COVID-19: BATTLING AN EVOLVING EPIDEMIC
The Lee Kong Chian School of Medicine (LKCMedicine), a partnership between Nanyang Technological University, Singapore (NTU Singapore) and Imperial College London (Imperial), is training doctors who put patients at the centre of their exemplary care. The School, which offers both undergraduate and graduate programmes, is named after local philanthropist Tan Sri Dato Lee Kong Chian. Officially opened on 28 August 2017 by the then Singapore Deputy Prime Minister Mr Teo Chee Hean, LKCMedicine aims to be a model for innovative medical education and a centre for transformative research. The School’s primary clinical partner is the National Healthcare Group, a leader in public healthcare recognised for the quality of its medical expertise, facilities and teaching.

Graduates of the five-year undergraduate medical degree programme that started in 2013 will have a strong understanding of the scientific basis of medicine, with an emphasis on technology, data science and the humanities. The School’s first batch of doctors graduated in 2018 with Bachelor of Medicine and Bachelor of Surgery (MBBS) degrees awarded jointly by NTU Singapore and Imperial.

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<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>MESSAGE FROM THE DEAN</td>
<td>Professor James Best</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04-05</td>
<td>RESEARCH &amp; COLLABORATION</td>
<td>Professor Lim Kah Leong</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>BOOSTING THE NATION’S TESTING CAPACITY</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>LKCMEDICINE FACULTY STEPS UP TO THE NATIONAL RESPONSE LINE</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>STUDYING SARS-COV-2 USING LUNG ORGANOIDICS</td>
<td>Assistant Professor Sanjay H Chotirmall</td>
</tr>
<tr>
<td>09</td>
<td>PRIMARY CARE IN A PANDEMIC</td>
<td>Associate Professor Josip Car</td>
</tr>
<tr>
<td>10</td>
<td>MODELLING THE PANDEMIC TO OPTIMISE PUBLIC HEALTH OUTCOMES</td>
<td>Visiting Professor Annelies Wilder-Smith</td>
</tr>
<tr>
<td>11</td>
<td>INNOVATING DIAGNOSTICS TO MAKE TESTING ACCESSIBLE IN ALL SETTINGS</td>
<td>Associate Professor Eric Yap</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IMPACT OF COVID-19 ON BLOOD VESSELS</td>
</tr>
<tr>
<td>12</td>
<td>DIABETES AND COVID-19</td>
<td>Associate Professor Yusuf Ali; Associate Professor Andrew Tan;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chow; Associate Professor David Lye; Associate Professor Ng Oon Teck;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr Barnaby Young; Dr Chia Po Ying</td>
</tr>
<tr>
<td>13</td>
<td>STUDYING THE STRUCTURE AT THE HEART OF THE VIRUS</td>
<td>Professor Luo Dahai</td>
</tr>
<tr>
<td>14</td>
<td>COVID-19 AS A CATALYST FOR EDUCATIONAL CHANGE</td>
<td>Professor Jennifer Cleland</td>
</tr>
<tr>
<td>15-17</td>
<td>ON THE NATIONAL INFECTIOUS DISEASES TEAM</td>
<td>Associate Professor Yeo Tsin Wen; Associate Professor Angela Chow;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Young; Dr Chia Po Ying</td>
</tr>
<tr>
<td>18</td>
<td>CLINICAL REFLECTIONS</td>
<td>Associate Professor Tham Kum Ying</td>
</tr>
<tr>
<td>19</td>
<td>REFLECTIONS OF YOUNG DOCTORS AT THE FRONTLINE</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>EDUCATION</td>
<td>Professor Pang Weng Sun</td>
</tr>
<tr>
<td>21</td>
<td>PREPARING TO JOIN THE WORKFORCE IN A COVID-19 WORLD</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>LKCMEDICINE CLINICAL POSTINGS IN A COVID-19 WORLD</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>ONLINE LEARNING DURING COVID-19 PANDEMIC</td>
<td></td>
</tr>
<tr>
<td>24-25</td>
<td>TO THE COMMUNITY, WITH LOVE</td>
<td></td>
</tr>
</tbody>
</table>
Message from the dean

The COVID-19 pandemic has and continues to be a deeply life-changing time for everyone. It is my pleasure to present the broad ranging and important COVID-19 related work in which the Lee Kong Chian School of Medicine (LKCMedicine) is actively engaged, encompassing the areas of research, education and clinical care. In this publication, we throw the spotlight on the important roles our faculty and staff are playing in the national and international COVID-19 response, reporting on research undertaken by various labs and other contributions. We also cover how LKCMedicine responded to the impact of the pandemic on medical education and record reflections from some of our young doctor alumni working in the clinical field.

During the previous months when Singapore curtailed many activities involving gatherings of people and face-to-face physical interactions, LKCMedicine faculty and staff innovated and reimagined many processes involved in the day-to-day operations. The Education department stepped up to the challenge of preparing our graduating medical students for their Postgraduate Year 1, with simulated ward rounds and online teaching. They also enhanced virtual clinical training for the senior students, as well as bringing the integral team-based learning and anatomy classes online for our Year 1 and Year 2 medical students.

Our LKCMedicine researchers also swung into action, looking at the COVID-19 pandemic from the infectious disease angle, including how it damages various tissues and elicits an immune response. They have also reported on the virus’s impact on other underlying medical conditions and management of the infection in different clinical settings. Through their efforts, the researchers aim to discover ways to improve detection and treatment of the virus.

Some of our LKCMedicine faculty are directly involved with the national COVID-19 response through patient care, while others are contributing their insight and expertise to a variety of international bodies and organisations. Our faculty are also prominent in the national and international media, keeping the population well informed and reinforcing measures that enhance our safety.

I am also proud of the strength and resilience shown by the young doctors from our first three graduated cohorts from 2018 to 2020, who are now at the frontline of a health crisis unprecedented in modern history. Some of their inspiring experiences and their commitment are illustrated in this communiqué.

These various reports highlight the early contribution from LKCMedicine to the fight against COVID-19; we will update this review in the coming months, as our efforts are extended. In closing, I would like to take the opportunity to express my appreciation of the hard work and support put in by all during these uncertain times, as well as wishing everyone and their families the best of health.

Professor James Best
Dean and President’s Chair in Medicine
RESEARCH & COLLABORATION

Looking for answers to the COVID-19 question

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Our overall strategy has allowed us to mount a unified and concerted effort that converges on a multi-pronged defence against the threat posed by SARS-CoV-2, from the molecular level to public health engagement.

Professor Lim Kah Leong, Vice-Dean for Research

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We are living in unprecedented times. Never had the global economy and activities grinded to a halt like what we have experienced with the COVID-19 pandemic. It’s a health crisis of an epic scale that the world has not witnessed for a century. Faced with an entirely new threat that we know so little of, researchers are working round the clock to understand this pathogenic aggressor better. “Know thy enemy”, so that we can win the battle decisively.

Research has been a big part of the LKCMedicine vision since the beginning. We seek to redefine medicine and transform healthcare through discoveries that will impact patient care and improve the lives of people not just in Singapore, but across the world. Understanding the science of infectious diseases is one of our key research foci at LKCMedicine as we recognise that Singapore, being an international travel and trade hub, is particularly vulnerable to the threats posed by infectious diseases. COVID-19 has brought this into sharper focus, though it certainly will not be the last pandemic to hit us. With increasing open borders and urbanisation, the global ecological balance has become more and more fragmented, driving more cross-species transmissions as a result of our contact with totally new pathogens. There is thus an urgent need to put in place effective preventive and pre-emptive strategies to better protect Singapore and the rest of the world.

Our researchers in the Respiratory and Infectious Diseases domain are playing to their unique strengths in COVID-19 studies. Several have developed innovative approaches to study the virus, for example developing 3D human lung organoid cultures in the dish to understand viral entry. However, the SARS-CoV-2 virus causing COVID-19 affects not just the airway tracts but also other organ systems in our body, including the endocrine and vascular systems. Additionally, the psychosocial wellbeing of infected individuals and the community at large is also impacted significantly. Hence, a holistic approach is needed to combat this disease effectively. At LKCMedicine, we have adopted a “System Medicine” approach that promotes crosstalk and synergies between and among different research themes as well as across different disciplines. This includes a medical education arm that acts as a catalyst to transform education in the face of the pandemic. Our overall strategy has allowed us to mount a unified and concerted effort that converges on a multi-pronged defence against the threat posed by SARS-CoV-2, from the molecular level to public health engagement.

In the following pages, you will meet the School faculty who are working on the national COVID-19 response, many of whom are collaborating with their clinical partners at the National Centre for Infectious Diseases and Tan Tock Seng Hospital, as well as get a peek at the testing lab set up at the School’s Novena campus that will boost Singapore’s testing capacity. My research colleagues present their thoughts, takeaways and research outcomes of COVID-19 studies, as well as talk about next steps in finding out more about the virus so that we can take the fight to its doorstep.

The COVID-19 pandemic calls upon the best scientific minds everywhere not only to look into treatments that will lower mortality rates of those who are hospitalised but also embark on the quest for that holy grail – a vaccine. As we wrestle with an unprecedented public health crisis, I am pleased to note that our coronavirus research warriors are joining hands to slay the virus. It is by working collaboratively together, and not competitively apart, that we can collectively overcome this crisis.
Boosting the nation’s testing capacity

In early May, the Singapore government announced that the nation’s COVID-19 testing will be scaled up to reach a capacity of up to 40,000 tests daily. Easily accessible and widely used testing is a fundamental pillar of Singapore’s strategy to combat the SARS-CoV-2 virus. Prompt testing of suspected cases is especially key as the nation gradually lifts the restrictions implemented during its eight-week circuit breaker period.

“As a medical school, LKCMedicine does not just have a duty to contribute research that will improve patients’ lives and the world’s understanding of COVID-19 and the SARS-CoV-2 virus. The School also has a responsibility to support its healthcare partners in their immediate care of patients, especially in times of a pandemic,” said LKCMedicine Assistant Dean for Research Associate Professor Kevin Pethe, who oversees the running of the laboratory together with LKCMedicine Associate Professor of Human & Microbial Genetics Eric Yap.

To this end, the medical school transformed laboratory space in its Clinical Sciences Building into a dedicated and biosecure SARS-CoV-2 diagnostic laboratory. The design and fitting out of the laboratory were completed in record time, even as movement and labour were restricted.

The laboratory, which forms part of a nationwide network of COVID-19 laboratories, became operational in late June and will be able to progressively ramp-up throughput to perform up to 4,000 tests per day if required. It is staffed by dedicated personnel and a group of volunteers from the NTU community and supported by LKCMedicine facilities and operations staff who will help manage the needs of the laboratory.

While the laboratory will perform COVID-19 testing during the current crisis, A/Prof Pethe sees a future where the laboratory will evolve to trial innovations in testing technologies.

“In peacetime, this lab could be instrumental to enable scientists across the university to innovate in the area of rapid diagnostic for possible pandemic threats,” he said.
By mid-April 2020, the novel SARS-CoV-2 virus had raced around the world, infecting two million people according to official figures. Lockdowns and circuit breakers reduced movement, halted international travel and silenced cities and towns.

While the pandemic may have led to physical distancing, it united scientists around the world in an unprecedented way. Sharing data, rolling out worldwide clinical trials and assessing evidence never happened faster than it did now.

Working at the forefront, clinical faculty and population health researchers at LKCMedicine conduct studies to evaluate new treatments, assess the effectiveness of policies from personal protective equipment protocols to safe distancing. They contribute to international health guidelines and influence governments’ public health policies.

Coming together, they are leading the fight against COVID-19 in Singapore and beyond. These are the faculty members who are part of Singapore’s COVID-19 national response.
Studying SARS-CoV-2 using lung organoids

Sanjay H. Chotirmall, Assistant Professor and Provost’s Chair in Molecular Medicine

As the world searches for an effective vaccine and evidence-based treatment options to combat SARS-CoV-2, it is imperative to provide clinical guidelines that synthesise available evidence while investing resources to deepen our understanding of the molecular mechanisms which the virus relies upon to infect the human airway.

Along with colleagues from more than 40 countries, I sit on the steering committee of the American Thoracic Society-led international taskforce for Covid-19. We convened this taskforce of clinicians and researchers from academic centres at the frontline in the fight against Covid-19 to distill consensus suggestions for the most controversial topics in the clinical management of Covid-19 patients. As evidence accumulates, these guidelines have to be constantly reevaluated and updated to enable physicians to continue improving outcomes for patients and facilitate research by standardising care internationally.

In my own research at the Chotirmall lab at LKCMedicine we have established a “lung-in-a-dish” to advance the second imperative: to deepen our understanding of the mechanisms at play during Covid-19 infection. These lung organoids reproduce the structure and function found in the human upper and lower airways, the latter affected in severe Covid-19 disease. In collaboration with colleagues at Duke-NUS, the National Centre for Infectious Diseases and Tan Tock Seng Hospital, the Chotirmall lab is exposing these organoids to the SARS-CoV-2 virus to isolate key mechanisms and pathways induced by this infection. In addition to healthy lungs, the studies, which have been supported by a national NMRC Covid-19 Research Fund grant, have been extended to include organoids developed from patients with severe asthma and chronic obstructive pulmonary disease.

It is critical to understand why some patients progress to develop severe disease and succumb while others remain asymptomatic. The specific role host immunity plays in the cause, progression and consequences in Covid-19 remains uncertain and will be studied using the lung organoid model including with lung washings obtained from some of the most critically ill Covid-19 patients treated in Singapore. With knowledge gained from such work, clinicians may be better able to manage and even prevent severe Covid-19.

Employing a systematic, technologically advanced and robust scientific approach, the lung organoid model system offers an opportunity to better understand SARS-CoV-2 infection. The understanding gained from such work is essential for an effective long-term management strategy to combat the virus. As we start to stratify communities into varying risk profiles and sub-groups, the lung organoid models offer us an opportunity to apply precision medicine to Covid-19 management. Such calibrated knowledge informs both individual treatment strategies as well as preventative population health measures.
COVID-19 has seen remote consultations becoming the norm almost overnight. The simplicity of the term belies its complexity. Unpacking what ‘remote assessments’ mean, a range of questions begin to present: from the technicalities behind the choice of consultation medium, to adapting one’s line of inquiry to suit the context of the consultation, with interdependencies in between.

“COVID-19: a remote assessment of primary care” was published at these crossroads, put together after an extensive narrative review of the literature, various empirical studies, and data on COVID-19. The article, published in the *British Medical Journal* laid out evidence for conducting remote consultations, and presented guidelines and best practices for assessing patients for COVID-19. These are now being incorporated in the UK-based National Institute for Health and Care Excellence (NICE) rapid guideline on COVID-19 for managing suspected or confirmed adult pneumonia cases in the community.

Primary care settings and processes have different nuances depending on health system and geography, which would also affect the medium of assessment chosen, whether by telephone or by real-time video appointments. The authors presented their recommendations in chronological order of how a remote assessment would be conducted, informing clinicians what to do before they connected to the patient, establishing the connection, taking patient history and noting red flags for COVID-19 symptoms. Although consultations can be done by telephone in many cases, video provides additional visual cues and therapeutic presence, which the authors ultimately recommended as especially being more useful for sicklier patients with more difficult social and auditory circumstances.

It is notable that there are currently no validated tests for remote assessment of breathlessness, a key symptom for COVID-19 diagnosis. In the absence of direct research evidence on how to assess breathlessness over the phone, the authors sought expert opinion through a survey of 50 people, mostly doctors who conducted breathlessness assessments in their job. Interestingly, the respondents shared similar advice regarding the ability of patients to answer open-ended questions.

Teleconsultations will be here to stay. Convenience, flexibility, ease of access amongst others are benefits of proliferated technologies, from portable test kits to the iPhone. Without losing rigour, technologies that promote improved access can lead to greater adherence, and ultimately move the needle towards stronger outcomes. The world can now look expectantly towards further technological advancements of teleconsultations to aid in the assessment and diagnosis of COVID-19, and for other chronic health conditions as well.
Without true data on how a novel virus can be controlled, we have to rely on models. And the importance of robust modelling has never been more profound than during the COVID-19 pandemic, where it shaped the right policies around the world.

When the virus struck the Diamond Princess cruise ship in late January, the outbreak was still largely confined to Asia and our understanding of the virus’ transmission was in its infancy. Using the cruise ship outbreak, our models identified three key factors that increased the transmission rate: confined and prolonged contact, high mixing between persons on board and further compounded by crowding. The Diamond Princess’ population density was four times higher than that of Wuhan, the epicentre of the outbreak then. These insights highlighted that any venue with similar conditions could rapidly propagate an outbreak. Confined spaces with high population densities such as cruise ships and other settings such as dormitories and prisons should, therefore, have strict isolation and quarantine protocols in place as part of their pandemic preparedness.

Back on land, many countries adopted some form of lockdown or circuit breaker as the virus swept across the globe. Sweden, however, opted for mitigation. Even though its mitigation strategy was boosted by the closing of borders elsewhere around the world, initial results point away from mitigation as an effective solution. Europe is exiting lockdown, while Swedes continue to live in fear as the virus haunts their community. Most countries that entered lockdown early reduced the loss of life, and the initial socioeconomic costs seem to be outweighed by an earlier recovery.

We have yet to find the golden mean that will allow societies to control the virus alongside continued socioeconomic activity. Modelling is a tool that can help countries on optimising public health measures to effectively reduce the health and economic impact of the virus without necessitating nationwide lockdowns.
**Innovating diagnostics to make testing accessible in all settings**

**Eric Yap, Associate Professor of Human & Microbial Genetics, LKCMedicine**

Crucial to the containment and mitigation of any global disease outbreak is accurate, rapid and easy testing. The ongoing Covid-19 pandemic is no exception and governments around the world raced to set up large-scale testing programmes.

The current gold standard test for SARS-CoV-2 is reverse transcription polymerase chain reaction (rtPCR), a highly sensitive and specific diagnostic tool. However, rtPCR takes several hours and requires a molecular laboratory with trained personnel to perform the test. Without easy access to molecular laboratories, developing countries and remote areas, in particular, may not be able to execute an effective test-and-trace strategy to contain and mitigate the outbreak. The world, therefore, urgently needs rapid, simplified and cost-effective detection methods that can help fight the COVID-19 outbreak on all continents and in all settings.

Having previously developed a direct, rapid and extraction-free PCR (directPCR) detection protocol for DSO National Laboratories, my lab at LKCMedicine further developed and analytically validated this protocol for the SARS-CoV-2 virus. Using directPCR, we eliminate the need for nucleic aid purification. We can detect the virus at levels as low as six RNA copies in respiratory samples such as phlegm and nasal discharge using a one-step inhibitor-resistant assay. This one-step method eliminates the variability in sensitivity seen between rtPCR testing protocols.

To bring testing out of the lab to where it is needed in the community, we have validated the protocol on a commercially available and portable PCR thermocycler. In the lab, our approach cuts the test-to-results time to 36 minutes from 72 minutes. In addition, directPCR cuts the amount of reagents required in half compared with rtPCR methods. With reagents in short supply, this will help to maximise the use of existing resources.

This protocol executed using a relatively cheap 2kg PCR thermocycler could enable wider use of COVID-19 testing for diagnosis, screening and research in countries and regions where laboratory capabilities are limited.

Reference: Genes 2020, 11(6), 664; https://doi.org/10.3390/genes11060664

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**Impact of COVID-19 on blood vessels**

**Christine Cheung, Nanyang Assistant Professor and Provost’s Chair in Medicine**

Information is fast-evolving pertaining to the risk factors of COVID-19 severe outcomes. The general belief that an overreaction of immune system driving a ‘cytokine storm’, thus causing patients to deteriorate into organ failure, could just be the tip of the iceberg. Mounting evidence has now shown that blood vessel pathologies may contribute to blood clots, restriction of blood flow to tissues, and vessel leakiness which were reported in patients experiencing a downhill trajectory of COVID-19.

Specifically, the impact of COVID-19 on children, in its most primitive form without confounding age-related factors, is characterised by inflammation of the blood vessels. This resonates with why adults with preexisting conditions such as diabetes and hypertension, are most at risk of mortality due to compromised vascular health.

We are developing predictive biomarkers based on the analysis of blood-borne cells in patient samples. Vascular progenitors or cells in the blood show characteristic changes in their gene expressions and phenotypes in response to vascular injury. They are valuable markers of vascular dysfunction as seen in a variety of disorders including heart attack, stroke, atherosclerosis and coronary artery disease, etc.

We will extend this work to the study of COVID-19 patients and recovered individuals as a form of vascular phenotyping and potentially to facilitate prediction of adverse vascular outcomes. We hope that such cell-based biomarker strategy will provide a rationale for vascular-protective therapies such as the use of statins and anti-coagulants. Management of vascular outcomes will be particularly important for susceptible individuals with preexisting cardiovascular/ diabetic conditions where the stabilisation of vascular health is urgently needed during COVID-19 progression and post-recovery.
Diabetes and COVID-19

Yusuf Ali, Associate Professor of Metabolic Disease; Andrew Tan, Associate Professor of Metabolic Disorders; Wang Xiaomeng, Associate Professor of Molecular Medicine; Christine Wong, Nanyang Assistant Professor

Diabetes is an independent risk factor for COVID-19 severity and death, with yet unknown reasons. Our study focuses on the intersection of these diseases by asking why a diabetic response to SARS-CoV-2 can be so different from the response of a non-diabetic. Answers to which will allow doctors to manage severe COVID-19 patients better, thereby saving lives. We suspect that poor glucose control (i.e. diabetes) alters the ability of cells to respond productively and efficiently to the virus. An unproductive response by a diabetic host may cause more harm than good to various organs. Our approach is to treat different human cells in our laboratory with fragments of the SARS-CoV-2 virus and then subsequently measure the cellular response, function and survival under normal and diabetes-simulated conditions.

With different research groups forming a team, we can look at human neutrophils, macrophages, endothelial cells as well as endocrine cells, all of which are potential culprits for poor COVID-19 outcomes. We also plan to develop an animal model that mirrors both diabetes and COVID-19 well. This model will allow unfettered access to understand how COVID-19 adversely affects diabetics at the whole organism level. It will also allow an evaluation of drugs that improve COVID-19 outcome.

In addition, we are also concerned with possible changes in diabetic incidence, post COVID-19. Data from SARS (2003) suggest that coronaviruses may pre-dispose recovered patients to diabetes. This association needs to be studied in greater detail for COVID-19. Altogether, our aim is to produce data that will help guide management of diabetics during the COVID-19 pandemic as well as to help COVID-19 recoverees ward off diabetes.

Bernhard Boehm, Ong Tiong Tat Chair in Diabetes Research and LKCMedicine Professor of Metabolic Research

So far, available epidemiological data on COVID-19 does not support the hypothesis that diabetic patients are at increased risk than the general population for SARS-CoV-2. However, it seems clear that diabetes, particularly when not well controlled, exposes people with this pre-existing condition to more complications and increased mortality. The risk of death is the highest in insulin-deficient diabetic patients.

An important element in the disease process is the molecule that has the role of receptor for SARS-CoV-2, which has been identified in the Converting-Enzyme-2 (ACE2). Endocrine cells do express this molecule to a large extent. Therefore, the endocrine system – pancreas, thyroid, gonadal system – seems to be more severely affected during the acute phase of the infection (see "The ACE-2 in COVID-19: Foe or Friend?" published in Hormone and Metabolic Research). Hence, there is a scientific and clinical need to obtain more data on the presentation of the disease in diabetic subjects and to develop a long-term follow-up programme with them (see "Practical recommendations for the management of diabetes in patients with COVID-19" published in The Lancet Diabetes & Endocrinology).

We have initiated an international consortium following COVID-19 positive diabetic patients and for looking also at recent onset COVID-19 positive cases of diabetes (see "New-Onset Diabetes in COVID-19" published in The New England Journal of Medicine). In these very specific cases there might be a direct link of diabetes presentation and the damage of the pancreatic beta cells caused by the virus.

COVID-19 infection in patients with diabetes is associated with a greater increase in inflammatory and coagulation markers, compared with COVID-19 patients without diabetes. We are therefore also developing novel test systems to study these inflammatory processes in the context of chronic hyperglycaemia and virus infection.
As clinicians race to test antivirals that may be able to halt a COVID-19 infection, it is also paramount that we use this time to understand the molecular structures of the virus and its genes. Such data will inform longer-term solutions and optimise treatments and vaccines.

The main protease of the COVID-19-causing virus SARS-CoV-2 cleaves large viral polyproteins into smaller functional units, making it essential to the life cycle of the virus. This role at the heart of the virus replication cycle makes this protease an attractive target for the development of antiviral agents.

The protease becomes active when its two constituent molecules bind as a dimer in a heart-like shape. By investigating the atomic structure of the enzyme, my lab is searching for solutions to stop the protease from performing its function, thereby killing the virus. Such investigations will provide insights into both the shape and the interior structure of the protease.

These insights, in turn, guide our research to areas and parts of the enzyme that could potentially be inhibited by antiviral compounds.

By aiming for the heart of the viral machinery, we hope to stop an infection in its tracks.
COVID-19 as a catalyst for educational change

Jennifer Cleland, Vice-Dean for Education, Assistant Dean for Assessment, Professor of Medical Education Research and Director, Medical Education Research and Scholarship Unit

Among its many other impacts, COVID-19 has significantly disrupted workplace- and campus-based medical education. Around the world, medical students were – and in some countries, continue to be – withdrawn from bedside and campus teaching and redirected to online learning. These actions were necessary to avoid burdening staff and services, and for infection control purposes but they will likely have significant consequences both for individuals and healthcare systems. For example, will students have achieved the necessary competences if they have missed out on several months of experience, teaching and learning? Will systems suffer if cohorts of residents affected by COVID-19 take longer to achieve their competences and reach consultant status? Each educational decision taken during the COVID-19 pandemic will have short- and longer-term implications at a systems, group and individual level [1].

Yet there are potential gains for medical education amongst the frantic activity that has been associated with keeping the [educational] show on the road. COVID-19 has forced medical schools and postgraduate training programmes to set aside many of their existing beliefs and assumptions about education. There has been increasing awareness that medical education and training are not just about delivering a curriculum or receiving knowledge [2]. (Indeed, this is an impossibility given the rapid expansion of clinical knowledge [3]). There has been more explicit consideration of medical education as a process of supporting those setting out on their career to manage the process of developing the professional identity of a doctor [4], and the skills- and mind-set to be resilient, life-long learners.

Several papers and commentaries in high-impact journals have made a plea to colleagues to record and evaluate the educational innovations implemented in response to COVID-19 [5]. There are many articles in the literature already describing the impact of COVID-19 on medical and education, what I call “how we did ....” papers. Indeed, we published one such paper on LKCMedicine admission processes [6]. However, while interesting, such papers only hint at possible direction of travel for change. Educational change must be informed by research that does not simply describe, but explains, models, and predicts, and deepens our understanding of medical education, both during the pandemic and thereafter [7]. To ensure COVID-19 is a positive driver for change requires “developing our understanding of COVID-19 and resulting education responses in a way which both helps us understand what is happening and produces transferable knowledge” [8]. This means drawing on robust methodologies and theoretical frameworks. As an example of the latter, we [8] proposed that a sociomaterial framework, one which specifically assumes that all things are what they are in relation to other things, and the human and non-human are equal in terms of agency, would be appropriate. This emerged from our observations that using Zoom and Whatsapp to deliver teaching offered affordances, opening up new channels of communication and permitting new kinds of interactions, but at the same time, it changed some aspects of the encounter. For example, students were more likely to pose questions via the chat functionality than verbally. This suggests that the technology was shaping what teachers and students did, mediating patterns of teaching and learning. We will now use this and other theories to unveil and understand the implications of a shift to online learning during COVID-19.

In conclusion, if robustly researched, COVID-19 may be the catalyst which focuses medical education and educational research on what is truly essential and helps us question long standing assumptions about medical education and training.
On the national infectious diseases team

Yeo Tsin Wen
Associate Professor

LKCMedicine Associate Professor of Infectious Disease Yeo Tsin Wen is also a visiting consultant at the National Centre for Infectious Diseases and has been on the frontline caring for Covid-19 patients.

He has been involved in several clinical studies focusing on Covid-19, including the national cohort study PROTECT, on which he is a co-investigator.

He also contributed to two clinical trials investigating possible treatments for Covid-19. He worked on the industry-sponsored study evaluating the impact of remdesivir, an antiviral originally developed to fight Ebola. He is also involved in the recruitment of patients for the US National Institutes of Health-funded adaptive Covid-19 treatment trial that is being conducted in 60 institutions worldwide. This study design allows investigators to stop the use of treatments found to be ineffective and add possible new drugs to be evaluated.

Angela Chow
Associate Professor

Associate Professor Angela Chow holds a joint appointment as Associate Professor at LKCMedicine and as Head and Senior Consultant at the Department of Clinical Epidemiology at Tan Tock Seng Hospital. A/Prof Chow is also the Clinical Director of the Office of Clinical Epidemiology, Analytics, & Knowledge at the hospital.

A/Prof Chow is actively involved with the epidemiological surveillance, prevention and control of healthcare-associated infections as well as emerging infectious diseases including SARS and currently COVID-19. She has led research investigating the effectiveness of personal protective equipment for healthcare professionals, healthcare worker surveillance and within hospital contact-tracing systems.

In this, A/Prof Chow draws on her extensive experience gained at the national level at the Ministry of Health in developing Singapore’s communicable disease surveillance systems and strategies, influenza pandemic preparedness plans, health services development programmes and non-communicable disease interventions.
As Director of Research, he coordinates Singapore's research into COVID-19 and leads a national cohort study, called PROTECT, in close collaboration with infectious diseases doctors from across Singapore’s public hospitals.

The PROTECT study collects clinical samples from COVID-19 patients, which enable several scientific institutions in Singapore to study the biology of the SARS-CoV-2 virus, as well as answer questions about genomics, immunology, host susceptibility and antibody response.

The PROTECT group also collaborates with radiologists, intensive care specialists and obstetricians at several national hospitals. Working closely with Singapore’s Ministry of Health, A/Prof Lye also helps to ensure that outbreak research is rapid and responsive to the needs of the nation, and encourages collaborative and non-duplicative research among partners.

In response to the coronavirus outbreak, the national COVID-19 Research Workgroup, set up in January 2020, commissioned several seroepidemiological studies to determine what proportion of the population has been infected with the SARS-CoV-2 virus.

A/Prof Ng leads one of the studies examining seroprevalence and risk factors among close contacts of COVID-19 patients. This seroepidemiological study and risk factor determination by questionnaire will complete contacting 7,897 household, work and social contacts by end June. Preliminary analysis suggests an estimated 23 per cent of COVID-19 cases among household close contacts were asymptomatic. As repeated swab tests were not performed among asymptomatic subjects, the study is not able to estimate the proportion of pre-symptomatic subjects.

Additionally, A/Prof Ng has been involved in work on SARS-CoV-2 polymerase chain reaction (PCR) testing of returning travellers from Wuhan early in the pandemic, predictors of COVID-19 for prioritised testing as well as environmental studies examining patterns of surface and air SARS-CoV-2 contamination.
Dr Barnaby Young
PhD Candidate

Dr Barnaby Young is a PhD candidate at LKCMedicine who concurrently works as a consultant with the Department of Infectious Diseases at Singapore’s Tan Tock Seng Hospital and the National Centre for Infectious Diseases (NCID). He is also the head of NCID’s Research Clinic.

Since the outset of the pandemic, Dr Young has been involved in Singapore’s efforts to better understand the clinical implications of COVID-19 infection, acting as clinical lead for the national PROTECT cohort study. As part of the PROTECT study, Dr Young leads work that focuses on the immune response to SARS-CoV-2. In this work, he collaborates with scientists from Duke-NUS Medical School and A*STAR’s Singapore Immunology Network with the hope of developing better diagnostics, treatments and vaccines.

Among Dr Young’s publications are a case series of the first 18 patients with COVID-19 in Singapore, an investigation of nonsteroidal anti-inflammatory drugs on COVID-19 as well as a study of the host’s antibody targets on the SARS-CoV-2 virus.

Dr Chia Po Ying
PhD Student

Dr Chia Po Ying is a PhD student at LKCMedicine who concurrently works as a consultant with the Department of Infectious Diseases at Singapore’s Tan Tock Seng Hospital and the National Centre for Infectious Diseases.

In addition to being co-investigator of the national PROTECT cohort study, Dr Chia has been studying the patterns of environmental contamination of SARS-CoV-2 in hospital isolation rooms. This involves collecting samples from surfaces, personal belongings and healthcare workers’ personal protective equipment to understand how readily the virus contaminates the immediate surroundings of a patient infected with the virus. She was also involved in the first study that linked transmission between clusters via serology.

Dr Chia has published several studies on COVID-19, including a study of SARS-CoV-2 contamination from a symptomatic patient and detection of air and surface contamination by SARS-CoV-2.
The morale of the team is very important, especially when working under the pressure of a global pandemic that is affecting public healthcare. The staff must be confident that PPE won’t run out when used as directed, and that instructions must be timely, clear and actionable.

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Associate Professor Tham Kum Ying, Assistant Dean for Year 5, Emergency Physician, Tan Tock Seng Hospital"
LKMedicine may be a young medical school with only three graduated cohorts, but its young doctors are already contributing to the frontline fight against a global pandemic that has seen the infected numbers across the world pass the 10 million mark. While the numbers in Singapore may be low in comparison, the healthcare line must remain vigilant against this “crisis of a generation”. These young doctors have shown resilience and determination in this national mission. They share their thoughts and takeaways here.

**Dr Claudia Tong (Class of 2018)**

“As doctors, it is our calling to be at the forefront during disease outbreaks.”

**Dr Huang Baoxian (Class of 2018)**

“I feel honoured to be taking care of our migrant workers during COVID-19. It opened my eyes to their stories and resilience to leave their hometowns to come to Singapore to make a living for themselves and their family.”

**Dr Leon Tan (Class of 2018)**

“Working pre and during COVID-19 meant we had to adapt to different workflows, that cover non COVID-19 and COVID-19 wards.”

**Dr Aishwarya Narayanan (Class of 2018)**

“I feel it has definitely prepared us better to attend to any future pandemics.”

**Dr Lee Cheok Hon (Class of 2019)**

“There are a few precious gems who would go the extra mile in appreciating our efforts in working on the frontlines to look after their children, and senior colleagues showing true leadership, working to minimise their juniors’ exposure to virus-positive patients and boosting team morale.”

**Dr Ong Kim Yao (Class of 2020)**

“There is a sense of fear, but also privilege. We study hard to graduate and serve. What better time is there to serve than during a pandemic?”
The COVID-19 pandemic has greatly impacted the way we teach and learn at LKCMedicine but fortunately, our innovative and high-tech curriculum allowed us to adapt quickly to the COVID-19 crisis. The Years 1 and 2 students were able to transit to home-based learning seamlessly, while retaining our unique pedagogical approach with Team-Based Learning. For the safety and wellbeing of our students, and in order not to further stress the healthcare environment, clinical postings were cancelled or postponed; instead, teaching was delivered via a combination of online learning and simulation. As a result, our final-year students were able to begin their PGY1 without any delays, well-prepared for future challenges. Through this period of uncertainty, I’m pleased to see the commitment and support of our educators, clinical partners; the dedication and efficiency of our staff, and also our students, who have shown exceptional resilience, patience and professionalism.

Professor Pang Weng Sun,
Vice-Dean for Clinical Affairs, LKCMedicine
Preparing to join the workforce in a COVID-19 world

The Class of 2020 was just a week into their Student Assistantship Programme (SAP), when the Singapore government suspended all clinical postings due to the COVID-19 outbreak.

However, thanks to LKCMedicine’s state-of-the-art learning spaces, the students were still able to learn what it is like being in a clinical setting during their nine weeks of SAP. For instance, LKCMedicine Assistant Dean of Year 5 Associate Professor Tham Kum Ying came up with the idea of ‘SimRound’.

During ‘SimRound’, students were able to experience the work of a junior doctor by attending a simulated ward round. Working in pairs, the students clerked one of five ‘patients’, taking their history and finding out why the patient was ‘admitted’. A consultant later conducted a teaching ward round the patient’s bedside with the students, where they presented their diagnosis.

“SimRound is something that we have already done in a much simpler version in the early school years. So, to ramp it up and add on the rest of the features and complexity that are appropriate for a Year 5 teaching event didn’t take a long time,” said A/Prof Tham.

Besides the faculty, the LKCMedicine alumni also chipped in to help their juniors. Together, they drafted clinical scenarios for ‘SimConsult’, a simulated clinic session where a Year 5 student on his/her SAP conducts a consultation with a ‘patient’.

During the session, a family physician observed the consultation through Zoom, a cloud video-conferencing platform. When the consultation is completed, the family physician gave feedback to the student on the consultation and discussed the management of the patient.

Upon completion of the feedback, the family physician exited the video conference and the ‘patient’ later gave feedback to the student, who then completed a Clinical Case Record for the patient including reflection/learning points.

The alumni worked on some family medicine clinical scenarios for SimConsult. LKCMedicine Alumni Association President Dr Leon Tan said the scenarios allowed students to revise their content knowledge.

“With simulated patients, this was useful in giving them the confidence to approach patients in the real-world setting. Of course, nothing beats the experience of being in the real clinical world and learning on the ground. However, in view of the COVID-19 situation, having the simulation sessions was a good interim alternative,” said Dr Tan.
From the start of May to mid-June, LKCMedicine Year 4 students resumed clinical postings.

The medical students were posted to different healthcare institutions such as the School’s partner teaching hospital, Tan Tock Seng Hospital, Sengkang General Hospital, KK Women’s and Children’s Hospital and across polyclinics clusters.

The duration of each clinical posting depends on the speciality that they were attached to. For example, rehabilitation medicine posting lasted for a week.

Nonetheless, A/Prof Wong noted that clinical postings play an important role in medical education. “Subsequently, following the Ministry of Health’s guidelines for the safe resumption of clinical postings, our Year 4 students were excited to be back in the clinical environment. They had to adapt to a new teaching environment with restrictions in place to ensure their safety and that of their patients.” said A/Prof Wong.

The School also had to ensure that all students are competent in the practical aspects of infection control and use of Personal Protective Equipment (PPE) before they can resume clinical training.

To ensure that students continue to receive quality medical education, the School pulled out all the stops to conduct online learning. For example, those who were scheduled to be on the Obstetrics & Gynaecology posting attended tutorials virtually with their tutors. Other clinicians leveraged technology by recording hospital-based events, such as a caesarean section delivery, and using real-time footage to provide a virtual operating theatre teaching session, taking students through the events as they happen.

To prepare students safely for the resumption of clinical postings, the School provided PPE refresher training, which is in line with the Ministry of Health’s requirements. This ensured that students are reassessed in their proficiency in infection control and use of PPE.

Students were also given an information package which contained important information that they needed to note prior to resuming their clinical postings.

Due to the COVID-19 outbreak, they were restricted to entering high-risk areas such as COVID-19 designated wards and intensive care units (ICUs) during their clinical postings. They were also required to declare their temperature twice daily (including weekends) on the School and institution portals.

On the other hand, LKCMedicine Assistant Dean of Year 3 Koh Nien Yue said the Year 3 students have not returned to their clinical postings since 7 February. They will return to clinical postings as Year 4 students on 3 August, she added.

Nonetheless, the Year 3 and 4 students attended Direct Observation of Procedural Skills (DOPS) in the Practical Skills Lab. Held before the Circuit Breaker period, the DOPS is to make up for the work-based formative assessments that tests students on their practical skills such as drawing blood and performing an electrocardiogram.

A/Prof Koh said, “With the current DORSCON Orange alert, students cannot be assessed with DOPS in the usual way. Hence, the School has arranged for practical skills sessions to be conducted on campus to facilitate the learning and assessment of practical/procedural skills through the use of task trainers and assessment by clinical practitioners.”
LKCMedicine could swiftly adapt to the restrictions of the COVID-19 pandemic and carried out its education mission smoothly due to its technology-enabled curriculum. Since February, many of LKCMedicine’s lessons moved online as class sizes could only be up to 50 students.

Fortunately, due to the School’s extensive use of technology, students in Years 1 and 2 hardly noticed any change in their learning. They were already preparing for their classroom-based learning using their iPads, with all their learning materials and resources at their fingertips.

Students depend on their iPads during lessons, completing tasks and posting questions on a dedicated Team-Based Learning (TBL) platform. Adjusting to the pandemic, the Year 1 and 2 students attended TBL sessions online through video-conferencing platform Zoom, a form of TBL the School refers to as e-TBL.

Far from being alone during these sessions, the team-based format of LKCMedicine’s innovative pedagogy ensured students were able to learn in teams, in the comfort of their homes.

Although the switch to online learning was smooth, LKCMedicine Lead for Education Engagement Emmanuel Tan had to tweak his facilitating style. A TBL session involves the teamwork of facilitators such as Mr Tan, the content experts, Digital Learning and the Curriculum teams. As a team, they fine-tuned the lesson as it unfolds to meet the students’ learning needs.

Working remotely, Mr Tan and the content experts had to converse either over the phone or via WhatsApp group chat on how to take the TBL session further. He was also in close contact with the student representatives about how the session was going and listened to students’ immediate feedback as well as suggestions.

LKCMedicine’s Digital Learning department also played a pivotal role in ensuring that the e-TBL sessions ran smoothly. As part of the School’s business continuity planning, the Digital Learning department conducts routine tests of its systems. About a year ago, this involved holding a TBL lesson fully online.

The department’s Senior Assistant Director of Content & Instructional Design Ng Aik Song said the team went through a few iterations of e-TBL and extensively tested the integration of video conferencing software into the Learning Activity Management Sequences, an online resource portal.

“The e-TBL workflow was still fresh in our mind. Thus, when the call came (in February), we did several dry runs internally. Some of those involved the facilitator’s team. There were several challenges encountered, but we managed to overcome them and were ready just in time,” said Mr Ng.

For LKCMedicine Year 4 students who were scheduled to be on the Obstetrics & Gynaecology posting, the School similarly leveraged its digitally enabled infrastructure to enable the students to master their learning outcomes. Lessons on topics such as ‘Miscarriage’ and ‘Bleeding in Early Pregnancy’ shifted online.

Other clinicians leveraged technology by recording hospital-based events, such as a caesarean section delivery (with the consent of those filmed), and using the real-time footage to provide a virtual operating theatre teaching session, talking students through the events as they unfold.

Assistant Dean of Year 4 Associate Professor Wong Teck Yee said they were able to facilitate lessons through such asynchronous teaching. However, he pointed out that tutors who are usually in hospitals may encounter different hiccups during online lessons, such as issues with internet connectivity.

“Nonetheless, I am quite happy that our students and tutors have been responding to the changes quite well,” said A/Prof Wong.

At the same time, LKCMedicine Head of Anatomy Assistant Professor Sreenivasulu Reddy Mogali shared that anatomy lessons such as topics on the endocrine and renal anatomy were conducted on Zoom. During the e-TBL sessions, students asked questions through the chatroom or the platform.

“It was a different experience for us and a smart idea to leverage technology. Afterall, LKCMedicine’s curriculum is already technology-enhanced and we already have teaching materials online,” said Asst Prof Reddy.
To the community, with love
When COVID-19 started to spread rapidly around the globe back in February 2020, a problem ensued: the lack of face masks. A group of seven friends had been thinking about how they could help address the shortage of face masks.

Among them is LKCMedicine Year 3 student Gabriel Tan. “The understanding then, and now, was that the coronavirus spreads through droplets. As medical students, we can’t just be bystanders. We were extremely worried about community transmission of COVID-19,” said Gabriel.

Gabriel and his friends made up a team from LKCMedicine, NTU School of Biological Sciences, Imperial College London, and the National University of Singapore (NUS). They put their heads together to find innovative ways to contribute to the global need for durable, reusable face masks during the COVID-19 outbreak. One of the resulting projects led them to team up with Singapore’s Masks Sewn with Love, a national community project that aims to distribute 50,000 masks sewn by volunteers to vulnerable groups in the community and people working at the frontline.

“We wanted to work together with the existing and local movements. Given their experience in sewing masks for their own distribution, it would allow us to distribute the masks with sufficient time to meet the easing of [Singapore’s] circuit-breaker measures,” said Gabriel.

To date, the group of friends along with the volunteers from Masks Sewn with Love had sewn close to 1,000 face masks. These were handed out to seniors at the Lions Befrienders Senior Activity Centre and Dover Park Hospice, as well as NTU’s Rotaract Club to distribute to cleaning staff and bus drivers working at the university.

Looking back at their labour of love, Gabriel said, “I am happy that the efforts of our team can bless others in need.”