysis, including the sicker ones. An avenue was the portable subsidy scheme implemented by NKF in 2008, which KDF also subsequently offered. Through this scheme, ESRD patients with complex comorbidities and lower functional status deemed unsuitable for admission to or continuation in the VWO satellite centres were provided subsidies for dialysis at a private dialysis centre. While on the one hand it was a dialysis resource for these patients, however, it often led to greater demand for other societal resources such as financial aid for taxi or ambulance charges, and in the case where home care was inadequate, nursing home placement. These have become a new type of resource inadequacy that renal MSWs have to manage.

Singapore's rapidly ageing population, changing demographics and family structure have led to increasing need for social services, and ESRD patients are no exception. Discharge care problems are growing in numbers and significance in ESRD patients. These various factors, along with increased patient load and higher expectations on care and tangible support from patients and families have amplified the complexity and pressure of renal social work.

To better meet these challenges and improve the psychosocial care of kidney failure patients and strengthen professional competency, restructured hospital and VWO renal social workers organised a Renal MSW Community of Practice (CoP) in 2016.

Beyond 2020

Moving forward, renal MSWs will have an increasingly important role in the mental health of kidney patients and their loved ones in their difficult journey from CKD through ESRD, dialysis, transplantation and, where appropriate, cessation of dialysis. Even more than the primary nephrologists, the renal MSWs know their patients and their stories, the canvas of their lives, their pains and their joys. MSWs are therefore uniquely placed to minister to patients at every stage to help them adjust to change and participate as fully as possible in life.

There needs to be more focus on advance care planning (ACP) in kidney failure patients, which is critical for promoting patient's choice and autonomy. Renal MSWs, along with the members of renal multidisciplinary team, ought to consistently and conscientiously evaluate their practice and ensure that they do not merely treat kidney disease but the patient; in other words, to adopt a person-centred approach.

Developing knowledge competency in mental health, bioethics and palliative care will enable MSWs to more effectively manage the transforming psychosocial and emotional needs of patients. Besides competency, renal MSWs must demonstrate courage and compassion in having difficult conversations with patients and families when dialysis may no longer have meaningful value or align with patient's values and goals. All life-extending treatment will eventually reach its limit in postponing inevitable death. Enabling patients and families to come to terms with this is one embodiment of good renal social work. Renal MSWs must grow with the field of renal medicine as they walk with their patients.

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