DECEMBER 2021

VICTORIAN FACES OF THE FELLOWSHIP

AIMS NSM 2021 REVIEW

STUDENT PROJECTS

A DAY IN THE LIFE OF A RESEARCH SCIENTIST

BENCHPRESS

The official newsletter of The Australian Institute of Medical Scientists (Victoria Branch)

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Got News to Share?

We would be delighted to share the good things you are doing in the scientific world.

Contact us at secretary.aims.vic@gmail.com or via Facebook (@AIMSVictorianBranch) to let us know.

The submission deadline for next issue of Benchpress is the 31st March 2022.

A Note From the Chair

This year I have so much to be thankful for despite Victoria being the most lockdown state in the world. Being able to continue working in person has made the whole experience less lonely.

I want to express my appreciation to all the frontline health workers and all medical scientific staff who have sacrificed so much in the fight against COVID-19. Please take care and stay safe in these uncertain times.

I'm thankful for the awesome team of highly motivated Victorian branch committee members Patricia, Joe, Claire, Niki, Gurbaksh, John, Yuh-Ping, Clair and Jessica. We have started planning for next year's meetings so watch this space for upcoming events in 2022 - hopefully some will be in person.

I would also like to acknowledge AIMS national for the opportunity to host the virtual National Scientific Meeting 2021. It was a massive undertaking for AIMS Victorian branch and we delivered a highly successful meeting with over 100 speakers and more than 400 registrations.

A special shout out to the scientific committee members Denise Jackson, Kerryn Jones, Alex Laslowski, Huong Pham, Kerry Jones, Steven Schischka, Genia Burchall, Donna Rudd, Kevin Jessen and Mark Hardy for their contributions to putting together the fantastic program.

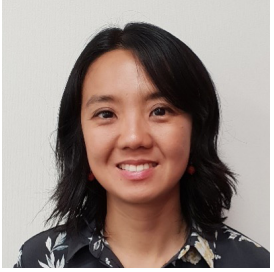
Congratulations to our 2021 Fellow recipients Hazel Chambers and Rohit Chadha – it is no easy feat so well done both!

Congratulations to Steven Schischka for being awarded the 2021 George Swanson Christie Memorial Award.

It's finally that time of year. Wishing everyone a merry Christmas and a Happy New Year.

Tina Pham
Chair
AIMS VIC Branch

Introducing your New Committee member & Student Representatives



Yuh-Ping Chong

Yuh-Ping Chong completed her undergraduate and PhD in Biochemistry and Molecular Biology at the University of Melbourne. She undertook postdoctoral research projects in Australia and Scotland, UK, where she specialised in protein kinases involved in oncogenic signal transduction pathways. A few years later, Yuh-Ping had the opportunity to work in the biochemistry diagnostic laboratories (Melbourne Pathology, Collingwood and Dorevitch Pathology, Heidelberg). The industry experience broadened her interest and knowledge in clinical biochemistry. She obtained her Membership qualification by examination (MAACB) from the Australasian Association for Clinical Biochemistry and Laboratory Medicine. Apart from serving as the Victoria branch AIMS committee, Yuh-Ping is also the Newsletter and Web Editor of AACB Victoria.

Yuh-Ping is currently employed as a Lecturer within the Discipline of Laboratory Medicine in the School of Health and Biomedical Sciences, RMIT University (Bundoora campus). She enjoys teaching clinical biochemistry to the Laboratory Medicine students. She hopes to provide education support and other professional development opportunities to the AIMS medical scientists, technicians and students.

She is delightful to be part of the team and look forward to contributing her expertise where she can – thank you AIMS for this wonderful opportunity!

Jessica Guglielmino

My name is Jessica, and I am currently in my final year of studies in a Masters in Laboratory Medicine at RMIT University with majors in Transfusion/Transplantation Science and Haematology. I have loved every minute of my studies thus far and the prospects of a future in medical science excite me beyond words; I absolutely can't wait to graduate and continue learning from professionals in the field of blood banking and haematology.

I'm very excited to be part of Victorian Branch of AIMS as a student representative. Being in my final year of studies I'll only have one year with the committee, but I'm completely dedicated to making my time here as impactful as possible. I'm looking forward to learning about the formalities of how a committee operates, as well as challenging myself to exist outside my comfort zone, engaging in discussion and taking on new responsibilities.

Beyond the university studies and the committee, I'm an adventurous character! Hiking with my golden retriever gives me a much-needed break when I'm feeling overworked and stressed. I also enjoy reading and keeping up to date on news and current events.

Clair Paul

My name is Clair, and I'm currently finishing my second year of a Bachelor of Biomedical Science (Laboratory Medicine) at RMIT University.

Prior to Laboratory Medicine, I've studied a Bachelor of Health Science, a Diploma of Biomedicine, and have worked in marketing, travel, & industry associations. As I look ahead to starting third year in 2022, I'm focused on Anatomical Pathology as my area of interest.

I'm delighted to be a Student Representative of the Victorian Branch of AIMS. We have a vibrant and active industry here in Victoria, I look forward to contributing to promote and advance the profession alongside my fellow future Medical Scientists.

Outside of my studies (and pre-pandemic), you'll find me camping, failing terribly at skiing, or just somewhere in the mountains. I'm an avid baker of gluten-free goodies, a fan of jigsaw puzzles, and I'm currently re-learning to play the piano.

Australian Institute of
Medical and Clinical Scientists
National Scientific
Meeting 2021

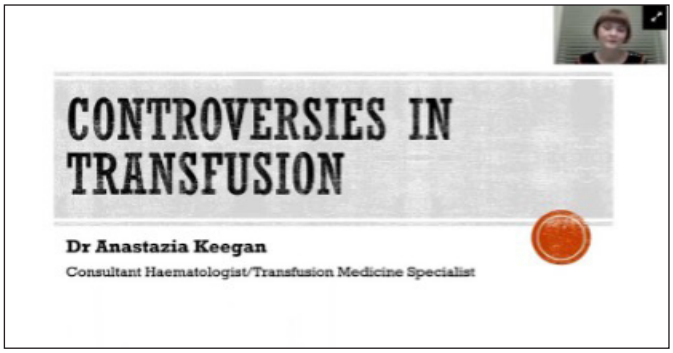
2021
RE-VISION
FOR THE FUTURE
30 AUG – 1 SEPT

AIMS National Scientific Meeting 2021 – A Student's Perspective

By Jessica Guglielmino, Student, Master of Laboratory Medicine RMIT University

The AIMS National Scientific Meeting was run over three consecutive days from the 31st August to the 1st September. Being my first NSM, I was somewhat disappointed about the event being moved to online due to COVID-19 restrictions. I had been excited to attend the NSM in person to meet new people, network with professionals in the field, browse posters and interact with like-minded people with similar interests. However, the AIMS OnAir Virtual Event Platform proved to meet all my expectations and more. I found I was able to not only watch all of the presentations that interested me, but I was also able keep up with my mountain of uni work in between speakers; it was the perfect way to spend the mid-semester break.

During the NSM, I 'attended' all three days and watched several presentations from the haematology, transfusion, quality and case study blocks. Given I was and still am a student, I was excited about the line-up of topics but was also expecting to be completely out of my depth with the level of assumed knowledge required to comprehend the presentations. I was, however, pleasantly surprised when I found myself not only being able to understand the information being presented, but also able to follow along and learn as new concepts were introduced. This really is an omen to RMIT's Laboratory Medicine course at preparing students for careers as medical scientists. It was great that I was able to apply concepts taught in class to real world problems and scenarios, as well as develop and broaden my understandings of these topics.



Personally, one of my favourite talks from the NSM was "Controversies in Transfusion" presented by Dr Anastazia Keegan from Red Cross Lifeblood. In recent decades, transfusion scientists have observed an exponential increase in the number red cell antigens discovered as well as growing demand for antigen negative units. With this, Dr. Keegan probed the question "is it time to change, or reconsider, how we provide antigen matched blood products?". In fact, the major controversy of her presentation centred around this idea of moving, or at least consider moving, towards antigen matched red cells at a genomic level. Over the last couple of semesters at RMIT, I have taken a particular interest to concepts in genotyping red blood cell, platelet, and neutrophil antigens. To see this being discussed at such a large forum like the NSM was exciting to say the least. The prospect of being able to witness a paradigm shift in the landscape of transfusion medicine during my lifetime is particularly exciting.

The entire NSM experience was incredibly rewarding and is something I would highly recommend for students at any level to do. The AIMS community felt very welcoming; questions were asked, discussions were had and overall it was clear that this is an environment that fostered continued learning and growth.

Australian Institute of Medical and Clinical Scientists

National Scientific Meeting 2021

2021 RE-VISION FOR THE FUTURE

30 AUG – 1 SEPT

AIMS National Scientific Meeting 2021 – A Speaker's Perspective

By Shivali Savita Chinni, Student, RMIT University (Bundoora)

My name is Shivali Savita Chinni, and I embarked on my journey in Laboratory Medicine in 2019 at RMIT University (Bundoora). I have always had a passion for cancer research since young and I was ecstatic to embark on a research component in my master's degree. I decided to conduct a systematic review on how insulin dysregulation affects breast cancer in patients. Since it was my first time conducting a systematic review, it was a tough but rewarding experience. With the firm belief that my review topic was niche and had never been explored before, I thought it would be an interesting paper to submit to present at the AIMS National Scientific Meeting (NSM).

I was delighted and honoured when I was invited to present my systematic review at the NSM. It was not only my first time presenting at the AIMS NSM but also my first ever presentation at a conference conducted by an esteemed organisation such as AIMS. I found the whole journey of presenting at a renowned conference both exhilarating and nerve-wrecking. Moreover, using a virtual platform to present was easier compared to a live audience, because the presentation was pre-recorded I could make sure I delivered the best version of my presentation. The platform used by AIMS was user-friendly and intuitive. Though it was easier and less nerve-wrecking to present virtually, I do wish I got to present in a live audience because I personally think it would have been a more invigorating experience. Moreover, there would have been a higher chance of audience engagement which could have provided different insights on my work. When I was approached to write a piece for the BenchPress newsletter after having received Best Oral Presentation Award at the NSM 2021 award, I was honoured and humbled to be able to share what I have been working on with other highly-trained and qualified experts in the field.

Breast cancer (BC) is one of the most prevalent diseases in women. Fortunately, its early diagnosis has proven to lead to good prognosis and high survival rates.

Like in any other cancer, the tumour microenvironment (TME) in breast cancer plays a pivotal role in its progression. One big risk factor of breast cancer is obesity which causes insulin dysregulation in the patient, which is one of the major hormones dysregulated in the tumour microenvironment and cells. Overexpressed hormones can interact with the breast cancer cells, activate downstream signalling and cause tumour cell proliferation, survival, invasion, and metastases as seen in Figure 1. Therefore, my systematic review focused on investigating the link between insulin growth factor-1 receptor (IGF-1R) and breast cancer via immunohistochemistry (IHC). I chose IGF-1R marker as a marker of interest as it has been

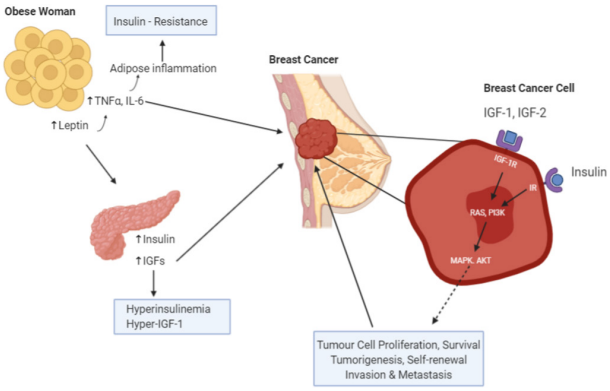


Figure 1: Dysregulation of insulin in BC

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optimised and validated across many studies compared to other insulin receptors. Moreover, I used IHC to quantify IGF-1R as it shows spatial resolution of protein expression and if the marker is validated to assess breast cancer progression in the future it could be easily added to the BC IHC panel.

I hypothesised that IGF-1R marker would be overexpressed in BC which would, in turn, correlate with poor BC prognosis. I conducted my systematic review using the established PRISMA flowchart on databases such as ProQuest & PubMed. It yielded 13 appropriate articles of which 7 were used for meta-analysis. Meta-analysis was conducted on the overall survival (OS) and disease-free survival (DFS) of BC patients in relation to IGF-1R marker. After data extraction, it was observed that the patient cohort primarily consisted of Caucasian women and had invasive breast carcinoma. Moreover, it was also observed that overexpression of IGF-1R was seen in invasive BC and hormone-receptor positive (estrogen & progesterone positive BC tumours) compared to triple-negative or HER2 positive BC. This could be explained by hormone receptors regulating IGF-1 signalling and when they are dysregulated, IGF-1 signalling/expression is dysregulated as well and vice versa. Additionally, IGF-1R overexpression was also seen in drug-resistant BC which could be due to the BC using IGF-1R as an alternative cell-signalling pathway to proliferate.

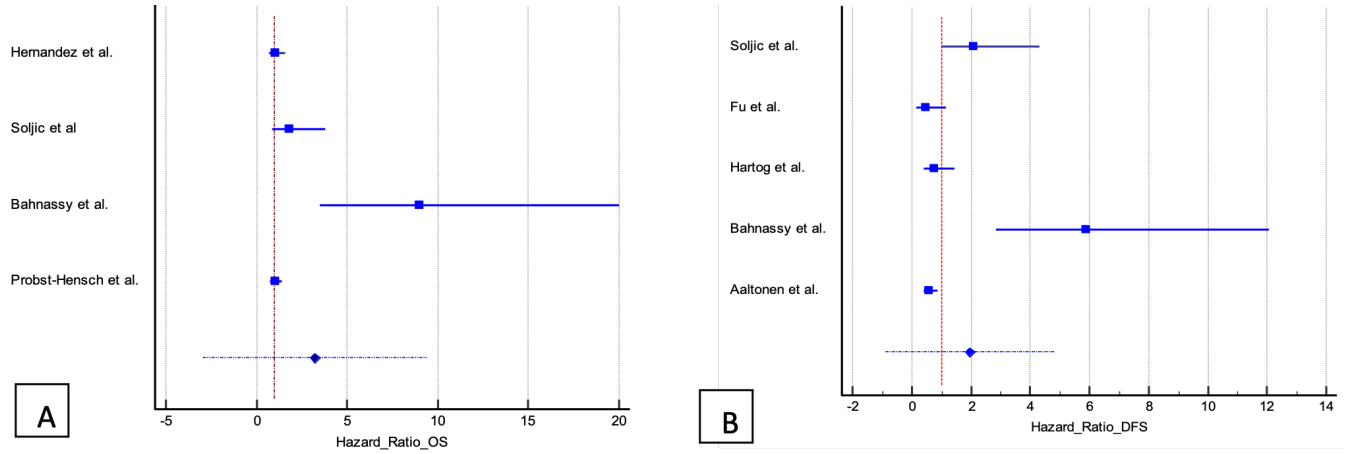

Figure 2: Meta analysis of the hazard ratios (HR) of OS and DFS in relation to IGF-1R and BC were conducted via forest plots. A) Forest plot of OS and B) Forest plot of DFS

Meta-analysis of OS & DFS revealed no statistically significant correlation between IGF-1R expression and BC (as seen in Figure 2). However, there were a few studies with HR that does not favour OS & DFS with increased IGF-1R expression. As such, further studies need to be conducted to establish a clear relationship between the two.

There were a few limitations to this review, as the patient cohort was primarily caucasian, the findings are not representative of the whole BC patient cohort as obesity is heavily dependent on genetics and the IHC quantification methods used in each study were not standardised. Thus, future studies with a diverse patient cohort and standardised IHC quantification methods should be done to further establish a strong relationship between insulin dysregulation & BC.

AACB 58th Annual Scientific Conference – review

By Yuh-Ping Chong

The AACB 58th Annual Scientific Conference (virtual) was successfully held on 28 – 30th September. Following the conference, AACB Victoria invited local members to present their posters at the branch meeting on Tuesday 26th October. The presenters comprised scientists, registrars and chemical pathologists across several laboratories (see the list of presenters below).

A total of eleven intellectually stimulating poster presentations were presented. We discovered new insights into areas such as pre-analytical errors, reference interval verification through data mining, intriguing case studies and method evaluation. A presenter from Melbourne Pathology described a newly developed algorithm to capture false hypernatremia results. It was concluded that an abnormally high sodium result with a difference of > 4 mmol/L between serum and EDTA samples is likely due to evaporation rather than reflecting true hypernatremia. Iohexol is

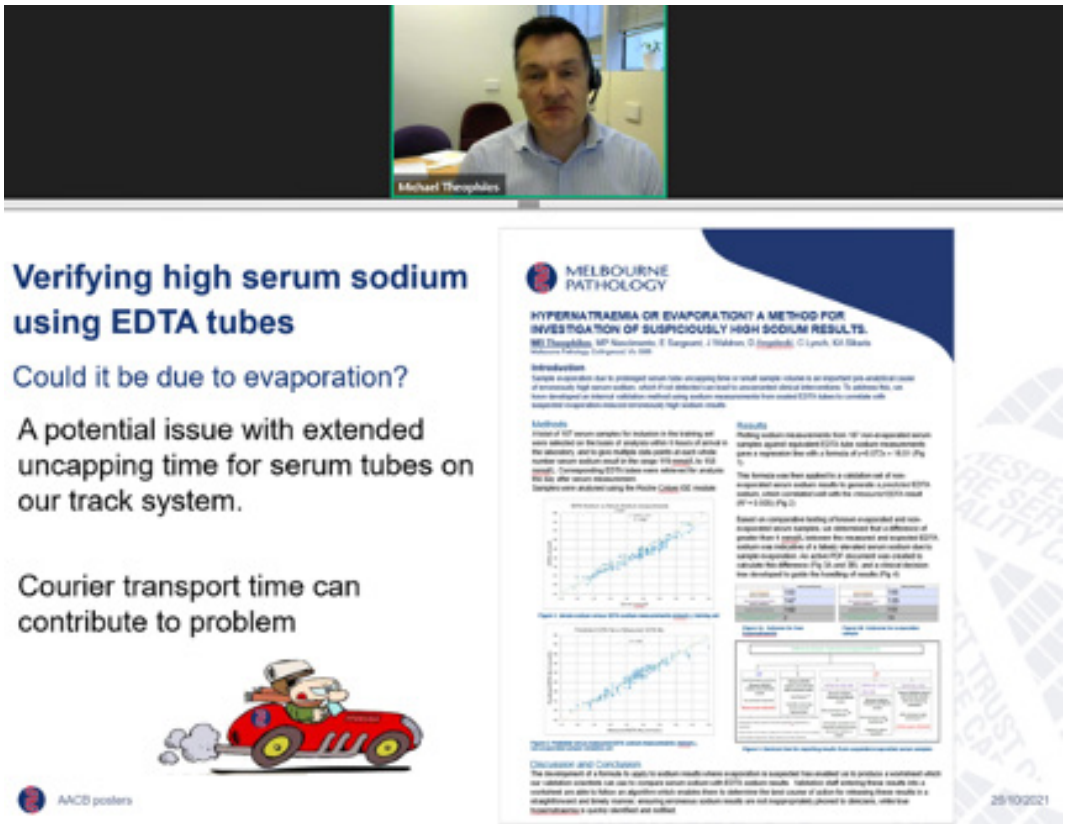

Figure 1. Dr Michael Theophilos presented his work on the investigation of suspiciously high sodium results..

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an exogenous compound used in computed tomography (CT)-assisted adrenal venous sampling. Interestingly, the presence of ≥ 4% (v/v) iohexol rendered the sample unusable as the compound can result in poor migration of the serum separator gel in vacutainers. It is recommended that non-gel tubes are to be used for adrenal vein sampling collection to avoid pre-analytical error.

HbA1c can be measured by capillary electrophoresis. At present, only K2 or K3-EDTA tubes are used for Sebia Capillarys 3 Tera®. A study at Melbourne Pathology evaluated if samples collected in fluoride oxalate (FlOx) tubes are suitable for HBA1c measurement. The findings revealed a close correlation of EDTA and FlOx-tube HbA1c measurement with a slight negative bias.

At Monash Health, an evaluation study was performed to assess the performance of Sebia Capillarys 3 for the detection and quantification of serum protein. This capillary electrophoresis method satisfied the performance characteristics. However, quantification of paraprotein in the β-region is challenging. The study also showed that paraprotein concentrations quantitated by capillary electrophoresis may differ from those determined by agarose gel electrophoresis.

Establishing reference intervals through data mining (indirect technique) has become increasingly popular in laboratory medicine. A study at Melbourne Pathology examined issues associated with unnecessary flagging of elevated fT3 in puberty. Over 60,000 thyroid function test results for patients under the age of 18 were extracted from the laboratory database. After excluding TSH results <0.1 or >10 mIU/L, approximately 8000 data were partitioned based on age-dependent median distributions. Outcomes of the study illustrated that by increasing the fT3 reference limit from 6.4 to 7.7 pmol/L was able to successfully reduce high fT3 flagging from 13% to 1%.

This year, John Abcede a Scientist at the Northern Pathology is the winner of Derek Rae Prize in recognition of his outstanding presentation. John described an interesting case investigating whether a patient has monoclonal or polyclonal gammopathy. Monoclonal gammopathy is one of the clinical features of symptomatic multiple myeloma. However, pseudo-monoclonal gammopathy may be observed in patients with autoimmunity, particularly in IgG4-related disease. When analysing the sample with capillary electrophoresis, the elevated IgG4 may produce discrete peaks which can easily be misinterpreted as monoclonal bands. Therefore, it is important to recognise pseudo-monoclonal gammopathy in rare occasions in order to avoid unnecessary bone marrow biopsy.

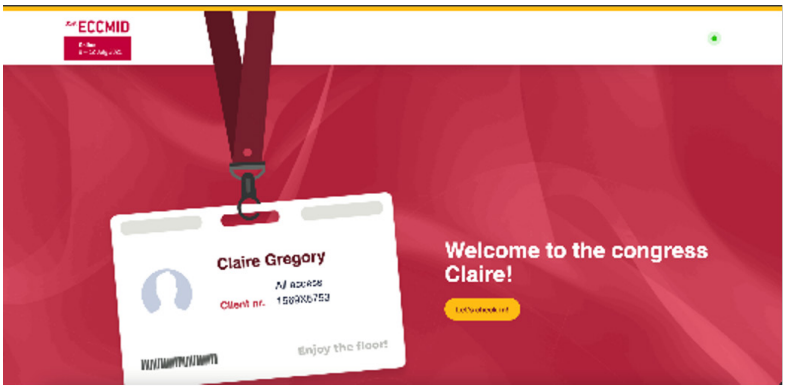
In summary, the first online poster presentation organised by AACB Victoria was successfully delivered. We had the opportunity to learn from the various research work happening in the biochemistry diagnostic labs in Victoria. The AACB Victoria would like to thank all presenters for their excellent presentations, as well as the audience for their active participation. A special thank goes to Dr Kay Weng the Chair of AACB Victoria for hosting this enlightening session.

ECCMID 2021 Virtual Conference – Review

By Claire Gregory

This year the 32nd annual European Congress of Clinical Microbiology and Infectious Diseases was held as a completely virtual event. This popular conference is held annually in a different location in Europe on a rotating basis, and brings together experts in the field of microbiology and infectious diseases to an audience of over 14,000 colleagues. The size of the event has steadily grown and now attracts over 3000 abstracts, of which 65% are accepted. This year was the first conference that was held as a virtual event.

I have had the privilege of attending this event in Europe in previous years, whilst living in Europe when it was a very easy event to access. Having since moved back to Australia it's been harder to get funding to attend. ECCMID has always been one of my favourite conferences due to the content diversity and quality of presentations, which cover bacteriology, virology, mycology, mycobacteriology, epidemiology, plus plenty more. Due to the organisers' decision to host as a virtual COVID-safe event, this year's conference was the first that I was able to attend in over 10 years and I was thrilled!



Due to the time difference between Europe and Australia, it was harder to watch presentations live. However all presentations were recorded and made available to registered delegates 24 hours after the conclusion of the conference. Due to the current pandemic the content was heavily COVID based, however there were still many presentations covering all aspects of microbiology and infectious diseases.

Whilst attending a conference in person is generally preferable for most delegates as opposed to virtual attendance (I definitely missed the scramble for canapes during the welcome reception and scouring the trade exhibit for the best free coffee), difficulties in obtaining funding can mean many are unable to register. Virtual registration has made many events available to those who were unable to attend for various reasons, and it is likely that this option will continue to be made available for future events.

I would encourage all microbiology staff to attend this event in coming years, particularly if the more cost-effective virtual registration remains available. ECCMIDD 2022 is scheduled to be held in-person in Lisbon, with a virtual option, followed by Copenhagen in 2023.

International Society for Laboratory Haematology 2021 Symposium

By Joe Rigano

The XXXIVth International Symposium for the International Society for Laboratory Haematology (ISLH) was held virtually from May 4th to May 7th 2021. This report provides a brief summary of some of the latest discoveries and technological innovations in Laboratory Haematology.

IRON DEFICIENCY: UPDATE ON DIAGNOSIS

Carlo Brugana, Boston Children's Hospital, USA

Anaemia is a global entity with iron deficiency anaemia (IDA) the dominant cause contributing 60% among the 1.9 billion people with anaemia worldwide which is 27% of the population. It is the most common nutritional deficiency worldwide accounting for over 1.2 billion people. Children at 1 year old require 6 times the dietary iron than adults due to the lower utilisation of recycled iron. Infants susceptible to iron deficiency leads to developmental and behavioural abnormalities which can continue into adulthood and may not be corrected by iron therapy or supplementation.

Serum ferritin (SF) is low in all stages of iron deficiency designating it a diagnostic indicator. However, defining SF cut-off values has proven challenging across multiple conditions. The WHO reports iron deficiency with a SF <15 µg/L. Many studies have shown that raising the SF cut-off to 30 µg/L increases sensitivity to 92% maintaining specificity of 98%. SF cut-off values differ across chronic inflammatory conditions. The recommended SF cut-off values for iron deficiency independent of anaemia are <100 µg/L for inflammatory bowel disease, <100 µg/L or <300 µg/L and <20% transferrin saturation (TSAT) for chronic heart failure and <500 µg/L and <30% TSAT for chronic kidney disease. A combined approach has been recommended using SF <100 µg/L or TSAT <20% and if the SF is between 100 and 300 µg/L the TSAT must be <20% to confirm iron deficiency.

Some studies have shown that reticulocyte haemoglobin (Ret-He) of <30 pg has the highest overall sensitivity and specificity for iron deficiency compared to SF, TSAT and MCV in the absence of thalassaemia and macrocytosis. When assessing haemoglobin (Hb) response to intravenous iron therapy, baseline levels <28.5 pg of Ret-He and <103 g/L of Hb achieved the best improvements. Patients in this group have been identified with the lowest Hb, MCV, MCH and SF recognising Ret-He as a valuable RBC parameter in diagnosing and assessing iron status fitting well with iron biochemical markers for IDA.

Anaemia of inflammation or chronic disease (ACD) accounts for approximately 40% of the world's anaemias. The laboratory diagnostic features include normal or elevated SF; low serum iron, transferrin and TSAT; reduced reticulocyte count and Ret-Hb; high serum and urine hepcidin levels and elevated inflammatory markers (e.g., CRP and IL-6). Hepcidin is a protein that regulates iron availability by inhibiting iron export out of enterocytes and macrophages. Hepcidin can be used diagnostically in iron-refractory IDA, ACD and predicting responsiveness to oral iron therapy. When used in conjunction with iron biochemical markers, hepcidin has a potential in the diagnosis and management of anaemia.

Hepcidin and CRP predicts the incorporation of iron into red blood cells following oral iron administration.

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The lower the hepcidin and CRP, the higher the iron incorporation into red blood cells. Alternate day doses compared to daily doses of oral iron therapy increases iron absorption by up to 30%. Daily iron oral doses increase hepcidin and decrease iron absorption on the following day. Hepcidin levels of >20 ng/mL is a predictor of a non-responder to oral iron therapy.

Methods for measuring hepcidin correlate well with SF levels in males and females. There is no one biological marker to diagnose iron deficiency. Haematological and biochemical parameters must be used in combination with cut-off values adjusted accordingly to the underlying condition. The pathophysiology of altered iron utilisation in ACD can be complex and multifactorial.

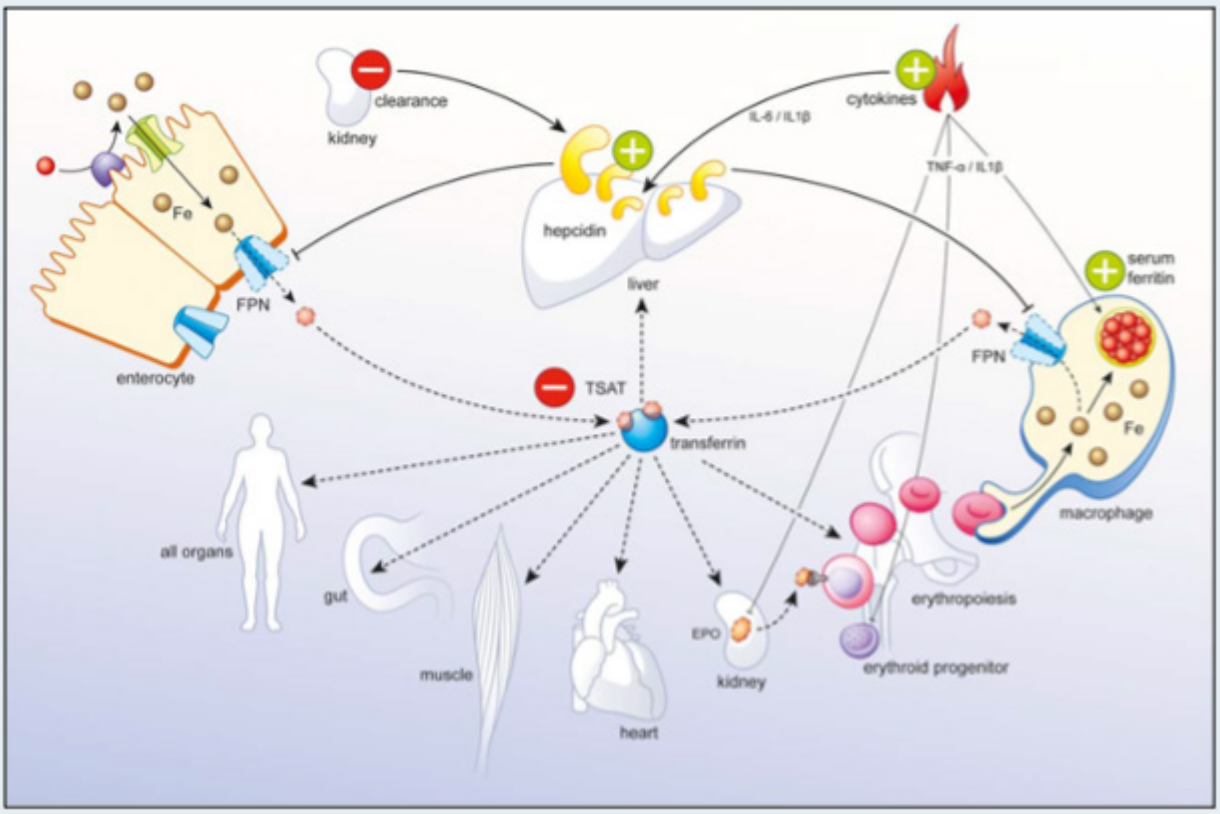

Figure 1. The pathophysiology of iron deficiency in chronic inflammation.

THE FUTURE OF SICKLE CELL ANAEMIA

Caterina Minniti, Einstein College of Medicine, USA

Sickle cell disease (SCD) is a genetic disorder punctuated by episodes of acute exacerbation with progressive organ damage and premature mortality. Mortality in childhood has decreased substantially since the 1970's with >95% of child born with SCD in high resource countries expected to reach adulthood. Adult mortality however has not followed the same improvement. Predictors of premature mortality are frequent hospital admissions, cardiorespiratory dysfunction, haemolysis and renal impairment. Polymerisation of haemoglobin S (Hb S) leads to red blood cell (RBC) sickling causing haemolysis and anaemia. Oxidant stress initiates inflammation, free haem and decreased nitric oxide results in endothelial dysfunction and RBC membrane fragments activate coagulation. This multistep, multicellular process leads to vascular occlusion and end organ damage (Figure 1).

Multiple biological targets exist to treat SCD including DNA (gene mutation β6 Glu→Val), protein (Hb S molecule), cellular (RBC) and end organs. Therapy can be disease ameliorating specific to SCD and supportive care or curative with bone marrow transplantation and gene therapy. Hydroxyurea increases Hb F, decreases Hb S polymerisation, decreases RBC membrane damage and subsequent

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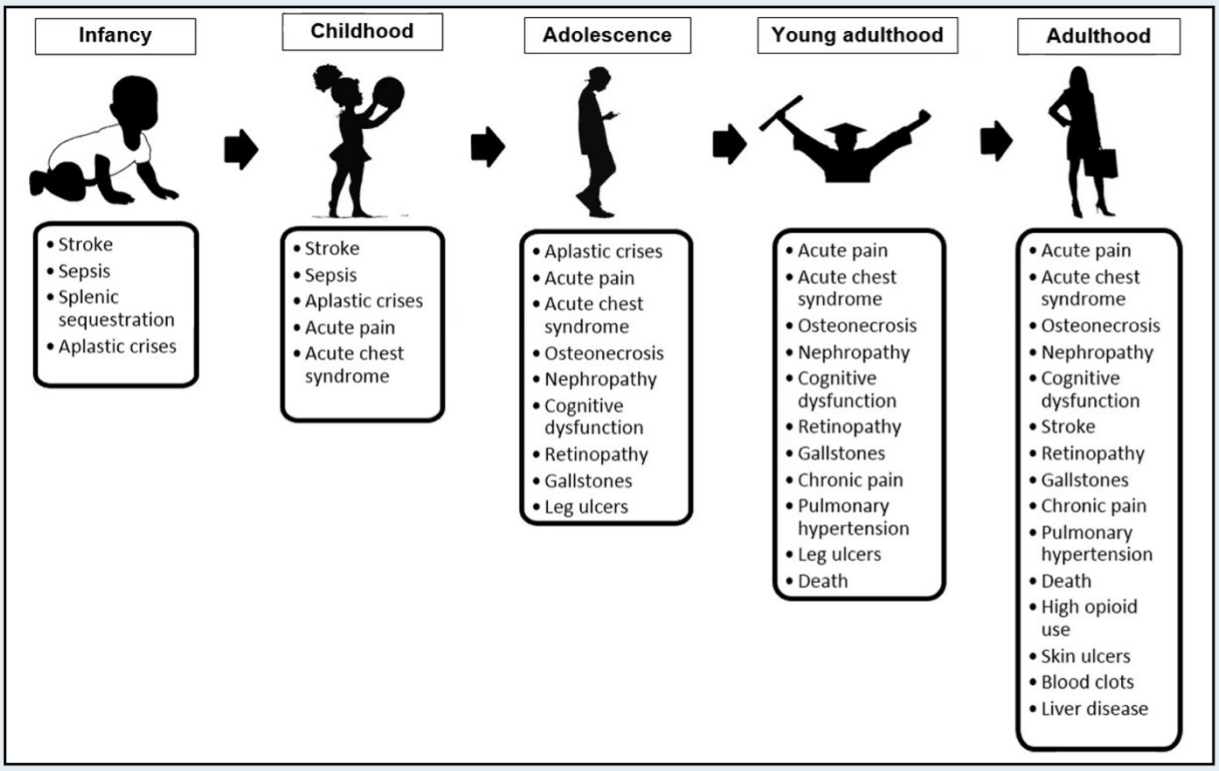

Figure 1. The vaso-occlusive and haemolytic complications of SCD accumulate with age.

haemolysis and increases Hb. Hydroxyurea also decreases WBC and platelets, endothelial activation and adhesion, thrombosis and vasoconstriction. Overall, there is improved tissue oxygenation with decreased inflammation. L-glutamine (Endari®) is an antioxidant neutralising oxidative stress in sickle cells, improving oxygen delivery and reducing pain crises. Voxelotor (Oxbryta®) is a polyaromatic aldehyde forming a reversible covalent bond to the N-terminal valine of the α globin chain stabilising Hb in the oxygenated state and preventing RBC sickling. Crizanlizumab (Adakveo®) is a humanised anti-P-Selectin monoclonal antibody decreasing sickle cell cyto-adhesion to endothelium and significantly reducing vaso-occlusion and subsequent pain crises.

Myeloablative allogeneic bone marrow transplantation in childhood offers a curative therapy with a high overall survival rate. In adults, non-myeloablative transplantation protocols reduce toxicity. Challenges of transplantation are finding HLA matched donors, graft rejection and GVHD, achieving a high survival of transduced cells, myeloablation toxicity and decreasing survival with increasing age. Autologous bone marrow stem cell gene therapy negates the need for matched donors, eliminates GVHD and the use of immunosuppressants. Gene transfer involves transducing the therapeutic globin gene into the patient's stem cells using a viral vector (e.g., lentiviral vector). The therapeutic globin is then produced using the patient's normal gene regulatory elements. The LentiGlobin BB305 vector encodes the human HBB variant βA-T87Q which contains a single amino acid substitution of threonine to glutamine inhibiting Hb S polymerisation and allowing differential quantification (Figure 2).

Gene editing is another therapy for SCD. Increasing foetal haemoglobin reduces disease severity. BCL11A downregulates the γ globin gene and Hb F production after birth. Disruption of erythroid specific BCL11A enhancer allows γ globin gene expression and reactivates Hb F production. CRISPR-Cas9 is a method that can correct the single point mutation which causes SCD. Implantation of corrected induced pluripotent stem cells into the bone marrow develop into normal Hb producing RBCs. The CRISPR-Cas9 nuclease system is a bacterial immune system that can cleave bacteriophage or plasmid DNA enabling programmable targeting of insertions or deletions at a specific genomic DNA site.

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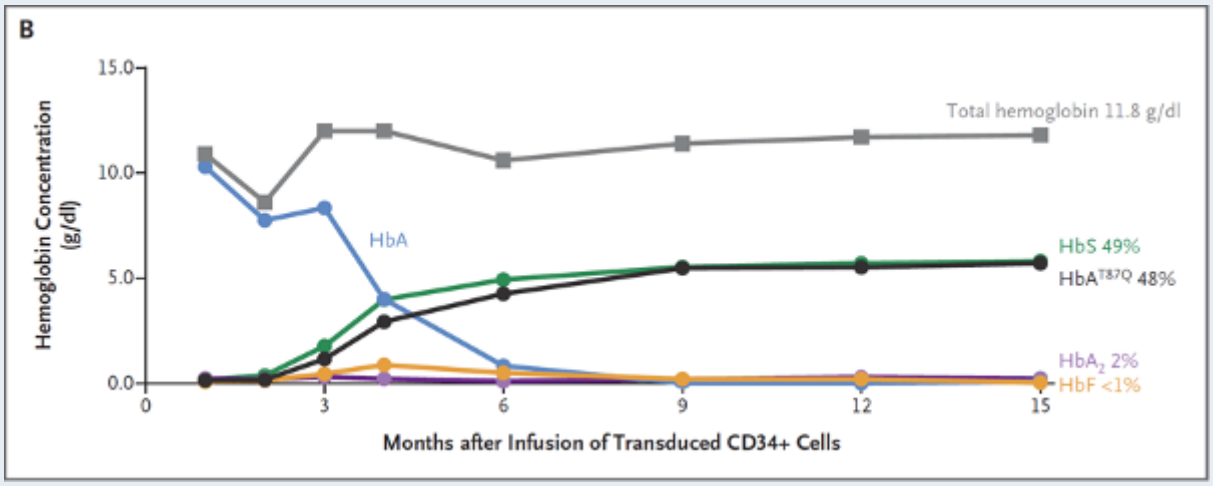

Figure 2 . Levels of each haemoglobin species at 15 months post engraftment with transduced cells. Results from HGB-205 clinical study.

THE ROLE OF ADAMTS13 TESTING IN THROMBOTIC MICROANGIOPATHIES

Paul Coppo, Sorbonne University, France

Thrombotic thrombocytopenic purpura (TTP) is a rare but potentially fatal blood disorder with an incidence of 2 to 6 per million individuals. TTP may be caused by inherited severe deficiency of plasma ADAMTS13 activity resulting from mutations in ADAMTS13, referred to as congenital TTP (cTTP). More commonly, TTP is acquired due to autoantibodies that inhibit plasma ADAMTS13 activity, referred to as immune-mediated TTP (iTTP) which account for more than 95% of all TTP cases. ADAMTS13 is a protease that cleaves vWF multimers preventing platelet adhesion which would otherwise lead to thrombocytopenia, microangiopathic haemolytic anaemia, and various degrees of organ damage. These signs and symptoms overlap with another thrombotic microangiopathy, haemolytic uremic syndrome (HUS). Rapid plasma ADAMTS13 activity testing is critical for the early diagnosis and distinction between TTP and HUS for initiation of appropriate treatment. In the absence of rapid ADAMTS13 testing, the French and PLASMIC score have been developed to predict the likelihood of severe ADAMTS13 deficiency in suspected TTP (Table 1). A plasma ADAMTS13 activity of <10% is the hallmark of TTP and when plasma ADAMTS13 activity is >10% the diagnosis of HUS should be considered after excluding other secondary causes of thrombotic microangiopathy. Therapeutic plasma

Parameters	French Score	PLASMIC Score
Platelet count	<30 × 10^9/L (+1)	<30 × 10^9/L (+1)
Serum creatinine level	<2.26 mg/dL (+1)	<2.0 mg/dL (+1)
Hemolysis		
Indirect bilirubin >2 mg/dL	[a]	+1
or reticulocyte count >2.5%		
or undetectable haptoglobin		
No active cancer in previous year	[a]	+1
No history of solid organ or SCT	[a]	+1
INR < 1.5	[a]	+1
MCV < 90 fL	NA	+1
Likelihood of severe deficiency of ADAMTS13 activity (<10%)	0: 2%	0-4: 0%-4%
	1: 70%	6: 5%-24%
	2: 94%	6-7: 62%-82%

Table 1. The French score or PLASMIC score predicts the likelihood of severe ADAMTS13 deficiency in suspected TTPclinical study. The French score or PLASMIC score predicts the likelihood of severe ADAMTS13 deficiency in suspected TTP

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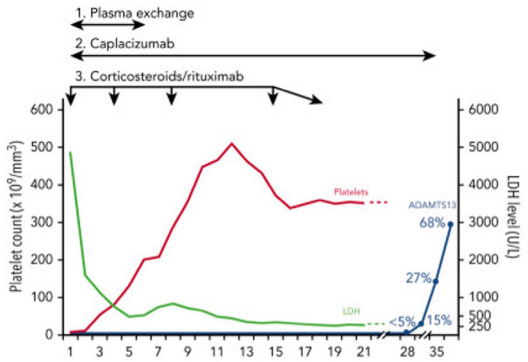
exchange (TPE) in conjunction with corticosteroids, rituximab, and caplacizumab has significantly reduced the mortality and morbidity in iTTP. Eculizumab, an anti-complement C5 monoclonal antibody, is a life-saving therapy for complement-mediated HUS.

The treatment options for iTTP are TPE which removes ADAMTS13 autoantibodies and replenishes ADAMTS13 levels, immunomodulation using corticosteroids and immunosuppressants to suppress autoantibody production and vWF GpIb inhibitors to block the interaction between vWF multimers and platelets. The historical treatment of iTTP with TPE and steroids showed a marked improvement in survival. However, patients with a suboptimal response experienced exacerbations, refractoriness and TPE related complications. Rituxumab prevents long term responses to TPE, limits the duration of treatment and is inefficient in the acute phase. However, Rituximab protects patients from long term clinical relapse when used in the acute phase. Until the platelet count recovers, patients are still exposed to the effects of TTP.

Caplacizumab, a humanised, bivalent, variable domain-only Ig fragment binds to the A1 domain of vWF multimers preventing interaction with the platelet GpIb receptor and subsequent microvascular thrombosis. The TITAN and HERCULES trials compared placebo against caplacizumab with TPE and immunosuppressants. Patients receiving caplacizumab achieved normalisation of platelet count significantly faster than placebo. Decreasing the duration of time of thrombocytopenia decreases the risk of death. Caplacizumab protects patients during the initial weeks of rituximab inefficiency in the acute phase. Compared to placebo, caplacizumab resulted in no deaths, no refractoriness, less exacerbations and less thromboembolic events. A clinical trial using the CAPLAVIE regimen of TPE, immunosuppression with corticosteroids and rituximab and caplacizumab reduced unfavourable outcomes in iTTP and alleviated the burden of care when compared with historical cohort of patients treated with TPE, corticosteroids and rituximab (Figure 1). The triplet regimen may become the new standard of management as the therapy targets the pathophysiology processes of iTTP.

In iTTP patients treated with the triplet regimen, caplacizumab added to plasma exchange hastens and stabilizes platelet count recovery until immunosuppression with corticosteroids and rituximab improves durably ADAMTS13 activity



As compared to the historical treatment, the triplet regimen prevents unfavorable outcomes and alleviates the burden of care

Outcome	Triplet regimen (N=90)	Historical cohort (N=180)	P-value
Primary outcome			
Composite of death and refractoriness	2 (2.2%)	22 (12.2%)	0.01
Secondary outcomes			
Death	1 (1.1%)	12 (6.7%)	0.06
Refractoriness	1 (1.1%)	16 (18%)	0.01
Exacerbations	3 (3.4%)	70 (44%)	<0.01
Time to durable platelet count recovery	5 (4-6)	12 (6-17)	<0.01
Number of daily TPE until remission	5 (4-7)	10 (6-16)	<0.01
Volume of plasma (Liter) until remission	24.2 (18.3-30.2)	44.4 (26.3-74.3)	<0.01
Time to ADAMTS13 activity > 20% (days)	28 (14-42)	48 (24-83)	<0.01
Length of hospitalization (days)	13 (9-19)	22 (15-30)	0.01

Figure 1. Outcomes according to treatment regimen for iTTP.

Victorian Faces of the Fellowship

Hazel Chambers
Anatomical Pathology

Royal Childrens's Hospital Melbourne

"I think I'll just do the Immuno module for fun" is how my Fellowship journey began. I went in confident and thought I would easily pass my first exam. IHC is my strongest area in Anatomical Pathology. How wrong I was! After revising for several months, I walked out of the exam feeling confident that I'd passed. Fast forward six weeks, I opened my email with the news that I wasn't successful with my exam. I was in disbelief, I had so much IHC experience, how could I have failed?

This was a reality check that the Fellowship was unlike anything I had studied before. I was really disappointed in myself and decided that I was going to do it again, but this time I had to work much harder and adapt to my study. The problem was that I had to wait twelve months for another chance at that module, and I'm not the most patient person. So, I decided to complete the first module (AP1) while I bided my time to resit the IHC module (AP2). I was so close to failing this module too. My exam was remarked. I couldn't believe it. But again, I was reminded that the Fellowship requires an extremely high level of knowledge and understanding.

The following exams went much better for me. I knew I had to be dedicated to studying to get through them. I could not rely on my previous knowledge and experience alone. Once I had completed two modules, I was encouraged to keep going. I was already halfway there. I'm so glad that I continued.

The Molecular module was the most challenging for me and by far the most enjoyable. I found this module brand new, fascinating, and like a whole new language that was very closely linked with IHC.

The finale of this experience was the Viva Voce exam. I was incredibly nervous being questioned by my peers! My mind went totally blank for some of the easiest questions! Thankfully, the wait to find out that I had passed was short. I was thrilled!

I can honestly say that completing the Fellowship has made me a better scientist. It is the Fellowship that has taught me the complexity of renal biopsies and how routine histology, IHC, and EM are absolutely integral to the final result, and how each test is dependent on the other.

Before I started the Fellowship, I completed an MSc a number of years earlier. I realise how generic in nature a masters is compared to the Fellowship. Having completed both, I would recommend the Fellowship all the way. It is totally specific to what we do in our chosen disciplines, and the knowledge you will gain is totally relevant and practical to your everyday life as a scientist.

Rohit Chadha
Haematology

Monash Health Pathology

I started my AIMS Fellowship in the Haematology discipline in 2017 and completed it in 2021.

Studying for a fellowship has substantially increased my knowledge and confidence in my chosen subject.

Fellowship is perceived as an inexpensive and flexible way to advance your professional qualification, although it is not as supportive of students as studying in the regular professional courses through a university.

Hence, I would like to reiterate that you would require a mentor to guide you due to the way this program has been designed. I would also encourage students to form a study group and do networking as this not only results in better outcomes in studying for the course but also keeps the morale up.

Fellowship is recognised and respected in the industry and I believe that just completing initial fellowship modules can advance your professional career as experienced by me and other students.

Finally, doing a fellowship requires a lot of commitment and I would like to thank my family for their patience and encouragement during this period.

A Day in the Life of a Research Scientist: Pramod Subedi

What has been your career/study path thus far?

My passion for doing research in Biochemistry and Molecular Biology started since I was completing my undergraduate degree in Medical Laboratory Technology (B.Sc. MLT) at Pokhara University, Nepal. After working as a medical laboratory scientist for a year, I started thinking of pursuing a postgraduate research degree in molecular biology and genetics overseas.

My profound interest in understanding the molecular basis of diseases drove me to undertake a master's degree in Biotechnology and Bioinformatics at La Trobe University. This is how I started my academic journey at La Trobe in 2014. While adjusting to a new life and culture in Australia, I was determined to maximise this educational opportunity to develop and grow personally and professionally. Fortunately, as a part of my research year, I was offered the opportunity to work in the laboratory of Associate Professor Begoña Heras investigating the virulence role of a group of proteins in Gram-negative bacteria which ultimately became the turning point of my research career. Following the completion of my master's degree with a high distinction grade, I was awarded a La Trobe University Ph.D. Scholarship in 2016 to carry out my Doctorate degree in the Heras laboratory. Excitingly, I was offered the opportunity to work as a postdoctoral position immediately after my doctoral degree and currently I am undertaking my postdoctoral research in the Heras laboratory.

What is your role as a research scientist?

As a postdoctoral scientist in the Heras laboratory, the primary focus of my current research is on investigating the structure-function relationships in proteins involved in bacterial pathogenesis and develop novel anti-virulence drugs that interfere with bacterial pathogenic process.

What do you like most about your role?

I am very grateful for the opportunities I have had throughout my La Trobe journey. I have been lucky to have A/Prof. Begoña Heras as my master's, Ph.D. and my postdoctoral supervisor. Begoña has provided me several wonderful opportunities both in my Ph.D. and Post-doctoral research which undoubtably helping me a lot to maximise my potential and advance my research career. I am also very blessed to call the Heras lab a home away from home.

Along with my supervisor, I have had an opportunity to work with other brilliant scientists in the Heras lab and at LIMS, in general, who are extremely passionate about what they do and find every day in the research. I have learnt so much from them throughout all these years; from how to be a better science communicator, to relevant scientific techniques, that have allowed to improve my skills as a researcher. I am also very much thankful to other teaching staff in the department who have provided me the opportunities to teach our next generation of scientists.

Additionally, LIMS provides the advance facilities and the collaborative environment to carry out the world class research. I am very proud to call myself a LIMS/La Trobe researcher.

What is your most memorable moment/experience?

Coming from the remote yet beautiful western Himalayan region of Nepal, where I was raised as a science-minded child, despite the very limited access to technology, everything since I joined La Trobe feels like a dream come true to me. I am very much grateful to all my mentors who inspires me every day and guide me towards the right path.

As an early career researcher, every day in the lab is different reminding me that research is always evolving and is a constant adventure. Being a part of the Heras laboratory team at LIMS has been an amazing experience to me. In the Heras lab, I have had an opportunity to get involve in projects that are focussed on understanding the fundamental mechanisms of bacterial infections to identify the novel antimicrobial therapeutics. This research is both timely and important because the rapid increase in bacterial antimicrobial resistance has become a serious global health concern. Hence, as part of the Heras team, I am working towards solving global problems including antibiotics resistance and improving health and wellbeing for all.

Do you have any advice for PhD students or Early Career Researchers?

All of the basic skills I use every day in the lab, as a full-time scientist, build upon skills I learnt during my master's and Ph.D. degrees. So, try to maximise your skills and abilities in your Ph.D. and early career research. Find out what skills are in demand and try and focus your research on those (if possible). Keep a record of everything you do. Importantly, treat science or research like a social activity. Talk to people about yourself, about your passion, and about your project, ask them what their interests are. Attend meetings, conferences, workshops and be active in them. You always have energy to do what you are passionate about so find it or sometimes you have to develop it according to the given circumstances. More importantly, take care of your wellbeing-Be Happy and Spread Happiness :)

What is something quirky about you – something that others may not know? A fun fact…

Cooking is something absolutely I love. Also, I love trekking- often, it feels good to be lost in the nature. Not surprising considering Praomod's hometown, Pokhara, is known as the gateway to the Annapurna Circuit, a hugely popular hiking trail in the Himalayas of Nepal.

STUDENT PROJECTS

Biochemistry project name: Validation of an ELISA protocol for serum cortisol
Student name: Najima Ahmadi, RMIT University

COVID-19 has been hard on all of us. The precautionary and preventative measures taken to control its outbreak have changed many aspects of our daily life, particularly in education and training. Many assessments and placements have been affected as a result of the pandemic, with some being cancelled, postponed, or adjusted in format. As a final year student, I was excited to apply the skills and knowledge that I have acquired throughout my studies in my final year project. Unfortunately, as the restrictions came into effect at the beginning of the semester, it has affected the project schedules and most sessions were forced into online delivery.

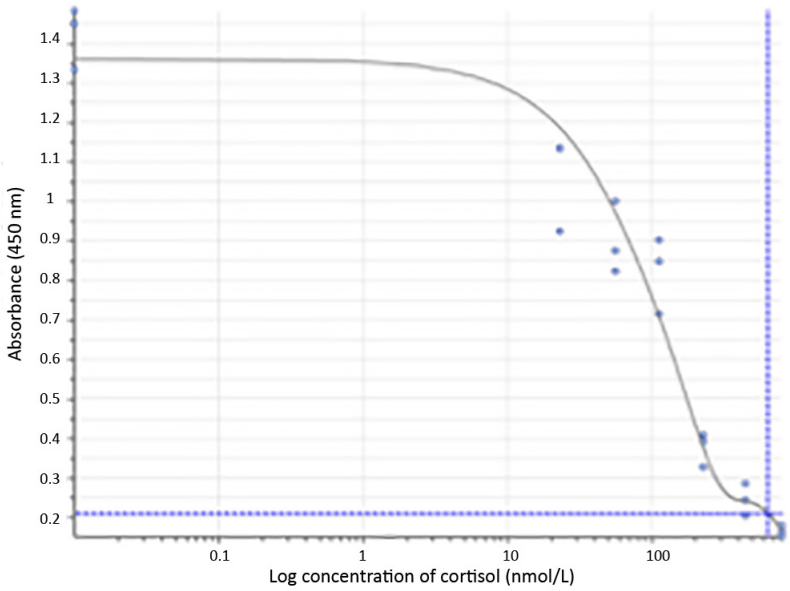


Figure 1: Calibration curve exhibiting the competitive format of the cortisol ELISA, where the detection signal (absorbance at 450nm) is inversely proportional to the concentration of cortisol in the serum sample.

Having chosen Clinical Biochemistry as my preferred discipline to complete my final year project, our project was based on the analytical validation of an ELISA protocol for serum cortisol. The aim of the project was to improve the detection of serum cortisol by the competitive ELISA. This project integrated several laboratory techniques, including liquid-liquid extraction of serum cortisol using various extraction solvents (hexane, methyl tert-butyl ether and ethyl acetate), performing a dose-response experiment, optimising the detection signals, and constructing a full calibration curve.

The competitive immunoassay works on the principle that the labelled antigen competes with endogenous antigen with limited antibody binding sites. The detection signal produced is inversely proportional to the concentration of endogenous antigen. In our project session, I was able to demonstrate this working principle. I observed that the calibration curve I produced displayed the characteristic feature of a competitive immunoassay (Figure 1). This showed that I have successfully applied my technical skills to improve the detection of serum cortisol – I was indeed thrilled with the experimental outcomes!

Additionally, we were expected to design and perform method validation and method comparison studies to evaluate whether the developed protocol fulfils the analytical requirements and is fit for purpose. However, due to covid restrictions, we did not manage to perform these studies in the lab. We were provided with the relevant data for analysis instead. Here, we focused on the analytical skills to evaluate method performance in the context of precision, accuracy, linearity, and analytical sensitivity. The Deming regression and Bland-Altman graphs were plotted to assess if our developed protocol has good correlation in comparison to a reference method.

The most valuable experience I gained from the project is that I was able to develop an improved ELISA protocol to detect serum cortisol within a limited time, despite interruption to our normal project schedule. I believe that being resilient and able to quickly adapt to unexpected changes during the pandemic have helped me overcome the challenges as a final year student.

I am grateful to our project supervisors, Dr Yuh-Ping Chong and Mrs Paula DeThomasis, for guiding and providing us with the golden opportunity to work on this wonderful project.

Student Projects

Microbiology project name: Can aspirin be used as a new treatment for established biofilm infections?

Student name: Alyson Gilmore, RMIT University

For my final semester subject at RMIT, Advanced Laboratory Medicine, I undertook a research project to determine if salicylic acid, the major metabolite of aspirin, could be used as treatment for established Staphylococcus aureus biofilms. S. aureus biofilms are a significant issue causing a major burden on healthcare systems, including a major financial burden. Currently treatments involve antibiotics and physical removal techniques, however it is evident that we are in need of newer and more cost-effective treatments to combat these infections.

Before starting my project, it was essential to research how biofilms are formed, and which genes are responsible for biofilm production in S. aureus. I chose to investigate two genes, icaAD, a gene responsible for production of Polysaccharide Intercellular Adhesin (PIA), a structural component of S. aureus biofilms, as well as SarA, a global regulon responsible for the regulation of genes required for biofilm production including icaAD. This led to my hypothesis that salicylic acid will affect the expression of icaAD and SarA, downregulating these genes responsible for biofilm production.

My workflow involved treating established S. aureus biofilms with varying concentrations of salicylic acid and incubating for three hours at 37°C. RNA was extracted from the biofilms and the concentration and purity of the RNA was measured. RNA quality control was performed to detect DNA contamination; this was then treated with DNAse. RNA reverse transcription was performed to synthesise cDNA, whilst cDNA quality control was performed to confirm the presence of cDNA prior to qPCR. Finally, qPCR involved using primers for GyrB as a housekeeping gene, icaAD and SarA to obtain Ct values for calculation of fold change.

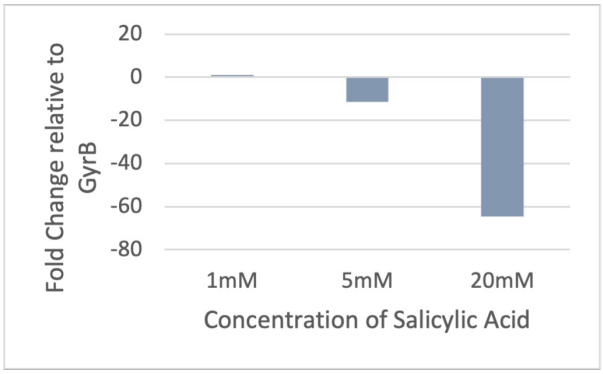


Figure 1: Salicylic acid affects gene expression of icaAD in a dose-dependent manner.

After analysis of these results, I could conclude that salicylic acid affects gene expression of icaAD in a dose-dependent manner (Figure 1). This meant that an increase in dose of salicylic acid resulted in further downregulation of icaAD, as I had expected. SarA results however, concluded that salicylic acid does not significantly affect gene expression of SarA after 3 hours incubation. Despite these unexpected results, previous studies demonstrating the downregulation of SarA after treatment with salicylic acid confirmed that this is achievable under different experimental conditions. Despite further studies being necessary, I was able to conclude that salicylic acid has the potential to be used as a treatment for S. aureus biofilms.

Reflecting on my experience completing this project, I have greatly broadened both my knowledge of microbiology and molecular methods as well as greatly improving my research and scientific writing skills. It has been a fantastic introduction to the research world and has prompted me to consider undergoing further study or research in the future. It came with some surprises; I remember being amazed that manual RNA extraction took me almost five hours in comparison to the 75 minutes it takes on an automated machine at my workplace! Fortunately, I loved every moment of it; it was very exciting to be back in the RMIT laboratory for my final semester, especially after a full year of virtual placement and online practicals due to COVID-19. It definitely took me out of my comfort zone; in the past I preferred to solve problems myself rather than speaking up – in this environment it was crucial to constantly ask questions and to ask for feedback. Whilst it was a challenge, I would strongly encourage future laboratory medicine students to consider undergoing a laboratory-based research project for their final project. Finally, a huge thank you to our project leader Anna; thank you for all your advice, feedback, support, and behind the scenes laboratory work to ensure everything ran smoothly, even at times when we were unable to access the laboratory during lockdowns.

Student Projects

Hostology project name: Antibody panels to identify and profile metastatic tumours
Student name: Nicola Pinolo, RMIT University

As Histopathology students in the faculty of Laboratory Medicine at RMIT University, we were tasked with the challenge of diagnosing and differentiating carcinomas of unknown primary (CUPs) using immunohistochemistry (IHC). We were presented with five case studies: five formalin-fixed paraffin-embedded blocks of excised tissue containing a metastatic CUP. The aim of our project was to develop a panel of antibodies that would help us identify the primary site and antigen expression profile of the metastatic tumours.

We first began by staining our samples with haematoxylin and eosin to visualise tissue architecture and assess tumour morphology. Next, we designed an indirect IHC protocol that involved heat-induced antigen retrieval (HIER), endogenous peroxidase blocking, the application of a primary antibody, a linker to amplify the signal, a secondary antibody bound with HRP and finally the addition of DAB to visualise the binding of each antibody before counterstaining with haematoxylin. We used a negative test control – omitting the primary antibody – and positive and negative tissue controls to validate our results.

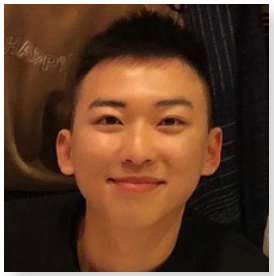
We started our IHC investigations by assessing cytokeratin expression of our cases. This involved an initial panel of CK7 and CK20 to guide the broad classification of each tumour. Were they of epithelial origin? Perhaps squamous, lymphoid, melanomatous or sarcomatoid? Using these results as a guide, each week we further evaluated the antigen expression profiles of the cases by researching useful tissue markers such as TTF-1, PAX8, GATA3, CDX2, p63, CEA, ER and Villin to name just a few, and tested them on our samples. This involved a lot of trial and error and optimising our antibody protocol to ensure we produced sufficient results. The staining pattern of each antibody was evaluated, including assessing localisation and intensity of each stain, and comparing our results to the control tissues to ensure they were valid and what was to be expected.

Our results showed that CK7 and CK20 were useful in identifying tumours of epithelial origin. Many of our cases were adenocarcinomas, and our extended antibody panels helped us differentiate each tumour. Some cases were able to be broadly classified as pulmonary, gynaecological, or lower gastrointestinal in origin by using tissue-specific antibodies. We were also able to rule-out many other tissue origins based on our results. Some cases were difficult to differentiate though this was not unexpected, knowing that up to 70% of CUPs remain undiagnosed after extensive IHC investigation.

In summary, our project gave us a thorough understanding of the importance of IHC in the anatomical pathology laboratory and in-depth experience in antibody selection, optimisation and analysis. We also delved into the realm of using IHC to identify theranostic targets to assist clinicians in selecting focussed treatment options to improve patient prognosis. I am very much looking forward to applying these learned skills into a diagnostic laboratory in the near future.

Student Projects

Transfusion project name: Investigating haematologic side effects of daratumumab
Student name: Ricky Lai, RMIT University



My final year project at RMIT University is about the risk of haematologic side effects in multiple myeloma patients treated with daratumumab. The systematic review and meta-analysis aimed to investigate the currently available daratumumab clinical trials and provide the clinician with supportive data on its haematologic side effects. It is helpful for them to organise the treatment plan for the daratumumab-treating patients to achieve a better treatment outcome.

Daratumumab is an anti-CD38 monoclonal antibody drug. Multiple myeloma cells are highly expressed with CD38; however, normal functioning haematopoietic cells are naturally present with CD38 on the cell surface. This gave us the assumption that daratumumab will increase the incidence of all types of haematologic adverse events compared to the non-daratumumab treating patients. According to my meta-analysis, the use of daratumumab indeed will increase the incidence of thrombocytopenia, neutropenia, and lymphopenia. However, the result showed that daratumumab has a protective effect on anaemia.

The result on anaemia is an interesting finding in my project because it is against my hypothesis of this project. After finding the relative studies on the antigen on the red cells, it seems that the white cells can get the antigen-antibody complex instead of killing the red cells. It might explain the reason why the incidence of neutropenia and lymphopenia are drastically increased. Research also showed that CD38 reduction not only appears on the red cells but also on myeloma cells, which leads to a potential daratumumab resistance in the future.

I initially chose the face-to-face project early this year. Still, due to the lockdown, our course coordinator, Denise Jackson, suggested that we swap to the online project because of the uncertainties. I was so disappointed initially as I thought I would have less practical experience than previous laboratory medicine students. But the online project has worked well for all of us; we have weekly meetings with the supervisors with many supports during all stages of the project. We can choose the topic we like and are interested in; it gives us more freedom and creativity to work on the project. Also, Denise provided extra practical sessions to ensure we could build up the essential practical skills before graduating.

The COVID-19 pandemic affected our face-to-face study experience a lot. Still, it also allowed me to work differently than other students, while I did not feel disadvantaged. While working on the systematic review and meta-analysis, I learned a lot about my topic because I had to read a number of studies to find the eligible article for my project.

You are invited

The Victoria branch AACB (Australasian Association for Clinical Biochemistry and Laboratory Medicine) would like to invite you to attend its Journal Club. The Journal Club is usually held fortnightly online on Monday morning at 8 – 9 am.

This will involve chemical pathologists or registrars presenting peer-reviewed journal articles to a group of audience with enthusiasm in clinical biochemistry. Diverse topics focusing on interesting case studies, clinical guidelines, emerging analytical methods will be presented throughout the year.

If you wish to attend the Journal Club, please contact Dr Kay Weng Choy at kayweng.choy@nh.org.au for further information on when the next session will be held.

WELCOME TO THE VICTORIA AACB JOURNAL CLUB!

When: Monday morning at 8 – 9am

Where: Online

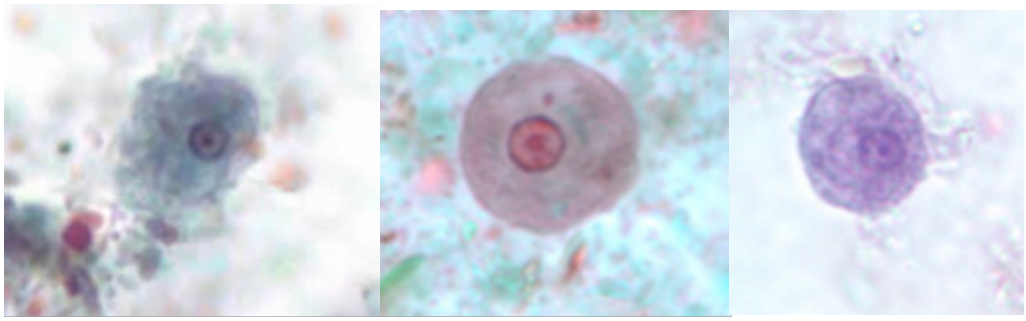
Admission: FREE, open to ALL

Contact person: Dr Kay Weng Choy kayweng.choy@nh.org.au

[Answers on next page]

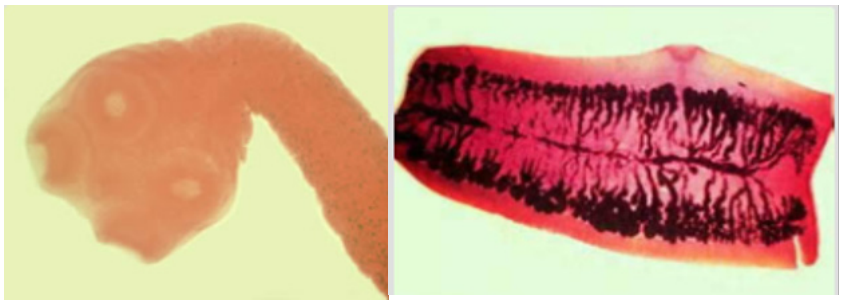
TEST YOURSELF

1. The following Trichrome stain images are of: (oil immersion, 1000x, measures <10µm)



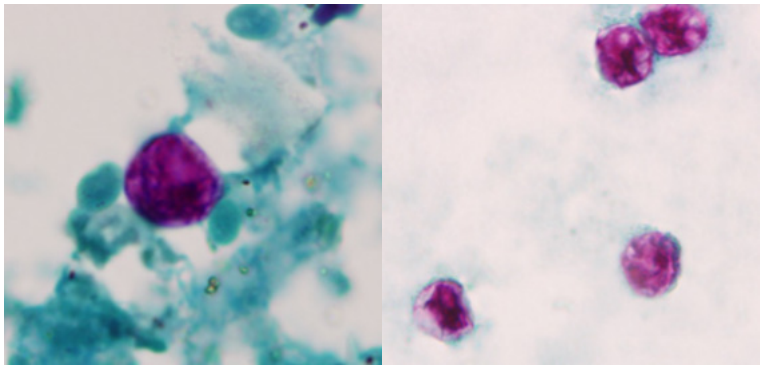
   A. Entamoeba hartmanni trophozoite and cysts
   B. Iodamoeba bütschlii trophozoite and cysts
   C. Entamoeba histolytica/E.dispar trophozoite and cysts
   D. Entamoeba coli trophozoite and cysts

2. The following Scolex and mature proglottid belong to:



   A. Taenia solium
   B. Taenia spp. (unable to accurately differentiate)
   C. Taenia saginata
   D. Dipylidium caninum

3. The following Modified acid-fast stained images is of: (oil immersion, 1000x, measures 7.5-10 µm)



   A. Cystoisospora belli oocysts
   B. Cyclospora cayetanensis oocysts
   C. Cryptosporidium spp. Oocysts

All images from: Centers for Disease Control and Prevention | DPDx – Laboratory Identification of Parasites of Public Health Concern

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- Recognition of participation in activities provides encouragement to maintain, improve and extend knowledge and skills for scientific and professional duties.
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- CPD participation ensures a competent workforce and enhanced quality of service for increased confidence of service users.

The programme is open to members of AIMS, AACB, ASM, THANZ, ANZSBT and FSA. APACE participants can lodge applications and activities using the online diary www.apace.org.au.

Answers to quiz on previous page:
1) A
2) C
3) B

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