SMA news

For Doctors, For Patients

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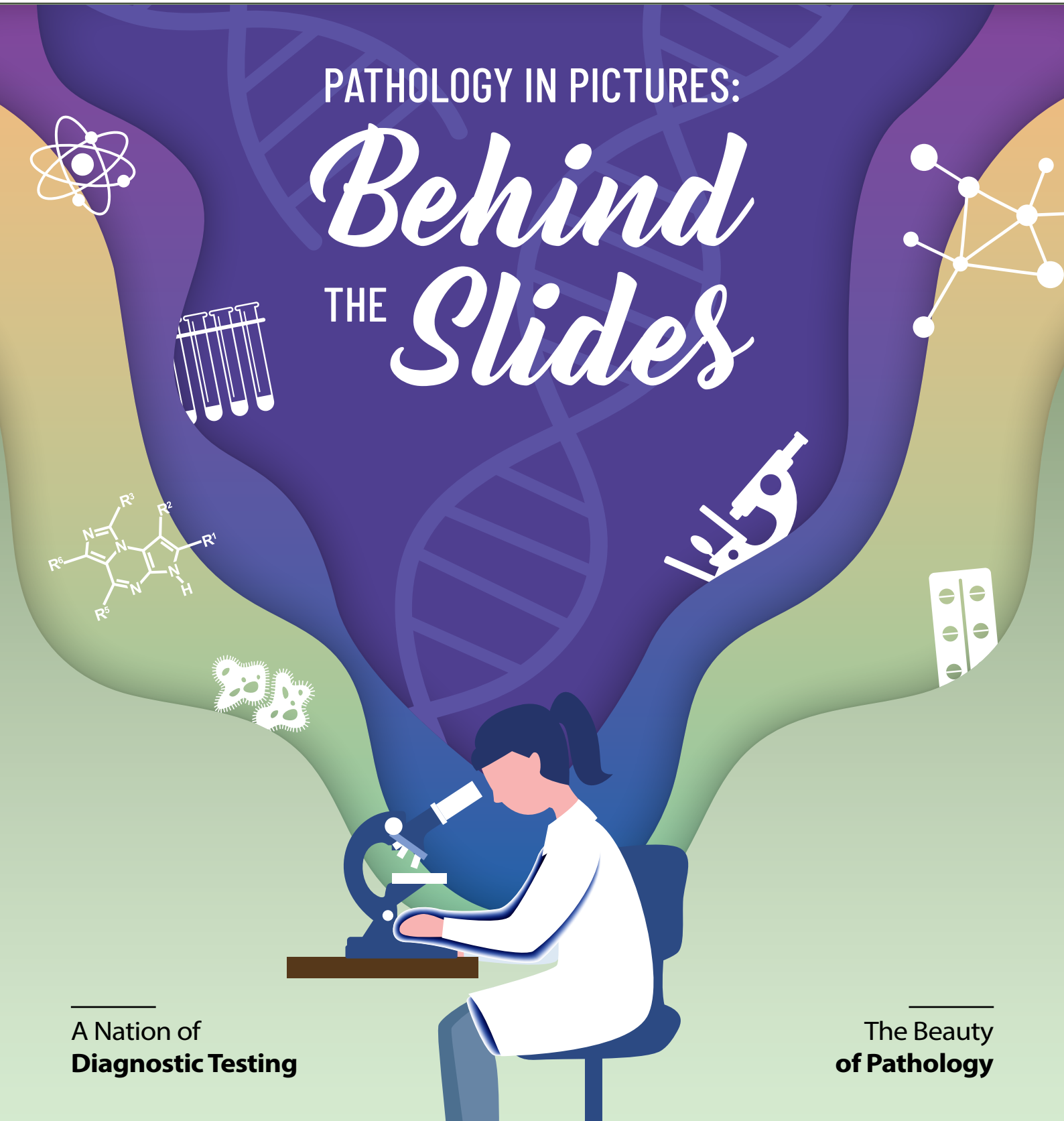

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PUBLISHER
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2985 Jalan Bukit Merah
#02-2C, SMF Building
Singapore 159457
Tel: (65) 6223 1264
Fax: (65) 6252 9693
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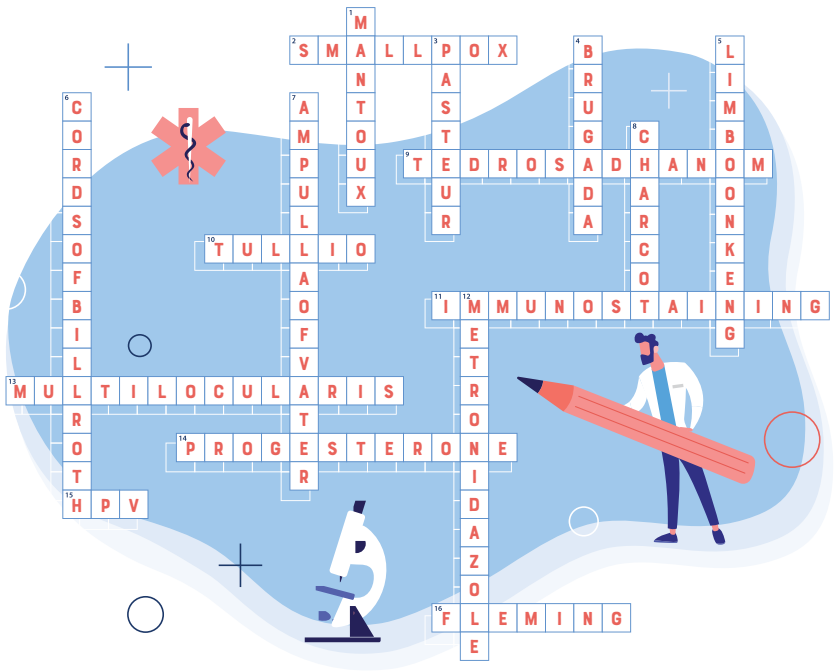


The EDITORS' MUSINGS

Dr Tina Tan

Editor

Dr Tan is a psychiatrist with the Better Life Psychological Medicine Clinic and a visiting consultant at the Institute of Mental Health. She is also an alumnus of Duke-NUS Medical School. Between work and family life, she squeezes time out for her favourite pastimes – reading a good (fiction) book and writing.

A/Prof Cuthbert Teo

Guest Editor

A/Prof Teo is a forensic pathologist by training, and an adjunct associate professor at the Department of Biological Sciences, National University of Singapore. The views expressed in the editorial are his personal opinions.

The focus of this month's issue is on pathology and the amazing work that goes on behind the scenes of the various pathology settings here in Singapore. I am especially grateful to my guest editor, A/Prof Cuthbert Teo, for coordinating the various authors and contributions and for garnering the beautiful photographs that we have showcased this month.

Pathology is not a field for all of us in the medical profession, but its role in medicine cannot be understated. The articles featured here are meant to bring the work of our pathology colleagues to the forefront, and act as a commemoration of the important contributions that they make to our own daily practice of medicine.

While not pathology-related, the article by Danielle Sim and Dr Alex Cheng highlights the need for better surrogacy laws to be implemented in Singapore. This is a highly-controversial topic, but the authors have suggested an approach that would be useful for our policy-makers looking into this issue, especially with our low fertility rates.

Happy reading!

The origins of the use of science and medicine in law are hidden in the mists of the past. The advent of written history gives us a glimpse into the early use of forensic medicine and science. Around 2660 BC, Imhotep, priest and physician to the Pharaoh Zoser, investigated deaths in the royal family. The body of the assassinated Julius Caesar was examined by Antistius in 44 BC, and in the 13th century, Song Ci in China published a textbook which included a story about identifying a killer through the use of flies attracted to the sickle which was used as the murder weapon. Since then, forensic science and medicine have progressed to a point where they provide the scientific evidence to prove or disprove a crime. Research in forensic science and medicine must stay at the cutting edge so that evidence can be relied upon in court. The authors of our Feature article, "The NUS Forensic Science Laboratory", give a brief peek into some of the research work carried out in toxicology, dactylography and entomology.

In 3rd century BC, a Greek school of anatomy had been established in Alexandria where autopsies were conducted. Subsequently, Leonardo da Vinci produced meticulous drawings of the human body from dissection, while the Italian anatomist Giovanni Battista Morgagni published his five-volume *On the Seats and Causes of Disease Investigated by Anatomy* where he attempted to correlate disease with autopsy findings. We take a "visual stroll" through the garden of pathology in Clinical Assistant Prof Leow's photo essay.

At a basic level, the discipline of pathology looks at the cause of disease from macroscopic and microscopic morphology. The mental process of interpretation in pathology involves the stimulus of the image entering the eye, to recognition and understanding of the image in the brain. This mental process is also part of the visual arts, so it is no wonder that pathologists behold beauty in gross specimens and histology slides. Anatomy teaches us order; pathology teaches disorder. When that disordered cell comes from your loved one, it may be very difficult to find any beauty in it at all. Those cells that pathologists see have the potential to start a cascade of events from worry, to surgery, to possible death. Pathologists always remember that what we find exciting and beautiful, can be devastating for the patient. I share Prof Leow's marvel at the sparkle of colours like those of a calm lake. I also know that a raging storm could lie ahead with waves breaking the water's calmness. ◆

The NUS Forensic Science Laboratory

Text and photos by Teo Shun Wen Raymond, A/Prof Stella Tan Wei Ling and A/Prof Cuthbert Teo

Raymond is a Year 4 undergraduate in the NUS Faculty of Science. He is majoring in Life Sciences with a minor in both Forensic Science and Geoscience. Raymond is currently doing his final year internship in the NUS Forensic Science Research Laboratory in collaboration with the Health Products Regulation Group of the Health Sciences Authority.

A/Prof Tan has postgraduate qualifications in science and law from NUS, and also holds a postgraduate qualification from the Henry C. Lee Institute of Criminal Justice and Forensic Science. She is the academic director in charge of the NUS forensic science undergraduate and postgraduate programmes, as well as the principal investigator of the NUS Forensic Science Research Laboratory.

A/Prof Teo is trained as a forensic pathologist, and is an adjunct associate professor of the NUS forensic science programme. The views expressed in this article are his personal opinions.

Introduction

Forensic science and medicine is science and medicine that is in the service of the law. Forensic scientists and pathologists assist in uncovering the truth in the pursuit of justice.

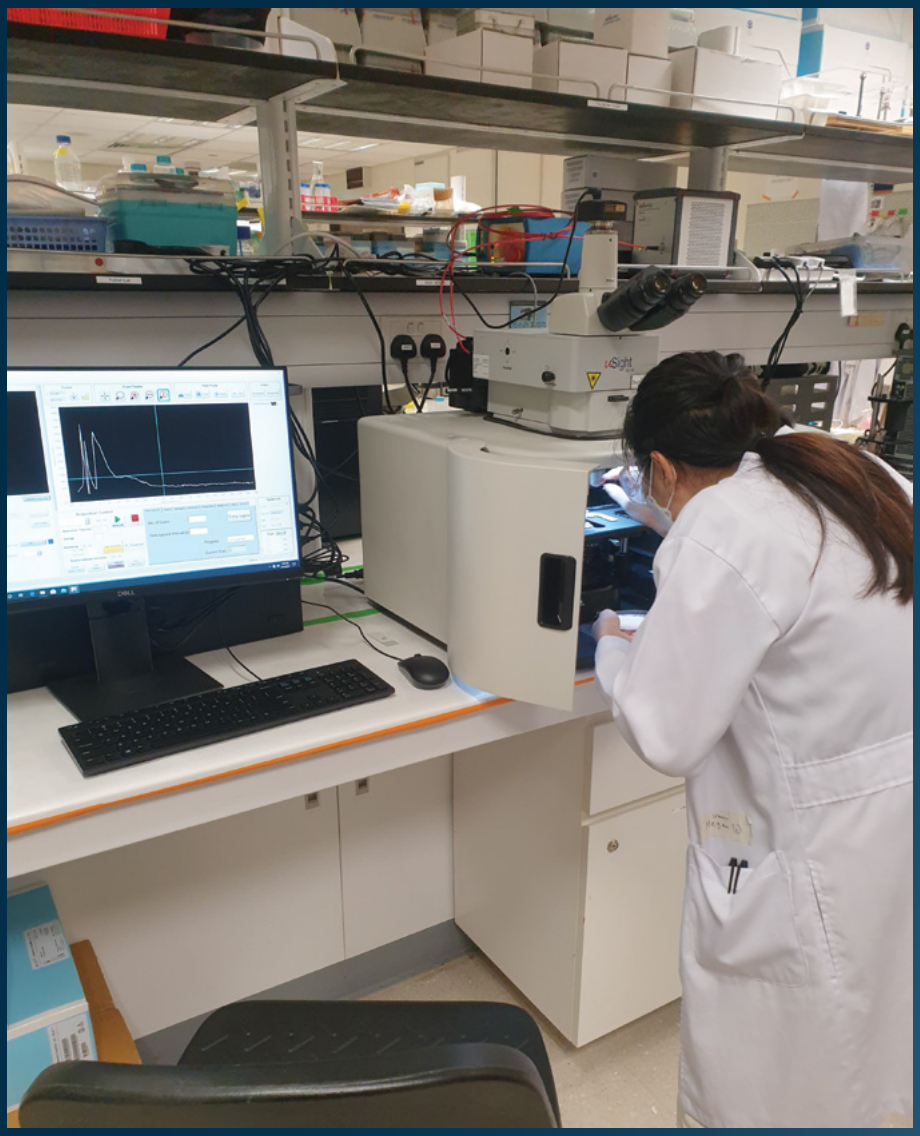
"Every contact leaves a trace" – Locard's principle is one of the most well-known of forensic science. Science analyses trace evidence to answer five important questions: who, what, when, where and how. In our laboratory, our research adds new information to make retrieval and analysis of evidence more efficient and effective.

How the laboratory was formed

The National University of Singapore (NUS) Forensic Science Research Laboratory was founded in August 2017. Located at the Department of Biological Sciences, it is the only tertiary institution forensic research laboratory in Singapore. The laboratory started with four branches of study – document examination, fingerprint identification, entomology and paedology – but now includes other fields like toxicology and pathology. Projects usually involve collaborators within NUS as well as external collaborators like the Singapore Police Force (SPF), Health Sciences Authority (HSA) and Central Narcotics Bureau (CNB). Eager students enter the laboratory as "forensic explorers", learning while carrying out projects at the same time. A stringent selection process selects highly motivated students who conduct preliminary studies before moving on to execute their own projects.

NUS offers both undergraduate and postgraduate forensic science modules. Undergraduate modules include Forensic Toxicology and Poisons, Forensic Entomology, and Articulating Probability and Statistics in Court. These academic modules incorporate fun and interesting practical sessions to help students understand each field. Collaborators include various NUS departments like the Department of Pharmacy, Department of Statistics and Data Science, and other sections in the Department of Biological Sciences.

Students who seek a deeper understanding in forensic science can learn from expert practitioners through hands-on experiential learning in the NUS Master of Science (Forensic Science) programme. For example, in Advanced Crime Scene Investigation Techniques, SPF experts share their knowledge and experiences in crime scene processing, while experts from the Home Team Science and Technology Agency provide insights in areas like forensic defence science and digital forensics. Psychiatrists and psychologists from the Institute of Mental Health and the Ministry of Home Affairs, respectively, help students understand the importance and limitations of psychological evidence in court in Forensic Psychiatry and Psychology.



Paracetamol being placed in the 1064nm Raman Spectrometer. The 1064nm Raman Spectrometer is the newest addition to the NUS Forensic Science Laboratory

Forensic toxicology – the dose makes the poison

Forensic toxicology helps in the detection of harmful substances either in the body or in a medium. Harmful substances can cause harm and death by incapacitating one's mental capability, being abused, and adulterating food and medical products. In the late 1800s, the Singapore Government was concerned about the quality of liquor supplied to sailors. There were also concerns about the safety of food and drugs, and the nature of local plant poisons. In the early 1900s, *chandu* (opium) became a concern. Before World War II, the main poisons of concern included caustic soda, morphine, alcohols, tuba root and arsenic. After the war, other poisons included heavy metals and plant alkaloids. Since independence, pharmaceuticals have become important in toxicology, and instrumentation has become more and more sophisticated.

Students in the laboratory have the opportunity to work with the CNB and HSA to conduct analytical testing on confiscated items, such as illicit drugs and controlled or adulterated health products. Forensic toxicology is one of the author's (Raymond) favourite fields in forensic science and he was lucky enough to do an insightful internship with the HSA's Health Product Regulation Group. A current student project in the laboratory is determining the limit of detection for some controlled substances, which may be present in minute amounts, using Raman spectroscopy.

Dactyloscopy – tiny mountain ranges on the fingers

In the 1870s, Scottish surgeon Henry Faulds was working as a missionary in Japan. While out on an archaeological dig, he noticed unique impressions left on ancient clay fragments, and wondered whether the ridges on his fingertips were unique. Soon after this, there was a robbery in the hospital where he worked, and a suspect was arrested. Based on fingerprints found at the crime scene, Faulds was able to exonerate the suspect and persuade the police to release him. This remarkable event occurred during a period when the use of fingerprints for identification was not yet established.

Dactyloscopy is the study of fingerprints for identification purposes. Fingerprints are created from the ridges and furrows on the fingers, and everyone has their own unique pattern. Have you ever wondered how fingerprints are formed and why they are unique to even identical twins? The secret lies within the uterus. Epidermal basal cells undergo increased proliferation at around the gestational age of seven to ten weeks. The formation and regression of the volar pads (transient subepidermal mesenchymal eminences) adds stress to the proliferating cells, giving rise to precursors of ridges. Sporadic fetal movements create additional stress from friction against the uterine wall. These processes eventually lead to individualising of fingerprints.

Methods of fingerprint collection include powder dusting and

cyanoacrylate (superglue) fuming. Fuming is a technique which greatly enhances the clarity of the deposited latent print. It allows for lifting prints off uneven and difficult-to-dust surfaces, including from the skin of corpses. Lifted prints can then be compared against known prints, based on specific plot points called minutiae, which characterise the ridges. Examples of important minutiae include where ridges end and birfurcate, or where they form dots, islands, lakes, spurs, bridges and crossovers.

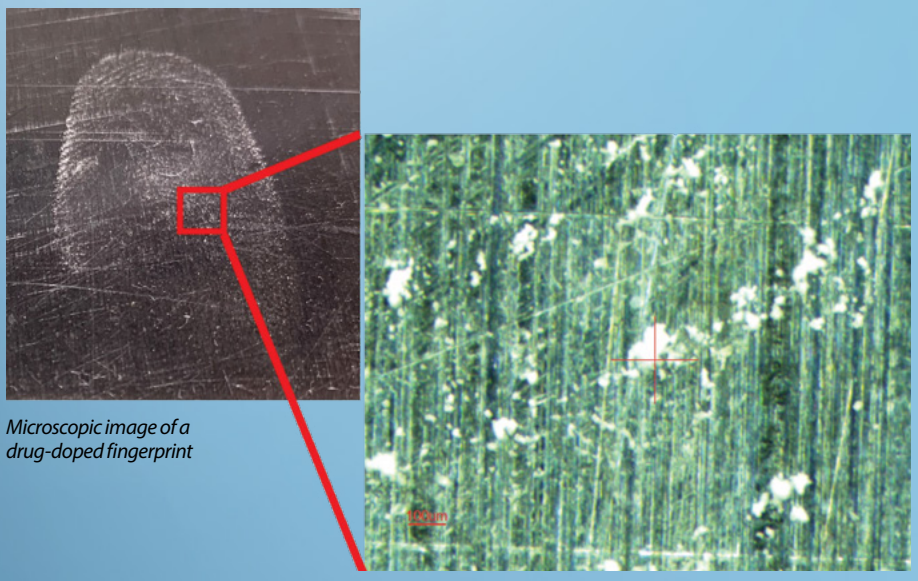
Fingerprint matching can be a very tedious process. The laboratory is researching on the use of software that can reliably match fingerprint patterns, and the statistical models of different patterns in relation to ethnicity.

Forensic entomology – ancient creatures that "pronounce" the time of death

Insects, in particular flies, can give a range of time of death in a rather unique way – their life cycle. When animal or human life is extinguished, a panoply of insects, equipped with a keen sense of smell, are able to find a suitable corpse to lay their eggs, which hatch into maggots. These necrophagous flies claim the bodies of the departed for lodging and board, making it their personal bed and breakfast. A minimum post-mortem interval can be estimated by studying the population of maggots present. Maggot size is indicative of the fly's life cycle stage. A back-calculation to the day when the flies first laid their eggs corresponds to a likely range of the time of death.

The differences in insect species composition and life cycle time depends partly on environmental conditions. In our laboratory, we research differences such as arrival time, species and number of flies by concealing chicken carcasses using various objects like cloth, plastic containers and plastic bags. This information, known as carrion ecology, can be applied to actual cases to offer a more accurate estimation of the post-mortem interval. There is still a lot to learn – about how maggots develop, their role in decomposition and the ecosystem surrounding a body, and what they do when they are not feeding. If we don't fully understand what these flying, walking and wriggling critters are up to, we are at risk of making false assumptions regarding a crime scene. The research will help to fill in the blanks.

A/Prof Stella Tan giving a lecture on forensic science



Microscopic image of a drug-doped fingerprint

Conclusion

The story of forensic science and medicine is the story of how each piece of forensic evidence forms a sentence, and we combine the sentences to form a book. The NUS Forensic Science Research Laboratory and the NUS forensic programmes will be the petri dishes which will incubate future generations of forensic scientists and pathologists. In the future, forensic science will comprise powerful tools used to solve crimes, but it is not infallible. Its use needs to be scrutinised with care and objectivity to achieve objective findings, for the prosecution of criminals and to absolve the innocent.

INTERESTING INSECTOID INSIGHTS

Scanning electron micrograph images are produced by a focused beam of electrons directed at the specimen. Some electrons ionise the specimen while some are reflected as backscattered electrons. Ionised specimens also release secondary electrons. Detectors reconstruct the backscattered and secondary electrons to produce images of high magnification.

Fly egg

Typically, it takes around 23 hours at 21°C for blowfly eggs to hatch. Exposed wounds and natural body openings are more prone to decomposition by bacteria. Hence, these areas are usually prime breeding sites for the flies as the decaying material provides food for the hatched larvae.

Blowfly

Blowflies are usually the "first responders" and arrive at the corpse within a day, which makes them one of the key species to study when estimating the post-mortem interval. Their acute sense of smell allows them to locate a corpse up to 20 km away.

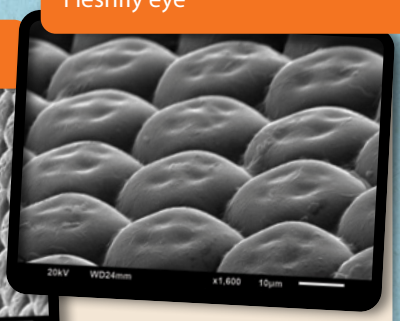
Maggots

The larvae stage of flies belonging to the suborder *Brachycera* are often referred to as maggots. Maggots can be classified into three stages: instar 1, 2 and 3. The time intervals between each stage are relatively constant, making them useful for estimation of the post-mortem interval. The timespan of each stage is directly influenced by the ambient temperature – the higher the temperature, the shorter the time spent in each instar.

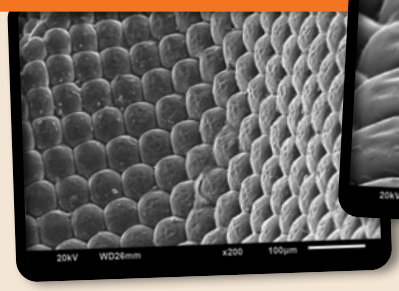
Fleshfly

Fleshflies belongs to the same superfamily of *Oestroidea* as blowflies. They arrive at the corpse later as compared to blowflies at around four days after death, as they pick up the smell of the gas produced from putrefaction of the corpse. Notably, they are territorial and will kick out other flies that compete for the breeding sites.

Fleshfly eye



Blowfly eye



Flies are known to have compound eyes which are made up of thousands of small hexagonal units known as ommatidium. Each unit provides information of just a small area of the whole image. Flies are built to be highly sensitive to any movement across each of these small areas. Male flies make use of this motion sensitivity to look out for potential mates. Mating is crucial as it precedes the laying of eggs on the corpse which subsequently can help us estimate the post-mortem interval. ◆

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1 PM	Introduction	A/Prof Daniel Fung *President, College of Psychiatrists, Academy of Medicine, Singapore*
1.10 PM	Taking Up the Challenge as a Family Physician	Dr Goh Kar Cheng *Family Physician, National University Hospital*
1.40 PM	Joy and Perils of Capacity Assessment	Prof Bharathi Balasundaram *Senior Consultant, Geriatric Psychiatry, Psychological Medicine, Changi General Hospital*
2.10 PM	Person-Centred Care	Dr Chen Shi Ling *Physician, Tsao Foundation and Khoo Teck Puat Hospital*
2.40 PM	Break	
2.50 PM	Panel Discussion	
4.20 PM	Closing Address	

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Empathetic Leadership

Listening to the Voices on the Ground

Text by Dr Tan Yia Swam

Dr Tan is a mother to three kids, wife to a surgeon; a daughter and a daughter-in-law. She trained as a general surgeon, and entered private practice in mid 2019, focusing on breast surgery. She treasures her friends and wishes to have more time for her diverse interests: cooking, eating, music, drawing, writing, photography and comedy.

The first time it happened, I did not know what to expect. "Tilt your head back, don't worry, it will just be a bit uncomfortable." The thin swab stick slides in, and it's not too bad – but then suddenly there is a sharp pain, and as the swabber twirls the stick, it felt like a drill piercing the back of my head. I tried to pull back, but she held my head firmly in place as she counted, "… six, seven, eight, nine, ten."

"There, all done!" She chirps brightly, "not too bad right?"

Tears streamed down my eyes. I left and then sneezed uncontrollably half a dozen times outside the clinic, with my snot and mucus dripping non-stop. Fine streaks of blood coated the tissue papers. "It's okay," I told myself. I have a sensitive nose.

The second time, the same thing happens. With a bit more tears, a bit more snot and a bit more blood. After that, my nose was blocked and I couldn't breathe properly for the next day.

The third time, I got a splitting headache as well. Each time after that, it just got a bit worse.

I reported and gave feedback to various people. While some were sympathetic and a few suffered the same as I did, some chided me: "You should be thankful! This is to protect you; it can detect asymptomatic disease! It is your responsibility, it is your duty!"

In the meantime, I continue to do my part to protect myself and my loved ones by commuting from home to work only. I eat alone, at off-peak hours. I always don a surgical or N95 mask. Thankfully, my office has an open window and there is additional ventilation. I'm fully vaccinated. I always have my TraceTogether (TT) on.

One day, I woke up with a metallic, sour feeling in my mouth. My heart was pounding. My palms were sweating. I wanted to vomit. Why? Did I have a bad dream? The morning passed in a daze. I dragged my feet to the clinic, and scanned my TT token.

When I breathed in, both nostrils were partially blocked and I could hear a faint whistling sound. Here it comes again: head tilted back and eyes closed. Felt that funny tickle in the first two seconds, then blinding pain. Tears rolling down, I screamed, "Stop hurting me!" I tried to push her hand away.

When I looked down, I was expecting to see blood pouring down – it seemed that painful. But strangely, there was only the usual egg-white-coloured mucus, with a small trace of blood.

I must be overreacting.

"You very sensitive *hor*?" I sniffed and nodded dumbly.

Yes, the problem must be with me. I'm too sensitive.

After all, so many others have had this done to them and no one else is complaining.

It's my fault that I'm so sensitive, that I thought too much into it. No one else has this problem. Think positive thoughts! It's for my own good. It's just a bit uncomfortable. Just relax and it'll be over soon. It's for the greater good. Just tahan *a bit. Other people have had it worse. I don't have a choice, right? The only way is to go through with it. Suck it up. Pretend it never happened. Try to forget about it. And brace myself to go through the next few days in a protective, numbing, foggy haze.*

Until the next time – just a few seconds of pain; scream it out and it's over. And then the next time, and the next time, and the next time… I try not to think of the future.

Representing the ground: RRT

Is this fact or fiction? While reading this, some might think that this is just the fictional work of an overactive imagination. Some may dismiss it as pure nonsense. But some of you may feel and understand what the writer was going through.

Empathy is the ability to understand another person's experience, perspective and feelings. It's assessing how **they** would feel in their shoes, not how I would feel in their shoes.[1]

What makes an empathetic leader?[2] An empathetic leader seeks to relate to his/her team members on a personal level, to better support and help them through good communication, active listening, and by raising them up and empowering them to make changes. One can learn to develop empathy, much like any other skill.

This matter of rostered routine testing (RRT) started as a distressing personal problem which left me at a loss. I reached out to friends and colleagues and found that I was not alone in feeling so. Perhaps we were in the minority, but we were definitely not alone. I went on to discuss this with the Chapter of Otorhinolaryngologists at the Academy of Medicine, Singapore, and infectious disease physicians for some medical insights. I have also spoken with Mr Bernard Menon, executive director of the Migrant Workers' Centre to understand how migrant workers perceived RRT. Interestingly I learnt that there was a great difference in the technique of nasal swab used for migrant workers – superficial nares, rather than deep nasal swabs; not even mid-turbinate.

Here are some resources with descriptions of the types of nasal swab tests to help readers better understand the tests available: (1) A reporter's experience with the four types of swabs,[3] (2) an excellent diagram to show how deep the swab goes for nasopharyngeal swabs,[4] (3) an illustrated guide on nasal mid-turbinate swabs,[5] and (4) a resource video on three types of swabs.[6]

Swabber training is offered by the Ministry of Health (MOH) under Singapore Healthcare Corps, Nanyang Polytechnic and private healthcare institutions.

The allergic rhinitis incidence in Singapore[7] is 5.5% of the adult population. Here are some ballpark figures:[8] we have 15,000 doctors, 42,000 nurses, 10,000 allied health professionals, 2,400 dentists, and don't forget all the inpatient support staff. At 5.5%, that's almost 4,000 healthcare workers with allergic rhinitis.

I pondered for weeks – how large is the problem, and how can we best represent healthcare workers on the ground? Discussion within the SMA Council generated strong support for a survey, to get a quick snapshot of the sentiments on the ground.

We are limited in our scope, as we are a volunteer organisation, where funds come mainly from membership fees. Many of you would have received an email for a survey on "Perceptions of RRT by HCW". As of 19 August, about a week into launch, we had 1,400 responses from doctors, nurses and allied health professionals. We have closed the survey after four weeks, and will publish the analysis in our newsletter next month, as well as use them in engagements with MOH.

Representing doctors' concerns

This is one of the ways I envision the SMA to be a voice for people on the ground: to reflect ground sentiments and piece them together in a coherent fashion, so that we may present them to policymakers to engage in meaningful discussion. There are so many other areas that the SMA wants to advocate for, and this is where we need honest feedback. We need our Members to share their views – we want to hear from you, and we want representation in numbers.

The ongoing work in the Multilateral Healthcare Insurance Committee has been a test in empathetic communications and negotiations. Those of us on the committee are sworn in under the Official Secrets Act which forbids open discussion of sensitive issues brought up during these meetings. I assure Members that SMA 1st Vice President Dr Ng Chee Kwan and I have listened to all the ground feedback over the past year and we are doing our best to represent these views to the committee of all the relevant stakeholders.

These meetings happen around once every two months and last about three hours each time, interspersed with multiple small meetings every week and dozens of emails to discuss, deliberate and debate on pain points. There is still quite a lot of give-and-take needed as we address existing problems and clarify misunderstandings. The key is to forge a common ground in which all parties – and most importantly, the patients – win.

We will all be patients one day, sooner than we might think, and we need to work together to make sure that the Singapore healthcare system is sustainable for ourselves, for our children and the generations after.

Another group close to my heart are the young doctors. For the handful who have reached out to me, I hope that I have shown you respect and listened to the problems you raised with an open mind. The SMA Doctors-in-Training Committee, under the leadership of Dr Chie Zhi Ying, will continue to engage with all of you. Advocacy for systemic change is not a simple one-off event, but may take a lifetime of commitment.

Would you commit to being a change-maker? Join us in the SMA and support our work, whether as a Student or Ordinary Member, as a more proactive committee member on one of our working committees, and maybe even take on a bigger leadership role on the SMA Council someday. ◆

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HIGHLIGHTS

From the Honorary Secretary

Report by Dr Ng Chew Lip

Dr Ng is an ENT consultant in public service. After a day of doctoring and cajoling the kids at home to finish their food, his idea of relaxation is watching a drama serial with his lovely wife and occasionally throwing some paint on a canvas.

Clarification on changes to six-monthly medical examination

We refer to the recent joint circular ("Changes to six-monthly medical examination for migrant domestic workers", MOH No. 104/2021 and MOM No. 08/2021) by the Ministry of Health (MOH) and Ministry of Manpower (MOM), issued on 5 August 2021.

SMA wrote to both MOH and MOM on 9 August 2021 to seek clarification on the changes to the requirements. College of Family Physicians Singapore (CFPS) and SMA representatives met with MOH and MOM on 20 August 2021. After obtaining clarifications, a joint CFPS-SMA advisory was issued on 28 August 2021 to help doctors with the transition to the new medical examination.

The advisory can be found at https://bit.ly/3h7LrJh.

The *Straits Times* article on doctor burnout

An article on doctor burnout published in the *Straits Times* on 4 August 2021 cited an opinion article by *SMA News* editor and SMA Council member Dr Tina Tan printed in the May 2020 issue of *SMA News* (https://bit.ly/5205Opinion2).

The *Straits Times* article can be viewed at https://bit.ly/2XoKyEY.

SMA Members who wish to seek psychological support can refer to the "Psychological Wellness and Support" section of our COVID-19 page at https://www.sma.org.sg/covid19.

MOH circular on Healthcare Cybersecurity Essentials

On 6 August 2021, MOH issued a circular (No. 105/2021) on Healthcare Cybersecurity Essentials, which sets out 12 recommendations for cybersecurity.

The circular can be viewed at https://bit.ly/37QQAAa. If you have queries relating to the circular, you can contact MOH at eLIS@moh.gov.sg.

Memorandum of Understanding with SG Cares to grow skills-based volunteerism

SMA signed a Memorandum of Understanding (MOU) with the Ministry of Culture, Community and Youth's (MCCY) Singapore Cares (SG Cares) Office on 27 August 2021. We look forward to growing skills-based volunteerism within the medical sector.

The MOU was featured in a CNA news clip and can be viewed at: https://bit.ly/3ytmF7V. ◆

L to R: Dr Tan Yia Swam (President of SMA), Mr Edwin Tong (Minister for Culture, Community and Youth) and Dr Ang Hak Seng (Deputy Secretary of MCCY) at the MOU signing.

Surrogacy

Text by Danielle Sim and Dr Alex Cheng Wei Ray

Introduction

Surrogacy is where a woman is artificially impregnated, whether for monetary consideration or not, with the intention that the child is to be given and adopted by some other person or couple.[1] Together with in vitro fertilisation (IVF) and intracytoplasmic sperm injection, surrogacy may be considered a form of assisted reproductive treatment (ART). With couples in Singapore getting married later,[2] declining fertility rates[3] and the success rate of IVF hovering at around 50%,[4] surrogacy is increasingly considered as a possible solution to infertility.

Surrogacy, however, remains fraught with ethical and legal questions.[5] The matter is further complicated by the transnational surrogacy arrangements that may result in cross-border legal tussles, exploitation and even stateless orphans. Despite the unavailability of surrogacy procedures in Singapore, there is evidence of Singaporeans going abroad to seek surrogacy services.[6] A Singapore legal framework addressing the issue is thus due.

With the hope of shedding light on how Singapore could regulate surrogacy in future, this article examines jurisdictions with priorities similar to Singapore, namely the UK, Hong Kong (HK) and the US (specifically, California). The UK legal system forms the foundations of the Singapore legal system,[7] hence it is fruitful to examine how the UK system has developed to address changing social concerns. HK provides an excellent comparison given its similarities to Singapore – a former British colony that became an affluent cosmopolitan city grounded in Asian values. Finally, California has positioned itself as a commercial surrogacy centre[8] and has incentives to ensure a robust legal framework to protect both commissioning parents (CPs) and surrogate mothers (SMs). Examining California's regulations provides a holistic perspective on balancing the different interests of all parties.

Surrogacy laws across jurisdictions

United Kingdom

The Human Fertilisation and Embryology Act (HFEA) 2008 governs the surrogacy procedure and its only prohibition involves the use of embryos with altered DNA.[9] Hence parties may use gametes that come from the CPs, SMs or anonymous donors. There is the possibility of creating an embryo from two gametes that come from anonymous donors, although this might present a complication for legal parenthood.

The Surrogacy Arrangement Act makes commercial surrogacy arrangements illegal.[10] *Commercial* is defined as involving "payment", but "does not include payment to or for the benefit of a surrogate mother."[10] Hence the label "commercial", which renders an arrangement illegal, must be distinguished from permitted paid surrogacy services. Courts have generally been quite accepting of a wide range of permitted expenses which include loss earnings of the SM and her partner, pregnancy-related therapies, clothes and expenses, and even a modest recovery break for the surrogate and her family.[11]

The arrangement however does not automatically confer legal parenthood to CPs. Instead, the SM and her husband, or civil partner, are considered legal parents, even when donated eggs are involved.[9] For CPs to gain legal parenthood, a parental order has to be applied for with the SM's consent, and a genetic link has to exist between the child and at least one of the CPs.[9] The last requirement may create challenges in an application for a parental order where two donor gametes are used. Previously, only couples in marriages, civil partnerships or enduring relationships were allowed to apply for the parental order, but now singles may also apply.[12] However, surrogacy arrangements are not enforceable should parties change their minds.[10]

The UK Law Commission has since also highlighted the inadequacies of the current legal framework for surrogacy and has announced a review on surrogacy laws.[13]

Hong Kong

The Human Reproductive Technology Ordinance (HRTO) prohibits the use of ART for surrogacy unless CPs are married, and donated gametes come from CPs.[14] The Code of Practice on Reproductive Technology and Embryo Research further states that the surrogacy procedure may only be provided where "the wife in that marriage is unable to carry a pregnancy to term and no other treatment option is practicable for her."[15]

The HRTO prohibits "commercial" surrogacy where "no person shall make or receive any payment."[14] However, it excludes reimbursements for:

- the ART procedure,
- a gamete donor's expenses and loss of earnings, and
- the SM's ART- and pregnancy-related expenses.[14]

The commercial surrogacy arrangements prohibition extends to arrangements made outside HK.[14]

As in UK, legal parenthood in HK is conferred by default on the SM and her husband.[16] The similarity is unsurprising since s9 and s10 of the HRTO were taken

from the UK HFEA 1990.[17] For legal parenthood, CPs must apply for a parental order with the SM's agreement.[16]

Similarly, "no surrogacy arrangement is enforceable" should parties change their minds.[14]

California

There are no restrictions on the surrogacy procedure or source of gametes used. In 1998, the Court of Appeal already had to determine legal parenthood for a baby conceived with the gametes of two anonymous donors.[18]

A legal arrangement is required before medical procedures for surrogacy may commence.[19] The mandatory arrangement requires specific information like the identity of gamete donors and CPs, and disclosure of how medical expenses will be managed.[19] Furthermore, both CPs and the SM have to be "represented by independent licensed attorneys of their choosing."[19]

Payment for the surrogacy is regulated by § 7961 which requires the involvement of a "licensed, independent, bonded escrow company" or an "attorney."[20]

Unlike in UK and HK, the "intended parent[a] is treated in law as if he or she were the natural parent of a child thereby conceived."[21] This parent-child relationship may also be legally established before birth.[19]

Surrogacy arrangements are enforceable as held in the 1993 landmark case *Johnson v Calvert* where the CPs were recognised as legal parents on the basis that they "intended to procreate the child."[22] The emphasis on "parenthood by intent"[23] was also depended upon in *Buzzanca*.[18]

Singapore

Carrying out a surrogacy procedure in Singapore is prohibited.[1] There is however, no law regulating Singaporeans' participation in surrogacy procedures abroad.

There is also no law addressing surrogacy arrangements, partly due to the unlawfulness of carrying out such procedures,[1] and the possibility that there is presently no settled public policy on surrogacy.[6]

In the landmark case of *UKM v Attorney-General* (*UKM*) regarding a gay father wanting to adopt his biological child conceived via surrogacy in the US, the High Court found that paid surrogacy fell within the ambit of unlawful payment for adoption.[6] The payment could however be sanctioned by the court rendering it lawful.[6] In *UKM*, the court sanctioned the payment after assessing that payment was made to adopt the child "with a sincere desire to benefit and promote [the child's] welfare."[6] Hence there appears to be no prohibitions against paid surrogacy overseas if the adoption intent is genuine.

The law regarding legal parenthood for surrogacy also appears unsettled. While the Status of Children (Assisted Reproduction Technology) Act (SCARTA) addresses parenthood for children born through ART,[24] the bill was not intended to "address the larger question of surrogacy."[25] In *UKM*, the court however did observe that for children who were born after SCARTA, "the parentage of the child would likely fall to be determined under the SCARTA."[6] However, it is worth noting that between 2008 and 2018, ten out of 14 adoption applications for children born through surrogacy had been approved in Singapore[6] and no less than 15 children born via surrogacy arrangements in the US were brought back to Singapore in 2017.[26] In *UKM*, the court placed emphasis on the welfare of the child, but also found that the appellant's status as biological father was favourable in "asserting his legal rights as the Child's father," which suggests that genetic relation is used to assess parenthood.[6]

Context of foreign laws

In the US, surrogacy issues are embedded within the context of changes in family structure and the role of women.[27] There is a long history in reproductive rights discourse,[28] especially concerning women's reproductive choices.[29] Moreover, recent narratives of LGBTQ equality[30] include the issue of rights to form a family.[31] As these discourses develop, the permissive stance towards surrogacy in California has also had the practical effect of attracting CPs from other countries,[32] turning surrogacy in the US into a "billion dollar industry."[33]

In UK, issues of consent and rights dominate.[34] Although surrogacy is available in UK, many CPs still go abroad given the unenforceability of surrogacy contracts and uncertainty surrounding payment for SMs.[35]

In HK, traditional Confucian beliefs on social order and role expectations[36] remain relevant.[37] Hence, unlike western discourses about individual rights,[38] reproduction issues in HK are framed as an obligation to carry on the family line.[39] Surrogacy is thus restricted to situations of medically proven infertility, and confined within the traditionally recognised family structure of a married heterosexual couple.

Should surrogacy be allowed in Singapore?

Genetic affinity and profile of CPs

Reasons for procreation in Singapore are similar to HK where couples seek to carry on the family bloodline.[40] Recently, in *ACB v Thomson Medical Pte Ltd (ACB)*, a case where a wrong donor sperm was used in an IVF procedure, the Court of Appeal recognised "genetic affinity", a new head of damage for parents of children born out of medical negligence.[41] Procreation in Singapore is seen less as an assertion of rights, but more as an extension of a marriage.[42] Hence, if Singapore chooses to allow surrogacy, HK's restriction of limiting CPs to married couples whose gametes are used for the procedure could be applied to Singapore without too much controversy. Limiting surrogacy to situations where the donor embryo is exclusively constituted from the CPs' gametes will also cohere with evaluation of parenthood based on biological relation. In such situations, there will be no need to invoke the Californian concept of "parenthood by intent"[23] since the couple initiating the surrogacy arrangement will also be biologically related to the child.

Equality and surrogacy locally or abroad

Restricting surrogacy to married infertile couples may however seem unfair. In the UK and US, equality and rights to reproduction form a large part of the surrogacy discourse.[43] However, such expressions of self-focused concerns may not find support in Singapore where communitarian interests are valued.[44] Similar to HK, Singapore is influenced by Confucian ideas[45] that espouse the

placing of "society above self."[46] Hence discourse about reproductive rights is generally muted.

The equality debate in Singapore is more about the socio-economic divide[47] between those who can afford surrogacy overseas, and those who cannot and have no option for surrogacy in Singapore.[6] Singapore could equalise opportunities for surrogacy by (1) allowing surrogacy to take place within Singapore, (2) preventing those with the means from seeking surrogacy services abroad while disallowing surrogacy in Singapore, or (3) make surrogacy available in Singapore, but disallow it abroad.

It is submitted that Singapore should address surrogacy in two stages. The first stage should make surrogacy available locally to a narrow group of people where surrogacy would be fairly uncontroversial, similar to HK's position. Singapore may also consider banning overseas surrogacy in the initial stage while it formulates its policy towards more controversial situations of surrogacy. This interim period will allow Singapore to quickly stem Singaporean involvement in transnational surrogacy while it weighs the complex issues in more controversial surrogacy arrangements involving gametes from dead donors[48] or surrogacy for non-married people.[49] The second stage can then allow a more nuanced approach towards a greater range of surrogacy arrangements, including permitting transnational surrogacy that falls within official guidelines.

Conclusion

Currently, in the absence of a holistic legal framework on surrogacy in Singapore, inconsistencies and injustice may result. Laws are urgently needed to address surrogacy locally and abroad. Without this, individuals with the means will continue to seek surrogacy overseas and courts may then be hamstrung to only react to situations where a child has already been born. While it is clear that developing a policy on surrogacy will present real and difficult questions about ethics, the value of life and the role of medical technology, these are no reasons to skirt the issue. Without a clear legal framework, there will inevitably be continued participation in surrogacy overseas that incurs greater legal risks and ethical challenges. ◆

Danielle graduated from the Singapore Management University's School of Law with a Juris Doctor summa cum laude (with highest distinction). She has a keen interest in areas where law and technology meet – be it in legal tech innovation or where technological growth calls for further development of law.

Dr Alex is a family physician who works as a locum medical doctor during his free time. He is currently pursuing a Master of Laws with the University of London. Aside from his medical qualifications, he also holds the degrees of Bachelor of Laws, Master of Professional Accounting and Master of Business Administration. He is an incoming practice trainee lawyer at Donaldson & Burkinshaw LLP.

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Note

a. California uses the term "intended parent" where this article has chosen to use the term "commissioning parent". Both refer to an individual who seeks a surrogate mother to carry and birth the baby.

The Beauty of PATHOLOGY

Text and photos by Clinical Assistant Prof Leow Wei Qiang

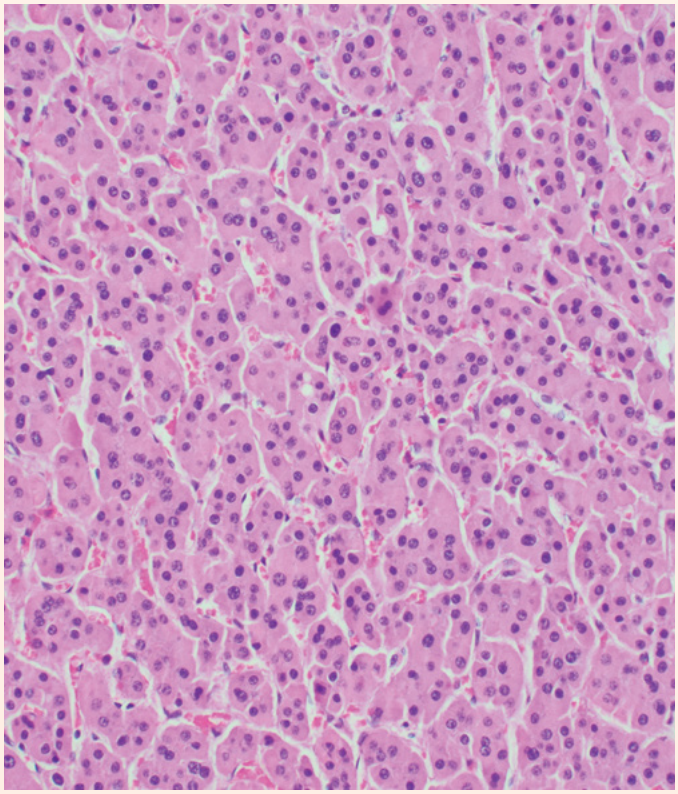
Pathology has been intricately linked to Singapore's history and healthcare since its colonial days. The history of pathology began with the arrival of the late Dr George Alexander Finlayson in Singapore on 12 May 1903, when he took up the appointment of Municipal Bacteriologist.[1] 118 years later, we co-celebrate #pathology118 with Singapore General Hospital's bicentennial birthday.

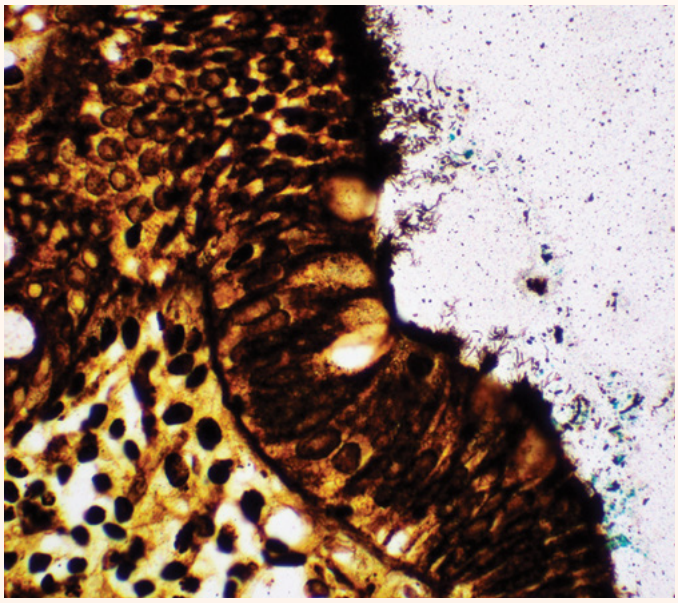
In my job as a specialist anatomical pathologist, I am blessed to be able to marvel at the beauty of pathology day in, day out. In this photo essay, I hope to provide a sneak peek into that natural beauty, so come along for a visual stroll through the garden of pathology.

Undoubtedly, the macroscopic manifestation of disease provokes the most visceral reaction (pun intended) to pathological beauty. The above photograph is a striking example of a polycystic liver, with innumerable variably sized cysts scattered throughout the liver parenchyma.

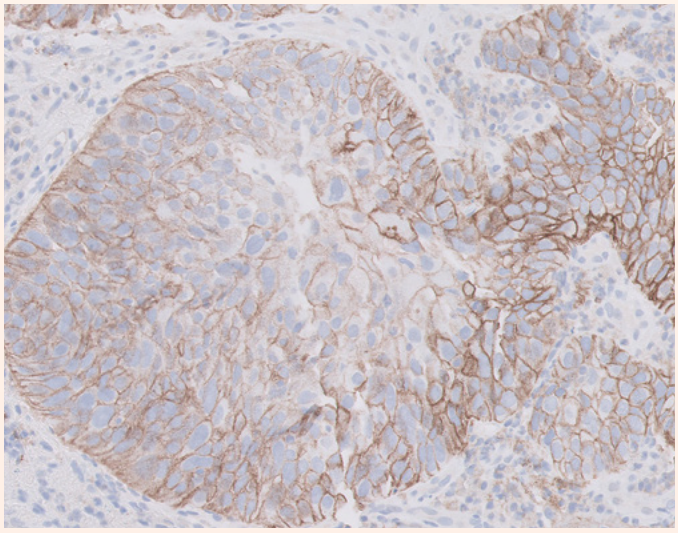
Armed with stains for every occasion

The haematoxylin and eosin (H&E) stain is the most widely used histochemical stain in histopathology and it is a combination of two stains: haematoxylin, which stains cell nuclei purple, and eosin, which stains the cytoplasm and extracellular matrix pink. In this example of a hepatocellular carcinoma, the H&E stain perfectly demonstrates the contrast between the abundant pink cytoplasm and round purple nuclei of the hepatocytic tumour cells.





Analogous to the various photo filters in our smartphones, the Histopathology Laboratory has an arsenal of special histochemical stains that allows us to accentuate various pathologies. This Warthin-Starry histochemical stain highlights the spirochetes embedded along the luminal borders of intestinal epithelial cells.



Immunohistochemistry (IHC) allows for the identification of specific tissue proteins via the binding of specifically raised antibodies and an accompanying chromogenic reaction. This revolutionary technique allows us to continue providing accurate diagnoses, discover new diagnostic entities and even provide therapeutic information. The oesophageal squamous carcinoma cells express programmed death-ligand 1 (an immune checkpoint protein) in a positive membranous staining pattern, predicting that the patient is likely to respond to immuno-oncotherapy.

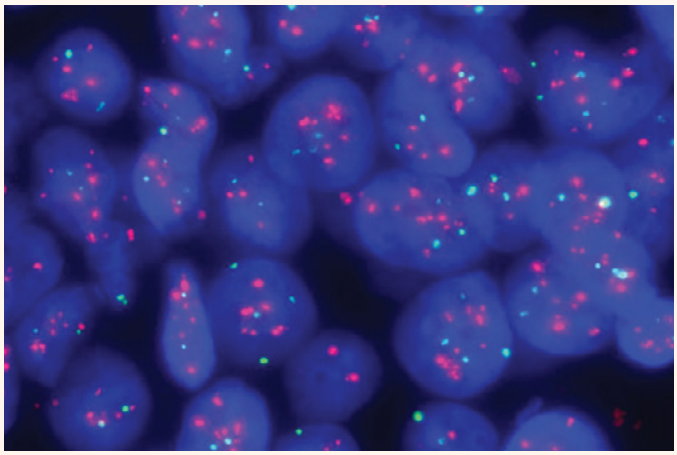


Photo: Clinical A/Prof Alvin Lim Soon Tiong and Ms Lim Tse Hui, Singapore General Hospital Cytogenetics Laboratory, Department of Molecular Pathology

In instances where the interpretation of IHC is equivocal, we turn to our pathology colleagues at the Cytogenetics Laboratory for help. This fluorescence in situ hybridisation image shows amplification of the human epidermal growth factor receptor 2 (HER2) gene (in red) in breast cancer tumour cells. Observe the relatively increased HER2 signals compared to the green control probe targeting centromere 17.

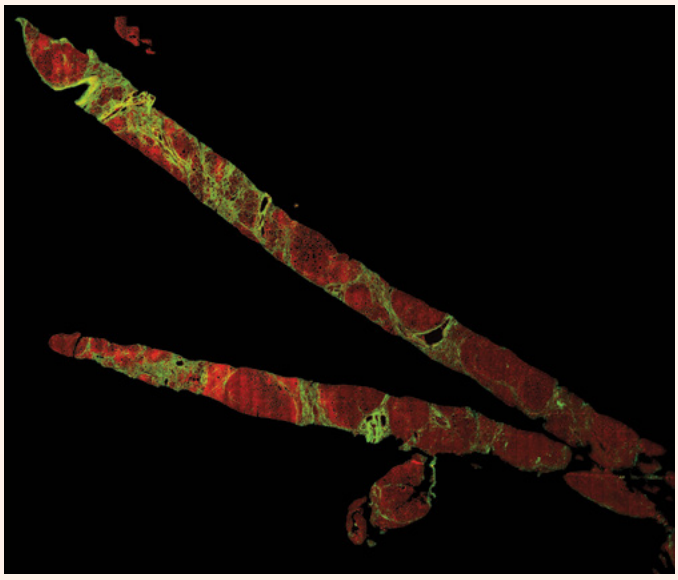


Photo: Dr Dean Tai and Mr Ren Yayun, HistoIndex Pte Ltd

Cutting-edge technology

In my academic research collaborations, I have been fortunate to experience novel technologies that allow us to admire pathologies with higher clarity and definition. These two liver tissue core biopsies are imaged with second harmonic generation microscopy, a tissue imaging system that uses non-linear optical microscopy to observe endogenous tissue signals in unstained tissue samples.[2] Look at the bright green fibrous bands in this cirrhotic liver.

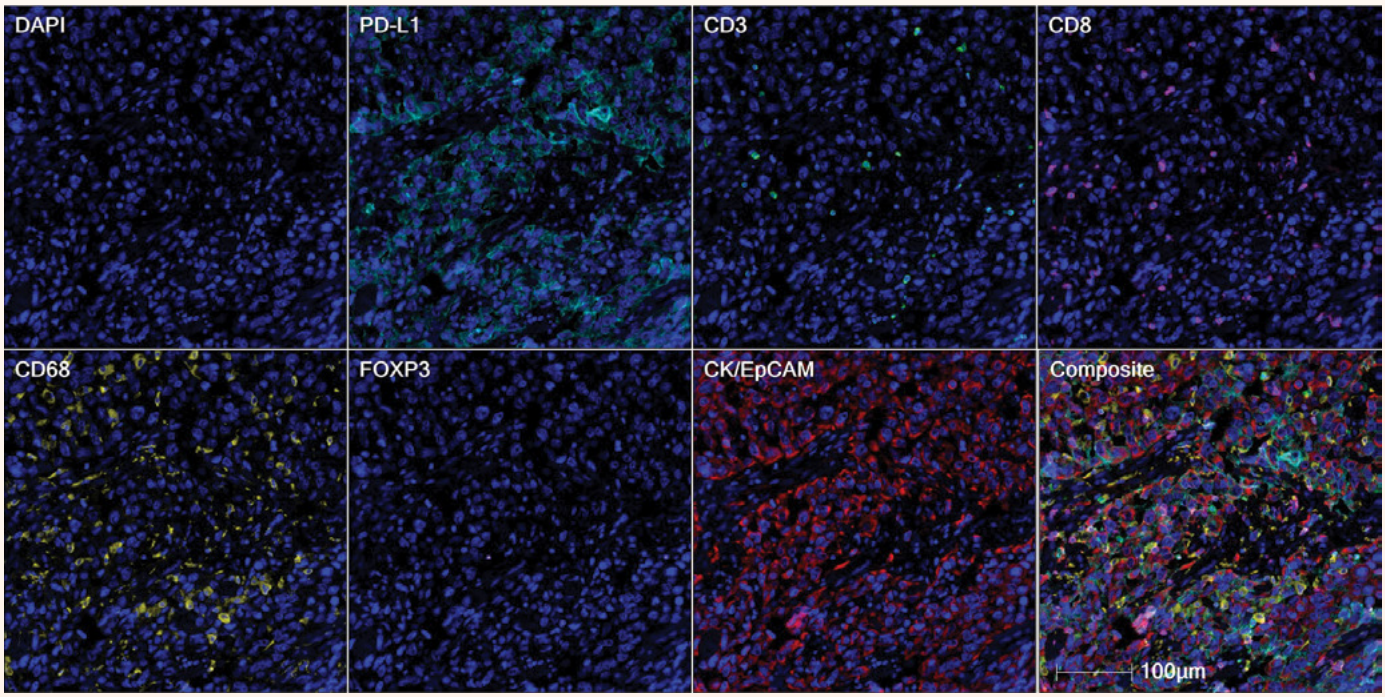


Photo: Dr Joe Yeong and Ms Justina Lee, Integrative Biology for Theranostics Laboratory

Immuno-oncotherapy is a major breakthrough in the fight against cancer, and has heralded intense research into the tumour microenvironment. Quantitative multiplex immunofluorescence opens the door to spatial phenotyping, allowing pathologists to simultaneously look at multiple cell proteins in order to unravel potential biomarkers, all while using only one section of tissue! The composite image above shows the various immune cells (highlighted in cyan, green, magenta, yellow and orange) among the colorectal cancer cells (in red).

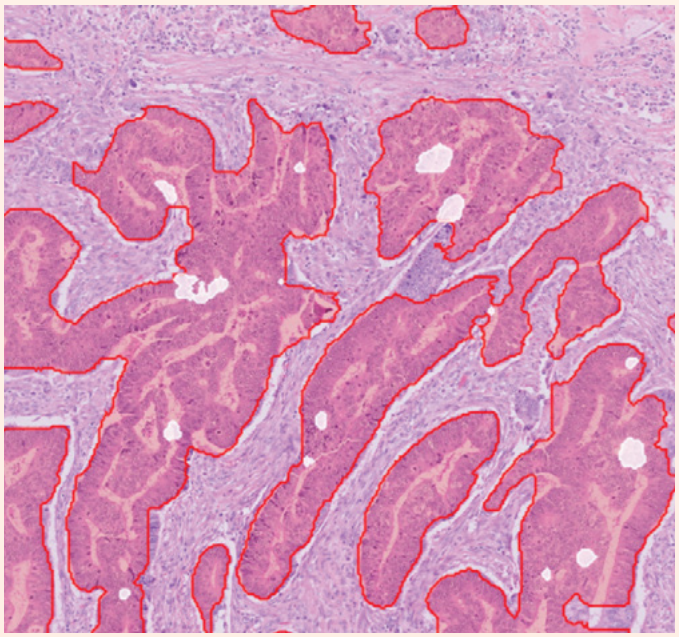


Photo: Dr Sahil Ajit Saraf, Qritive Pte Ltd

Artificial intelligence (AI) is permeating all aspects of life. In the pursuit of laboratory digitalisation, collaborations with medical technology start-ups will yield the development of pathology-focused and AI-driven applications that can assist busy pathologists in their diagnostic work. Wonder at the abilities of a deep-learning convolutional neural network as it detects malignant colonic glands in the whole slide image on the left.[3]

Thank you for taking a moment to walk with me through this garden of pathology. Like me, I hope you find the beauty of pathology mesmerising. As pathologists, and more importantly doctors, it is our fervent hope that by understanding the basis of diseases that lie behind every glass slide, we will be able to find a cure and alleviate the suffering of the patient. ◆

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Clinical Assistant Prof Leow is a consultant pathologist with the Department of Anatomical Pathology, Singapore General Hospital, with special interests in hepato-pancreato-biliary and gastrointestinal pathology.

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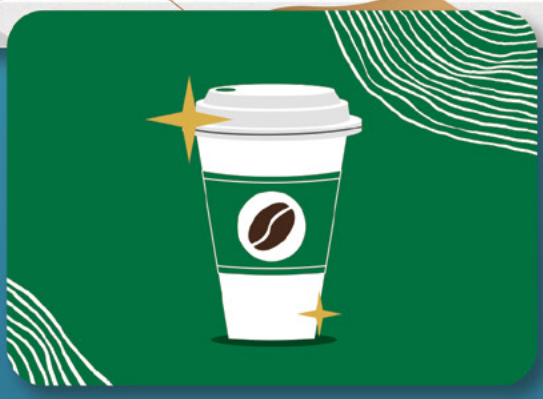

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A NATION OF DIAGNOSTIC TESTS

Text and photos by Dr Jipson Quah, Editorial Board member

A couple of years ago, I moved into private practice and joined a general practice group. But even as I embarked on my career in family medicine, I continued to maintain a special interest in pathology and stayed in touch with my ex-colleagues and seniors in the discipline. I constantly sought online Continuing Medical Education sessions, journals and courses to keep myself acquainted with the latest developments in the field. Another field that fascinated me greatly was digital health, especially with the advent of teleconsultations and digital medicine applications. These two interests were thrust into the forefront by the COVID-19 pandemic. I have previously written about the impact of digital health for the medical fraternity in *SMA News* (https://bit.ly/5201Opinion3, https://bit.ly/5209Feature), and will be focusing more on the pathology aspect this time.

1

Improving diagnoses

I was very fortunate to contribute to the Diagnostics Development Hub at A*STAR, where I was able to utilise my experience in laboratory operations, standard operating procedures and testing services in the field of pathology. My work involved collaborating with project managers and researchers to understand their novel diagnostic technologies and how a test could develop a clinical use-case. One of these new biomarkers was the MiRXES GASTROClear, a qPCR-based diagnostic test kit that measures 12 microRNA biomarkers linked to gastric cancer to calculate a cancer risk score for each patient using a proprietary algorithm that has been clinically validated. Gastric cancer, with its many variants, is known to be notoriously hard to detect at an early stage. The late symptoms of gastric obstruction, poor nutritional intake and unexplained weight loss usually herald a poor prognosis. A product of Singapore, this test was jointly developed by the Singapore Gastric Cancer Consortium, a translational research group comprising clinicians and scientists working in gastric cancer research, and other healthcare partners. The Consortium aims to solve important clinical questions to improve the care of gastric cancer patients, facilitated by close interactions between clinicians and scientists, and with synergism that enables biologic discoveries in the laboratory to be validated in the clinical setting. Thousands of tests have been performed since and it is gradually becoming a useful tool in the screening and monitoring of gastric cancer.

As with new medical technologies, there are many detractors who feel that the clinical use is not developed enough, or perhaps that the results are inconclusive. One may prefer to recommend an oesophago-gastro-duodenoscopy or MRI instead for a more conventional and definitive diagnosis. The cost, at a couple hundred dollars per test, could prove to be prohibitive for some patients, especially for a screening modality. However, I take the viewpoint that instead of applying a one-size-fits-all strategy, some patients may benefit from the availability of other diagnostic options. For example, some patients may be unwilling to undergo a gastrointestinal scope procedure or have an insurmountable fear of MRI machines. This may also prove to be a valuable option for another patient with a strong family history of gastric cancer and predisposing risk factors, who has undergone yearly scopes and radiology screening but without any significant findings. Over time, I believe

that the diagnostic option's clinical use does evolve and will ultimately benefit different patient populations. Medicine has always been about marrying art and science, hasn't it?

COVID-19 pathologies

As COVID-19 started to rage in 2020, the scientific community was galvanised into action. We witnessed several local companies launching their COVID-19 polymerase chain reaction and serology test kits, hence putting Singapore in the limelight. With impressive speed in research and development and manufacturing, Singapore's diagnostic companies were able to quickly ramp up their testing capacities and also supply test kits to international clients. Local laboratories armed themselves with highly expensive but accurate testing technologies to serve the community while Public Health Preparedness Clinics swabbed patients aggressively. These increased testing capabilities allowed us to detect and limit the spread of COVID-19 effectively. When the dormitory clusters emerged, our colleagues from both the private and public sectors were able to implement high-volume testing and control the surge. As we move into the next phase of COVID-19 as "a nation of diagnostic tests", these are also fruits borne of our nation's efforts in the biomedical and diagnostic industries. (Nobody really imagined it would culminate in rostered routine testing, widened nostrils and abused turbinates, but what choice do we have, honestly?)

In my clinical practice, I also assisted a biotechnology company in obtaining blood samples from patients who had recovered from COVID-19. These patients were a treasure trove of IgG antibodies which were used to validate point-of-care serology test kits. Although they are not commonly used in practice nowadays, it was an honour to be one of the first clinicians to trial these products on recovered patients and discuss the findings with industry partners. It is also sobering to know that sometimes, new products may not find the same use and acceptance as what was initially intended. Regulatory hurdles and health policies are also tremendous challenges for new diagnostic products.

Another new test that emerged during the pandemic is the cPass™ assay, which detects COVID-19 neutralising antibodies. It is the first US Food and Drug Administration approved test for the presence of neutralising antibodies which may block COVID-19 viral infection. Although the clinical use is still in development, I find that the technology and potential indications are very fascinating. According to recent immunology literature, there are indeed a variety of antibody responses to vaccination, and these do differ for mRNA and inactivated vaccines. As we speak, researchers are conducting trials on the antibody responses of the different vaccine and booster schedules and their effects on public health. On a personal note, I have had my cPass™ levels checked three times, and obtained one pre-vaccination and two post-vaccination levels. Unfortunately, it appears that I may need a booster. When, where and what vaccine is still yet to be determined though.

On a lighter note

As part of my work in pathology, I also delve into the field of medical humanities to enliven our experiences as doctors. The SingHealth Pathology Academic Clinical Programme will be raising funds for research through their concert series, in which I will be joining my pathologist colleagues in a live-streamed pop concert performance. Do look out for this upcoming event and support us if you can! ◆

*Disclaimer: The writer is under employment at Accelerate Technologies Pte Ltd, A*STAR to provide clinical support for laboratory operations and diagnostics technology development. This article does not aim to market any of the tests mentioned.*

Legend

1. Dr Quah at the microscope

2. Dr Claire Swa, Dr Sidney Yee and Dr Jipson Quah representing Diagnostics Development Hub at a test demonstration

Dr Quah is currently a clinical laboratory professional with a global clinical research organisation. He is also a member of the SMA Telemedicine Workgroup. He enjoys football, music-making and editorial work in his spare time, and has been actively trying to assemble a performing ensemble of local doctor-musicians.

STUDENT OUTLIERS

How Do They Do It?

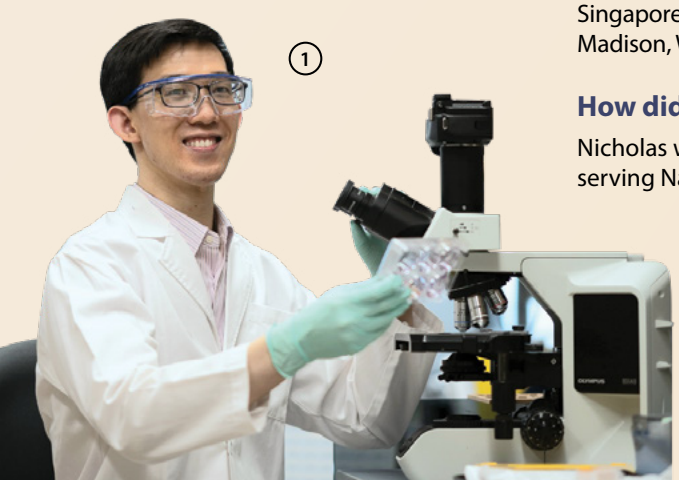
Text and photos by Daryl Lin and Dr Kenneth Lyen

Outliers are exceptional people who stand at the extreme outer edge of what is statistically plausible. An unspoken accomplishment of outliers is that they are self-made and although they may have had some initial help, they achieve their success largely by themselves.

Medical student outliers

We present two recently graduated NUS Yong Loo Lin School of Medicine (NUS Medicine) students who fit this definition. They are prolific researchers and writers, and one has even represented Singapore in international CrossFit competitions. How do they achieve their successes despite their heavy medical school schedules?

The first student is Nicholas Syn, then a fifth-year student with 127 publications, including 41 original research papers spanning basic, translational and clinical research, several of which were published in prestigious peer-reviewed international medical journals.[1] One of his notable publications, "De-novo and acquired resistance to immune checkpoint targeting", in *The Lancet Oncology*, has been cited 311 times. He has also won a number of awards and research grants, including Singapore Health Services' (SingHealth) Medical Student Talent Development Award, National University Hospital Department of Medicine's Junior Research Award, and an Honors with Distinction on a recent clinical informatics clerkship with Harvard Medical School, among others.



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The second is Ian Wee, a friend of Nicholas', who was a fifth-year student with a keen interest in research. He has more than 50 review papers published in peer-reviewed international journals, including the *Journal of the American Medical Association*, *Annals of Surgery* and *Gastric Cancer*. Like Nicholas, he has also undertaken original research and four of these papers have been published.[2] He has also been awarded research grants from SingHealth and has won awards from international conferences, such as the Asia Pacific Federation of Coloproctology. Not only is he active in his research with many collaborations, he is a top CrossFit athlete who represented Singapore in the 2019 CrossFit Games in Madison, Wisconsin, US.

How did they start?

Nicholas was fortunate that while serving National Service, he was posted to the Military Medicine Institute's Psychological Care Centre where he was involved in managing the emotional problems of fellow servicemen. Interacting with the psychiatrists looking after them motivated him to explore research in this area. During this period, Nicholas also found an opportunity to engage in some medical research and was mentored by Prof Goh Boon Cher, a haematology-oncologist.

Ian took a slightly different path. He began his medical education at the University of New South Wales, where the culture strongly encouraged medical students to engage in research. He too was fortunate to meet with mentors who started him on his research quest, a journey which continued when he transferred back to Singapore.

Both students agreed that the role of mentors was absolutely critical to their entry into research. "You want to find a mentor who truly wants to see you grow to become an independent and successful scientist, rather than simply getting the immediate projects done. I was absolutely fortunate to have started out with Prof Goh, who wanted me to pick up a variety of research skills for my own benefit (beyond the projects I was helping with), so he kept introducing me to more and more people whom I learnt a variety of skills from", said Nicholas.

Both Ian and Nicholas are overachievers. It is true that medical students are usually very hardworking, and most are overwhelmed by the mountain of facts they have to memorise. What were their strategies for combining research and surviving medical school?

Research difficulties

Not all was smooth sailing. They were thrown into the deep end of research, and according to Ian, they "had to quickly assimilate the purpose of the study, do background reading which meant trying to decipher the myriad of technical jargon, and then outline a plan for their project. Next, [they] had to do the actual hands-on research, collect the raw data, then apply statistical analyses to determine the p-value significance. With all the data analysed, the hardest part was to write the research paper."

Writing

According to them, it takes about two to six months to start writing an article from scratch. It also depends on the type of work they are working on – whether it is a review or translational research. With such a large time investment needed, total commitment is key.

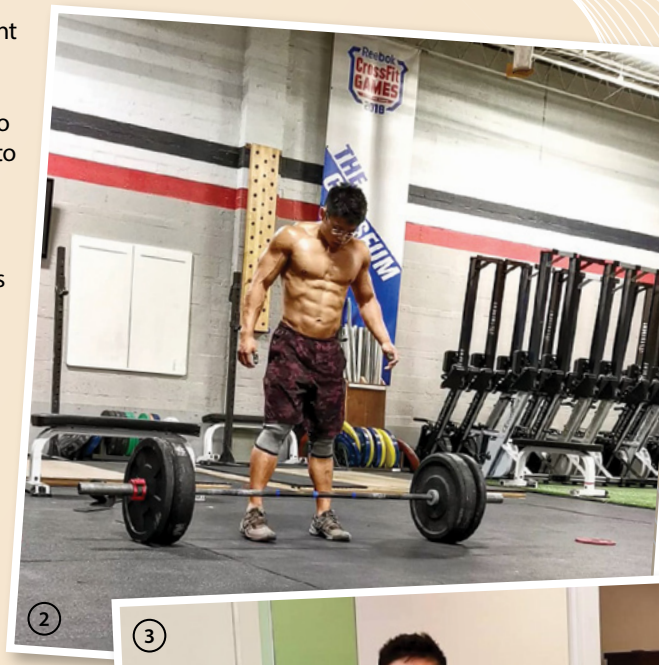
Ian remembered his first review taking about six months as he had to familiarise himself with the process of analysis and writing. To increase their efficiency, both have developed various frameworks and protocols which suited them. This streamlined the research process, which got easier with each succeeding publication, and built up momentum which kept them going. As for coming up with new ideas, Ian had this to say: "It pays to read widely, including research and review papers, go to international conferences, and spend time exploring new topics that are still incompletely understood".

"Another way to increase the pace at which our papers are pushed out is by working in groups, delegating each part of the paper to different members", said Ian. Information was then shared freely among the members during meetings. With COVID-19's safe-distancing measures, face-to-face meetings suffered and most meetings were via Zoom. This meant that some members were unable to enjoy the "full experience" of collaborative research, but it is up to the individual to take the initiative to step up the interaction.

Time management

"Sometimes we received updates and revisions of our research at 3 or 4 am", shared Ian. Indeed, sleep is one of the things that must be sacrificed to fit their tight schedule. Sometimes, they would stay up all night just to write a paper!

Be it waking up early to complete a paper or to train at the gym, discipline is important when it comes to completing their work and studies. "Lots of coffee", Nicholas declared. They had to prioritise and manage their time well, while remaining task-focused. That said, the majority of their work was done over weekends, something that most medical students are not willing to sacrifice.[3] "I don't feel like I'm sacrificing my weekend though – it is more like a leisurely hobby for me," quipped Nicholas.



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Rejections

Rejections by medical journals are part and parcel of getting published. Some reviewers rejected their papers without giving any comments. Ian and Nicholas suspected that the reviewers did not really understand their analysis, and probably rejected them on that basis. Other reviewers were kind enough to give a reason for their rejection, showing they did try to make sense of their paper, which both were thankful for.

The majority of Ian and Nicholas' publications were meta-analysis reviews. This genre of reviews, where one analyses and compares a number of published original research papers on one topic, is becoming increasingly popular in the research community as large numbers of researchers are pushing out mountains of papers at breakneck speed. Sometimes Ian and Nicholas are unlucky as the topic which they were working on has been recently reviewed by someone else, and they get rejected because journals were no longer interested in the same topic.

Support for student research and publishing

Should medical students do research and publish articles? "Yes!" answered both Ian and Nicholas. Reasons include building connections with professors, mentors and colleagues to discuss the research topics, planning, and executing the research. They are also made to think creatively and critically. They learn skills and knowledge that might not be taught in medical school. "In research, you're judged by how good your questions are, not how good your answers are," Nicholas pointed out. Before the COVID-19 pandemic, they were even able to travel overseas to present their papers and make international friends.

Legend

1. Nicholas doing laboratory research

2. Ian at his crossfit training

3. Ian receiving the Society of Vascular Surgery scholarship in 2019

4. Nicholas during his clinical elective at Boston Children' Hospital

The Ministry of Health has a published policy of promoting undergraduate medical research.[4] All three local medical schools encourage their students to do original research and publish medical writings.[5-7] It fosters critical and creative thinking, and some students may continue research work after they graduate.

A survey of British medical schools showed that about 49% of students had taken part in a research or audit project, and about 17% have submitted a paper for publication.[8] We do not have comparable information for Singapore, but personal impressions from NUS Medicine and the Lee Kong Chian School of Medicine suggest that it is unusual for students to publish more than a couple of medical papers, if any, before they graduate.

One other reason that medical schools advocate research and writing papers is that it can help students understand and critically evaluate medical publications. This will be useful for future doctors in determining which research publications are valid and which can be ignored.

Publications can also further their career prospects.[9,10] Research work may be intimidating due to the steep learning curve, but with a nurturing and knowledgeable mentor to guide and teach them, one can expect to overcome the challenges. For Ian and Nicholas, they understand the need to be wary not to fall into this trap of "racking up the numbers". Of course, there must be a genuine interest at heart, or it would just be another laborious task to complete for that residency position that they desperately want.[11]

Conclusion

Both Ian and Nicholas invest almost all their free time into their research, analysis and publication of papers. They were truly outliers as undergraduates. They openly admit that they owe a debt of gratitude to their mentors and to their collaborators. Time management is of critical importance, and to achieve a work-life balance is doubly difficult for medical students. Incredibly, Ian and Nicholas have succeeded and deserve the label "outliers"! ◆

Daryl is a researcher in the Department of Orthopaedic Surgery, National University Hospital, Singapore.

Dr Lyen is a paediatrician in private practice. He is the founder of the Rainbow Centre which runs three schools for intellectually challenged and autistic children.

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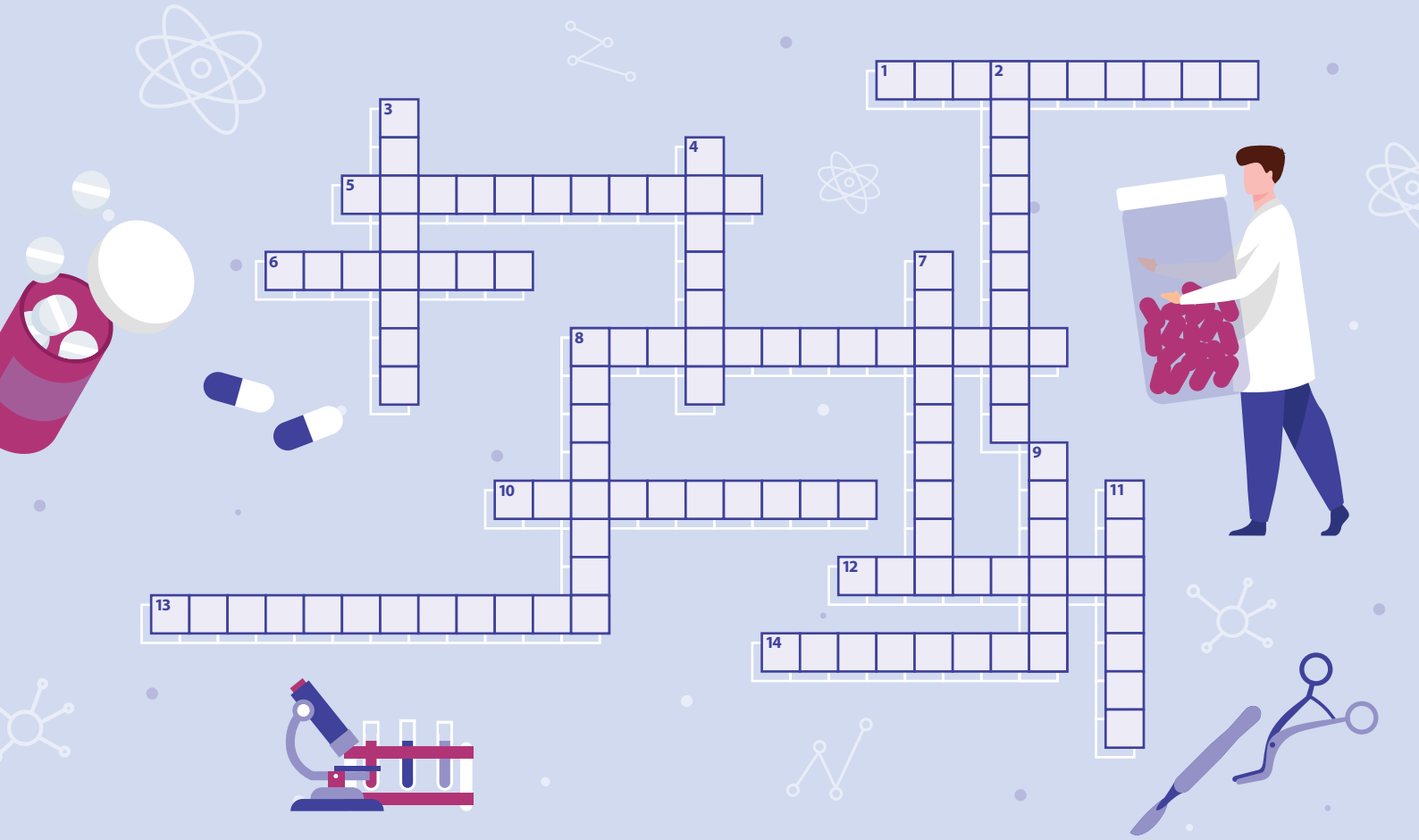
10. Detsky ME, Detsky AS. Encouraging medical students to do research and write papers. CMAJ 2007; 176(12):1719-21.

11. Nikkar-Esfahani A, Jamjoon AAB, Fitzgerald JEF. Extracurricular participation in research and audit by medical students: opportunities, obstacles, motivation and outcomes. Med Teach 2012; 34(5):e317-24.

MEDI-CROSSWORDS

Try not to use Google for this! *SMA News* and Dr Jipson Quah bring to you the next instalment of our crossword puzzle! We hope you have a little fun solving this and do feel free to share this puzzle with your friends and colleagues. The answer key will be released with the next instalment.



ACROSS

1. An irregularly formed haemorrhagic area of the skin; the colour is blue-black, changing to greenish brown or yellow
5. Widely known as the father of medicine
6. Phenomenon characterised by the worsening of neurologic symptoms in multiple sclerosis and other demyelinating diseases when the body is overheated
8. Loss of colour vision as a result of damage to extrastriate visual cortex
10. Lesser-known physician who was the father of the father of medicine
12. A neurological syndrome caused by severe mercury poisoning. Symptoms include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech
13. Destruction of soft tissue by bacteria that results in the release of waste gases and fluids
14. Special stain for amyloid proteins

DOWN

2. The Nobel Prize for Physiology and Medicine 2020 was awarded for the discovery of this virus
3. First director-general of the World Health Organization
4. A disorder affecting the sensory organ within the inner ear responsible for balance and hearing. It is characterised by episodes of dizziness, tinnitus and progressive hearing loss, usually in one ear
7. Surgeon who described an operation to treat an abnormal thickening of the hand (palmar fascia) causing curling of fingers and impaired function of the fingers
8. American physician who first discovered verrucous carcinoma
9. Founded the Institute of Lyon's Institute of Criminalistics and derived a famous exchange principle
11. German pathologist who postulated the origins of renal cell carcinoma

COIN COLLECTING: A *Fun* Investment?

1

Text and photos by Dr Jimmy Teo, Editorial Board member

I started collecting coins in earnest in the beginning of 2019, though I had coin and banknote albums as a kid. As part of my investment portfolio review in mid-2018, I looked at gold prices and found that they had been getting lower for quite a few years. Gold is a lousy investment as it has a negative carry, which means it costs to maintain your stash. It does not earn interest and significant amounts have to be put into a safe or safe deposit box. Nonetheless, many people think it prudent to have a small proportion of your total portfolio in physical gold.

Some people buy gold in gold savings accounts (eg, United Overseas Bank), or through a gold-backed exchange traded fund, but these carry a counter-party risk, as the custodians can refuse to let you have the physical gold when you really need it. As Singaporeans, we should learn to be like the Shaw brothers and keep a stash for any eventuality, but most of us do not have a backyard to bury it in. My research into physical gold coins shows that Singapore is a pretty good place to collect gold bullion (monetary or investment gold) as the prices are competitive with small buy and sell differences, and there is no goods and services tax (GST). Do note that you can expect to pay about 5% to 15% above the spot gold price for physical gold due to costs incurred in minting, storage and other administrative costs. You can check prices on websites like BullionStar and Gold Price. Of course, your spouse might very well prefer that you invest in gold jewellery that they can wear and run away with!

Collectible coins

Government-backed bullion coins like Canada's Maple Leaf, the US' Eagles and Buffalos, and Australia's Kangaroos, among others, are legal tender. Theoretically you can bring them to a bank and deposit them for the stated value. But of course, the coin is literally worth its weight in gold, and its intrinsic value is usually considerably higher than its face value. Coins can come in 916 or 9999 fineness (or purity). For example, American Eagles are 916 (22 karat) and Buffalos are 9999 (24 karat). They come in various weights and may be in troy ounces (oz) or in grams (g). Usually, people collect 1 oz or 30 g coins since lower weights make very small coins.

2

Though bullion coins are nice to collect, they are common and usually not encapsulated in plastic. They require careful handling in order to preserve their appearance. Serious collectors usually look to acquire proof coins (specially struck coins with outstanding finish and detail) which are encapsulated to protect their finish. There are usually proof versions of bullion coins, and many mints also produce commemorative coins. However, these coins are considered numismatic coins (ones that collectors will pay a premium for), are subject to GST and often priced much higher when first sold. Singapore used to mint the Lion bullion coins from 1990 to 2002.

The Singapore Mint produced many commemorative proof coins over the years, made of copper-nickel, aluminium, silver, gold or platinum. You can purchase these coins at the Singapore Mint, bullion stores, numismatic shops, numismatic society meetings or auction houses. But nowadays, many collectors use Carousell (an online marketplace where individuals can list and buy items), which is my

③

preferred way of getting coins. Once you meet other sellers and collectors, you will have a network where you may also be able to get the coins you desire.

Singapore's collectible coins

The first gold coin issued by Singapore was the 1969 $150 Lighthouse gold coin (containing 24.88 g or 22.79 g 916 gold) commemorating the 150th anniversary of the British founding of Singapore. It was issued as a bullion coin and came with optional boxes. Collectors often like to collect an original set (comprising the box and plastic envelope with intact staple). There is also a proof coin which is very rare and commands a high premium, whereas the bullion coin can be purchased at close to spot gold price. Investments in gold bullion were more popular in the years after World War 2 and the immediate post-independence period due to concerns about the stability of fiat currencies.

The 1975 Singapore 10th Anniversary of Independence gold bullion coins are often available. These are 1 oz, 0.5 oz and 0.175 oz gold coins in 900 fineness of $500, $250 and $100 value respectively. The design and images are an interesting reflection of that period (a lion, multi-racial arm-holding and a Housing Development Board apartment block). The proof versions are rarer and may command a 50% premium compared to the bullion version. Singaporeans like to collect Lion bullion coins and proof coin sets, though you can often get certain years of mintage close to spot gold prices. Fewer sets were produced in later years and these may command higher prices. You can check on the numbers produced at the Monetary Authority of Singapore's (MAS) website.

After reviewing many coins from different countries, I noticed that Singapore minted some of the highest legal tender value of precious metal coins (also printing the largest denomination banknotes for that matter)! In fact, if you are starting out and are worried about losing money in your coin collection, you may consider collecting the first series Singapore $500 Chinese zodiac 0.5 oz gold coins (1981 to 1992). You can redeem them with the bank or central bank if the price of gold crashes. In the early 1980s, the silver market was cornered and the price of silver was high. The 1980 and 1981 Singapore Financial Centre commemorative coins are legal tender for $50! These are also available in proofs.

There are very few platinum coins issued by Singapore. For many years, platinum has always been more valuable than gold due to rarity and correspondingly, their stated legal tender values are higher. The 1990 Singapore 25th Anniversary commemorative coins were issued in aluminium bronze ($5 non-proof), 1 oz silver, 1 oz gold and 1 oz platinum ($10, $250 and $500 proof coins, respectively). The other 1 oz platinum proof coin is the Board of Commissioners of Currency of Singapore (BCCS, which has merged with MAS). Currently, 1 oz of platinum is much cheaper than 1 oz of gold (about $1,400 versus $2,100), but the BCCS platinum coin carries a higher premium due to rarity (mintage 300 pieces). Another unusual coin is the Year 2000 Millennium bimetal piedfort proof coin (54 g). Piedfort refers to an unusually thick coin. This coin also has a holographic coat of arms!

There have been three series of Singapore general circulation coins since independence. The first carried images of marine creatures, the second had a floral theme and the current ones have national icons or landmarks. The first series had bare metal proofs which can command fairly high prices. There were some silver proofs of the stylised Lion $1, Sea Eagle $10, and Satellite Ground Station $10 coins. For some reason, Singaporeans like the stylised Lion $1 coins – the silver proofs are $80 to $100, and even general circulation ones are priced $4 to $8 on the market. The rare 1975 silver proof $1 coin can command prices in excess of $300 to $500. Sterling silver proof coin sets (silver at 92.5% purity) of the floral series were also minted. The sets contained rarer coins not usually seen in general circulation including the scallop-edged $5 coin. Some circulated when they were taken out of their festival packs (like the Lunar New Year Hongbao coin set).

More than just coins

One can appreciate the artistry of the designers of the coins. The photos here do not do them justice. Reading about coins, one also learns about history and fun facts. Do forgive me when I hold up the line using paper currency to get loose change. You can easily collect coins for investment, insurance and as a hobby in Singapore. Part of the fun is hunting down your desired coins or completing your collection. And you have a gold stash for the next calamity. ◆

Note: *The prices for gold and platinum were accurate at the time of writing in January 2020.*

Legend

1. 1990 25th Anniversary coin silver gold platinum proof coin set

2. 2000 Bimetal gold-silver piedfort coin

3. American gold eagle proof coin

Further readings

1. Singapore Numismatics Association. Available at: https://bit.ly/3Bahnoz.

2. Mavin International. Available at: https://bit.ly/3xLLtwv.

Dr Teo is an associate professor in the Department of Medicine, NUS Yong Loo Lin School of Medicine, and senior consultant in the Division of Nephrology at National University Hospital. He is the Division of Nephrology Research Director and an active member of the Singapore Society of Nephrology.

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