MowatLabs Progress Report 2022

Global excellence in liver disease research

2022 was another highly successful year for the MowatLabs. Together, we made exciting breakthroughs with new cell isolation techniques, uncovered significant insights, explored potential treatments for liver disease, pooled and shared our expertise and nurtured future talents.

This report outlines the considerable progress made at the MowatLabs over the last 12 months and summarises the pioneering work to address the complexities of liver diseases and improve the overall prognosis and quality of life for young patients.

Our success relies on collaboration – the vital relationships with our clinical and research colleagues, our patients and their families and our philanthropic donors.

We hope that you will enjoy reading about the many advances that have been made thanks to your generous support.

Research highlights

Hepatocyte Biology & Transplantation Group

The Hepatocyte Biology & Transplantation Group's current research aim is to improve the transplantation of liver cells for:

- Children with acute liver failure
- Children with liver-based metabolic disease

The group is also investigating:

- The role of bile acids in the onset, progression and severity of non-alcoholic fatty liver disease (NAFLD) in children
- The effect of minimal hepatic encephalopathy in children with liver disease

In 2022 the group, led by Professor Anil Dhawan, was composed of eleven clinicians, four PhD students, three postdoctoral researchers, one MSc student and one MD student.

Research progress

Clinical trials

After some unavoidable logistical and personnel delays, the clinical trial on the transplantation of our new hepatocyte microbeads (HMB002) is now on track. We hope to start treating patients with the new microbeads later this summer. We will recruit nine children with acute liver disease for the first phase of the trial and, if successful, we will expand the trial to a total of 17 young patients.

Project lead Dr Celine Filippi has been managing the complex process of preparing for the clinical trial, together with a large 'Trial Management Group'. Once started, members of the Hepatocyte Transplantation Group will work together with the King's clinicians and pharmacists to produce and administer the microbeads.

We believe that human hepatocyte transplantation could provide a real alternative to liver transplantation, especially for the treatment of acute liver failure in children. Our previous use of the original HMB001 microbeads showed how the alginate-encapsulated hepatocytes can be simply and safely delivered into the peritoneal cavity, without immunosuppression. Since then, we have modified the chemistry of our microbeads and added mesenchymal stromal cells (MSCs), which has greatly improved their function. The clinical trial, funded by the Medical Research Council, will enable us to test their safety and efficacy.

If our clinical trial demonstrates a proof of concept, we will seek a commercial partner to help us upscale the technology and make the microbeads more widely available. We also believe that this potentially game-changing innovation could be used to treat adults too.

Exploring microbead function

PhD student, Kadriye Güven made good progress in her study, which aims to better understand the interaction between the hepatocyte and mesenchymal stromal cells (MSCs) inside our new microbeads and how and why they are able to improve each other's function.

She has been perfecting a new way to retrieve and separate the cells, without damaging them.
To understand why HMB002 seem much more active than the original HMB001, Kadriye has been exploring the effect of cells in different alginate types. Alginate encapsulation allows nutrients, oxygen and metabolites to diffuse to and from the hepatocytes, but prevents antibodies or immune cells entering the microbeads, thus protecting the liver cells from the host immune response.

Later in her studies, Kadriye aims to test the use of spheroids to replace single cells within the beads.

Investigating the use of mesenchymal stromal cells as a potential cell therapy for biliary atresia

Postdoctoral researcher Dr Jessica Nulty continued to make great progress with her project, which is looking at using mesenchymal stromal cells (MSCs) as a potential cell therapy for the treatment of biliary atresia (BA).

BA is a rare medical condition, occurring in small infants, in which the bile ducts outside and inside the liver become scarred and blocked. This results in a build-up of bile in the liver which causes damage. This damage leads to scarring, tissue loss and cirrhosis.

The exact cause of BA is yet unknown, although it is hypothesised that either a genetic variant, viral infection or toxin triggers the immune system, causing an abnormal inflammatory response, which in turn causes damage to the cells lining the bile ducts.

MSCs have the ability to affect how the immune system acts and have been used to treat multiple diseases. This project is exploring the proposition that MSCs could potentially dampen down the inflammatory immune response in BA and minimise cell damage.

Jessica is investigating how MSCs might affect inflammation in BA, and in October 2022 PhD student Rhiannon Norman joined the group to look at how MSCs might affect fibrosis in BA.

By extracting cholangiocytes from explanted paediatric liver samples and putting them in specific culture conditions, Rhiannon has been able to grow three-dimensional organoids, some with BA and others without, which mimic the patient's bile duct. She is currently comparing these cells, looking for markers of fibrosis. She will then introduce MSCs to the cells to see how MSCs could benefit BA patients.

Later this year, Jessica and Rhiannon plan to test MSC therapy on precision-cut liver slices, which maintain all the different cell types in the right configuration that you would see in the liver. This will enable them to do a more in-depth analysis on how MSCs might affect inflammation and fibrosis in BA patients.

Thank you to the Papantoniou Family for continuing to support Jessica's work.

Optimising the cell isolation process from explant livers

Group quality manager and part time PhD student Hanish Anand has had an exciting breakthrough in his study as he is now able to successfully isolate hepatocytes from fibrotic livers.

The hypothesis for Hanish's project is that if the hepatocytes isolated from BA explants are functionally sound, they may be able to be infused back into the patient in order to repopulate the donor liver with the patient's own cells, thus reducing the need for immunosuppression. The reasoning for this hypothesis is that BA is a disease that directly affects the cholangiocyte cells that line the bile ducts but does not directly affect the hepatocytes.

Explant liver tissue, which we receive from young patients who have undergone a liver transplant, is very fibrotic and extremely difficult to isolate cells from. But Hanish has been able to perfect a technique that now makes successful hepatocyte isolation possible. He will now carry out extensive characterisation of these cells and examine how their functionality compares to cells isolated from healthy tissue.

Pictured below:
Dr Jessica Nulty

Investigating the effects of minimal hepatic encephalopathy in children with liver disease

PhD student Megan Earl has significantly advanced our knowledge of the under-recognised condition of Covert Hepatic Encephalopathy (CHE; brain dysfunction) in children with liver disease. Her study has highlighted the vital need for continued research in this area to help the children and families struggling with the effects of this disease.

CHE is an insidious form of Hepatic Encephalopathy (HE) – a serious complication of chronic liver disease caused by accumulation in the bloodstream of toxins normally eliminated by the liver. However, there is no established method for detecting CHE in infants and children. We think that this chronic exposure to toxins in the bloodstream may have a negative effect on brain growth and development, but there is very limited neonatal/paediatric neuroimaging data with this patient group, and we do not understand the impact of CHE on the microstructure of the developing brain.

Through her studies, Megan was able to design a service development questionnaire to assess the neurodevelopmental profile of all the children at King's with biliary atresia aged 12 and under, and 90 percent of parents responded to the survey (with over 100 responses). Sadly, results showed that children are struggling during the first 12 years of life, with over half of them requiring an additional support service of some description and nearly 40 percent of them requiring two additional support services.

In order to investigate when problems potentially start and if there is any correlation with biomarkers on BA, all of the children under five were invited to take part in a neurodevelopmental assessment. The results showed that regardless of their transplant status, all showed lower levels of development across all domains (including communication, socialisation and motor skills) compared to typical children. This suggests a global delay in development.

Liver variables were also examined to determine which children were more at risk of developmental problems than others. The key factor that emerged was how quickly children were clearing their jaundice after their Kasai surgery (a procedure which involves removing the blocked bile ducts and gallbladder and replacing them with a segment of small intestine, sewn to the liver, which functions as a new bile duct system). Currently, doctors see patients one month, three months and six months post Kasai, and at six months they will determine whether the Kasai surgery has been successful or not, based on whether they see jaundice. Megan's results suggest that assessing neurodevelopment as a predictive marker at six months is too late and should be done at one or three months.

We will never truly understand the mechanism of what is happening in these children unless we determine what is happening in the brain. Megan therefore designed an MRI protocol that allowed her to scan infants with BA at six months of age, without the use of sedation. Although she was only able to scan five children, due to access and staffing issues caused by the COVID-19 pandemic, she did see significant differences in their spectrum. Megan will continue her studies as a postdoctoral researcher until her funding runs out in August 2023. She will use this time to look at the older children (aged from 5-12) in more detail, to obtain more of a longitudinal idea of their development and pinpoint more disease-related factors.

Through this study, we have been able to offer practical help to many children and their parents, by referring them for support from speech and language therapists, physiotherapists and clinical psychologists. This has strengthened our belief that neurodevelopment assessments should become embedded in the routine medical care of children with BA in order to understand the trajectory of brain maturation in these children and to ensure neurodevelopmental needs are addressed alongside physical health.

Thank you to the Mowat family for continuing to support Megan's work.

Pictured below:
Megan Earl

Investigating the link between the gut microbiome and biliary atresia

Clinician Dr Van Jain completed her MD study, funded by charity Guts UK, to investigate links between the gut microbiome and biliary atresia.

Using serum and stool samples from children with BA, many of whom were involved with Megan's research, Van examined gut microbiomes, looked for cytokines and different markers of inflammation and tried to correlate this information with jaundice clearance and native liver survival after Kasai. These observations were carried out pre-Kasai and at three and six months post-Kasai. Improving the gut microbiome of these young patients may improve their outcomes, so Van now hopes to start a clinical trial to compare children who take probiotics with those who don't, and children who are breastfed with those that aren't.

She also plans to compare data sets with Megan to see if they can find any corelation between their studies and examine how the gut and liver might affect brain development.

Van is also a valued link between the MowatLabs and our surgical teams, helping to ensure that explanted liver tissue is sent to the paediatric biobank. This can then be released to support our studies.

Exploring the use of inflammatory profiles for children with liver disease

Last year, Dr Eirini (Serena) Kyrana, Clinical Senior Lecturer and Honorary Consultant in Paediatric Hepatology, began a pilot study to explore the effect of inflammation in children with liver disease.

If there is inflammation in the body then it is possible for children with the same severity of liver disease to experience different consequences from the disease, such as weight loss, muscle wastage and neurocognition issues.

Working with Dr Yun Ma, leader of our Liver Autoimmunity and Transplantation Group, Serena has been exploring possible ways to clinically assess patients in order to identify which of them are likely to have higher inflammation in their bodies (shown by the presence of high levels of cytokines – proteins that affect the immune system).

It's not standard practice to create inflammatory profiles of these patients but if we can find a way to link high inflammatory markers with specific issues, such as low weight, we may be able to use existing treatments and medicines to block or reduce the effect of the cytokines. Serena has presented the interim data from this ongoing study at a national conference (BSPGHAN 2023) and international conference (ESPGHAN 2023) and is focusing now on completing the study. They also hope to be able to apply their findings to a larger study in the near future.

Investigating liver disease in x-linked myotubular myopathy.

In January 2023, MSC student Stella Zhao joined the group to investigate why a rare genetic neuromuscular disorder can cause liver disease.

X-linked myotubular myopathy is a childhood disease that affects the nerves and the muscles. However, recent studies have shown that some children with the disease are dying due to liver-related complications.

It's very hard to obtain tissue samples for this condition because biopsies can be dangerous procedures for these very sick children. But last year a patient came to the hospital for liver surgery, giving us access to this extremely rare sample type.

Stella is optimising a new protocol to study membrane recycling to help us discover what is happening in the liver and why we think the disease is affecting the liver. Stella is working with hepatocytes in our lab in the first instance to help her perfect this method of study before she progresses to studying this extremely rare tissue sample.

Pictured right:
Stella Zhao

Future plans for the group

Further clinical trials

We will continue to seek approval and funding for future clinical trials in hepatocyte transplantation and the use of mesenchymal stromal cells (MSCs) as a therapy for children with BA.

MSC therapy has been successfully used to treat a number of conditions and we hope that it can be used to dampen down inflammation in children with BA, potentially preventing the need for a liver transplant at a later stage.

Following Minh Phuong Nguyen's PhD success last year showing the improvement of hepatocyte engraftment in models of hepatocyte transplantation, we will apply for funding to start a new clinical trial using the drug she tested in her study.

Reprogramming immune cells to reduce the need for biopsies

We plan to seek funding to reprogramme immune cells so that they can be brought back to stem cells and then turned into liver cells for study purposes. Immune cells could be collected from blood samples taken routinely from children at King's. If repurposed into liver cells, this would reduce the need for biopsies on our young liver patients.

3D Bioprinter

3D bioprinting is an emerging technology which offers the prospect of revolutionising the field of regenerative medicine. It uses additive manufacturing techniques to deposit biomaterials containing cells, know as 'bioinks', into precise, predesigned geometries in order to build 3D tissues.

With the generous support of Pallak and Faiza Seth, Mowatlabs will procure one of the leading 3D bioprinters on the market today, RegenHu's R-gen 200. These printers are being used across the field of regenerative medicine to transform patient care. For example, RegenHu's bioprinting platforms are used to print skin patches for grafting onto burn victims, to develop muscle tissue models by pharmaceutical company Novartis, and even to print cartilage for joint repair.

By using this printer to combine liver cells and bioactive biomaterials, we can create a 3D biological environment that can mimic the native liver. This will help advance our understanding of many liver diseases and may provide new 3D bioprinted therapies to treat young patients here at King's.

Pictured right: Bioprinter

Research highlights

Liver Autoimmunity & Transplantation Group

The group is working on several ongoing research projects, focusing on two areas:

- Understanding the disease processes of autoimmune liver diseases, aiming at establishing novel therapies to prevent progression to liver failure.
- Investigating the role of the immune system in the process of liver graft preservation, aiming at improving the quality of marginal liver grafts to ease donor shortages.

At the start of 2022, the Group, led by Dr Yun Ma and Mr Wayel Jassem, was composed of six members and three BSc students. It included one Senior Scientist (Yun Ma), one Consultant Transplant Surgeon (Wayel Jassem), two Senior Clinician Scientists (Dr Maria Serena Longhi and Dr Rodrigo Liberal), one Clinical Fellow (Dr Yeman Jebri) one PhD student (Tengfei Si) and one Research Technician (Dr Xiaohong Huang).

Research progress

New study into causes of non-alcoholic fatty liver disease (NAFLD)

The two-year project, which aims to better understand the causes of non-alcoholic fatty liver disease (NAFLD), is being funded by a £290,000 grant from the Kuwait Foundation for the Advancement of Sciences and is led by Mr Wayel Jassem.

NAFLD is very common in the UK and Kuwait and we aim to look into the initial causes of the disease and try to identify markers which could help us to develop future treatments. The study will involve the multiple profiling of two groups of adult patients with NAFLD, one with severe liver disease and the other with moderate disease.

We have applied for funding to support a PhD student from China and if successful, they will be supported by a joint PhD studentship between KCL – China Scholar Council (CSC) and join our group in September to work on the project.

Delays caused by paperwork and procedural necessities pushed back the start of this project, but we were still able to collect blood samples and data in readiness and the project has now begun in earnest.

Understanding the role of immune system cells in the spread of liver cancer

Surgeon and PhD student Dr Tengfei Si is making great progress with his investigations into the role of mucosal-associated invariant T (MAIT) cells and Hepatocellular Carcinoma (HCC), which is one of the most common malignant tumours in the liver and accounts for 90 per cent of primary liver cancer.

Intrahepatic MAIT cells are designed to clear liver cancer cells from the body, but if they become defective they may actually cause cancer to spread.

Tengfei has discovered a correlation between MAIT cells and three genes in blood and liver tissue samples of patients with HCC, which, he believes, may be responsible for weakened anti-tumour immunity.

He has been exploring the relationship between MAIT cells and a protein called osteopontin, which could be responsible for the promotion of tumour cell growth by inhibiting anti-tumour immunity executed by T cells and MAIT cells in the tumour tissue. This work is building on earlier experiments where he was able to ‘knock out’ (remove) the osteopontin gene from tumour cells.

His work is supported by Professor Nigel Heaton, Consultant Surgeon in Liver Transplant and Hepatobiliary and Pancreatic (HPB) Surgery, and a grant from King's College Hospital Charity has been awarded to support him to continue his study for a further year.

Understanding the role of immune cells in liver transplantation

We continued our work around the advancement of techniques to improve the quality of liver grafts, especially those currently being discarded, such as fatty livers caused by non-alcoholic fatty liver disease (NAFLD). Our study is focusing on the use of Normothermic Machine Perfusion (NMP), which has been shown to be an ideal tool to rescue fatty liver grafts. This novel technique for liver graft preservation and revival keeps the liver at body temperature with a constant oxygen supply. NMP also allows for the testing of liver graft performance and potentially therapeutic interventions prior to transplantation.

Late last year, Mr Wayel Jassem led a trial to add the natural drug Andrographolide to the normothermic machine to see if it can enhance the biology of fatty liver grafts by reducing fat content in liver cells. Andrographolide has been tested on animal models of fatty liver, but this was the first time that this drug had been tested on human liver cells in the context of transplantation. Preliminary findings are very encouraging and have shown similar results in the human cell line as we have seen in the animal models.

If we can publish a paper on this trial by the end of 2023, we hope to be able to secure two further years of funding to help advance this work.

Andrographolide is widely used to treat other conditions with inflammation, including the common cold. Post-doctoral Research Associate, Dr Zhenlin Huang, assisted by PhD student Dr Tengfei Si, has carried out many experiments to test the function of the drug in reducing fat content in hepatocytes and inflammation in immune cells.

By finding potential ways to make more marginal livers usable, our work could eventually help to dramatically reduce the transplant waiting list worldwide.

Advancing research into organ donation and transplantation through the management of the UK's busiest QUOD centre

Research Technician Dr Xiaohong Huang continued her work for the Quality in Organ Donation research programme (QUOD), the national initiative which facilitates research into organ donation and transplantation by providing researchers with samples and clinical data from appropriately consented / authorised organ donors.

As regional operational coordinator for QUOD – managing the busiest of all the QUOD centres – Xiaohong processes the blood, urine and small tissue samples of the kidneys, ureter, liver, heart and spleen before sending them to the QUOD central hub in Oxford. Her work to maintain this unique resource – a commitment that has spanned 12 years – is labour-intensive and time sensitive and requires her to constantly seek out funding to continue this vital work.

Autoimmune liver disease Ebook published

Dr Yun Ma and Professor Nanda Kerkar, Director of Division of Pediatric Gastroenterology, Hepatology and Nutrition at the Golisano Children's Hospital, University of Rochester, USA, successfully worked as guest editors for the influential international scientific journal: *Frontiers in Immunology* to publish a collection of 10 papers on The Association Between HLA Genes and Autoimmune Liver Diseases. A special eBook collecting the 10 papers plus the editorial was published in March 2023 and has drawn huge attention from the clinicians and scientists in this field.

Pictured right:
Dr Yun Ma

Understanding the role of regulatory T cells in autoimmune hepatitis

Unfortunately Dr Rodrigo Liberal was unable to work on his long-term studies into the role of regulatory T cells in the development and progression of autoimmune hepatitis in children last year. His three projects were close to completion one year ago. We hope that he will soon be able to continue the work with us to finalize these papers.

His projects were examining the role of T cells in three key patient groups:

- Pregnant women with autoimmune hepatitis who were paediatric liver patients at King's College Hospital. Dr Mohammed Yuksel, who was the formal group member as a Post-doctoral Fellow until October 2018, is happy to take over from Dr Liberal to complete this work after he starts his new post as a Lecturer at the University of Westminster, London, UK in July 2023.

- US paediatric patients admitted to hospital with acute liver failure, possibly because of an autoimmune liver condition. This project is on pause. Because the testing of one of the autoantibodies, anti-soluble liver antigen antibodies, should be performed by a Biotechnical company in Germany. We have not reached an agreement on the practical aspects including cost, etc., yet.

- Children with Primary Sclerosing Cholangitis (PSC) – a chronic disease which slowly damages the bile ducts inside and outside the liver. The disease is often associated with inflammatory diseases of the colon, especially chronic ulcerative colitis. We will re-start this project in September 2023 after recruiting a BSc student, Qing Shao, who will take an Extra Mutual Year as her third-year study of Biomedical Science at KCL.

Continuing our collaboration with Harvard to better understand autoimmune liver diseases

We maintained our close collaboration with Harvard Medical School, continuing our ongoing work with Harvard-based Group member and Senior Clinician Scientist, Dr Maria Serena Longhi, related to autoimmune liver disease in children. Dr Longhi published further papers on her ongoing work with Dr Ma.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9492699/

Supporting our future talent

We continued to supervise our three BSc Medical students and were delighted when Cheryl Wong received the Best Laboratory-based research project in Immunology award from the British Society of Immunology in July 2022, based on her high-quality dissertation derived from her research project conducted in Dr Ma's lab.

Future plans and new membership of the group

Joint group lead, Consultant Transplant Surgeon Mr Wayel Jassem, has submitted his Fellowship application to the Medical Research Council. If granted, the Fellowship will enable him to spend 20% of his time on research projects.

We look forward to welcoming four new members to our team and reporting on more progress in the coming months. We also believe that we are on track to publish a record number of papers for the third consecutive year. The four new members are:

- **Dr Huihong Yu**, Visiting Senior Research Fellow. She will start working with us in June 2023 on two research projects:
  1. Immunoregulation impairment in AIH
  2. Chronic paediatric pancreatitis

  Dr Yu is an Associate Professor / Consultant Hepatologist from the Department of Digestive Medicine, Second Affiliated Hospital of Chongqing Medical University, Chongqing, China.

- **Dr Xuan Luo**, PhD student to be supervised by Dr Yun Ma from Oct 2023 to Sep 2027 for four years. Dr Luo is currently a surgeon, working in the Department of Hepatobiliary Pancreatic Splenic Surgery, Nanfang Hospital of Southern Medical University, Guangzhou, China.

- **Dr Bowen Gao**, PhD student to be supervised by Mr Wayel Jessam from Oct 2023 to Sep 2027 for four years. Dr Gao has just graduated from Fudan University Medical School, Shanghai, China.

- **Miss Qing Shao**, a BSc student, will take an extramural year from September 2023 to August 2024.

Education and events update

Last year, our teams once again made great use of the excellent facilities in the Fraser Slorach Learning and Innovation Hub. This dedicated space, used for teaching and education, enables us to meet in person and remotely to share knowledge and expertise. It also continues to be a vital sanctuary for clinical colleagues, providing them with a space to take a break.

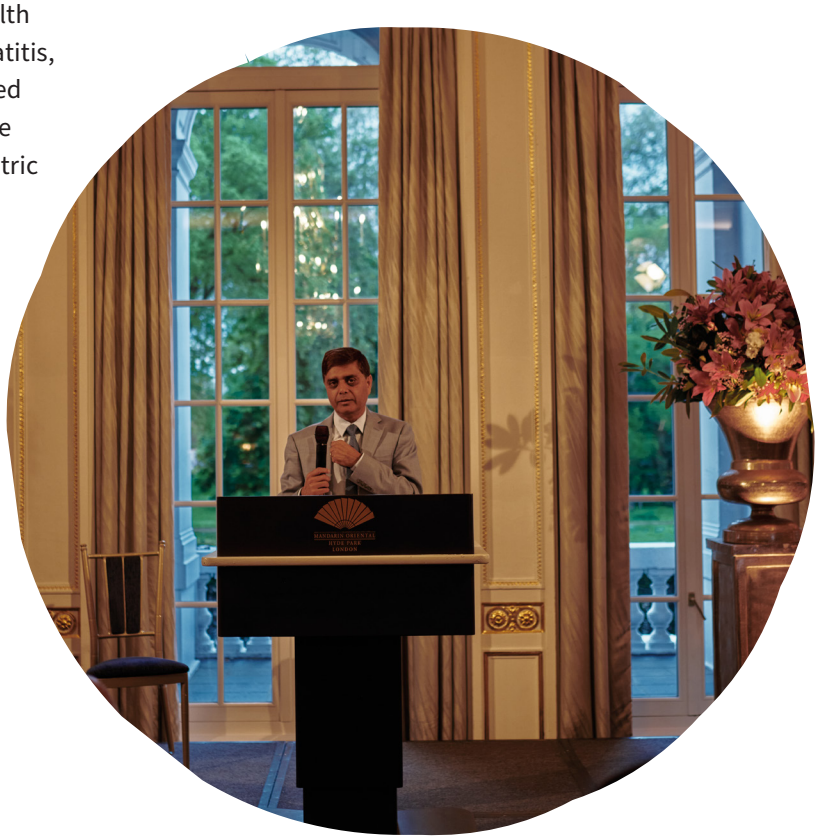
Through the hub we have been able to hold hybrid meetings with colleagues and collaborators at home and in hospitals, nationally and internationally. It has helped to keep our clinical care going, has improved our networking and has enabled us to continue our research and education work.

Professor Dhawan continued his involvement in a number of gene therapy trials in liver disease and consulted with senior neurologists. He advised the World Health Organisation (WHO) on the treatment of acute hepatitis, produced a number of publications and was featured in The Lancet. He was also a keynote speaker for the Annual Meeting of The European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) in May.

Transforming Liver Care Gala Dinner, May 2023

An incredible night at the Mandarin Oriental Hyde Park has raised over £200,000 profit for the TLC Appeal. Our wonderful volunteer committee, many of whom have had children successfully treated for liver disease by the King's team, worked incredibly hard to secure table sales and some amazing auction prizes.

Thank you to them: Georgie Beyhum, Vicki Millar, Candida Petersham, Rebecca Macmillan, Cathryn McAlpine, Olivia McAlpine, Ed Butler, Ann Totman and Sophie Taylor.
A number of representatives from the Mowatlabs team were able to attend and were given a personal thank you by Professor Dhawan (pictured below).



Biobank update

The King's Paediatric Liver Biobank is the largest of its kind in the world. It exists to facilitate research, and in 2022 we sent out more samples to research projects and received more applications from varied sources.

We continued to diversify, opening up our collection to a wider variety of tissue from surgical procedures, building on our collection of stool samples and setting up new pathways on wards to collect stool samples from our young patients. With the growing number of research projects focusing on the links between the liver and the gut microbiome, we expect that stool samples will become a larger part of our focus over the coming years.

Our figures for 2022 are outlined below:

Donors

- We collected samples from 311 patients.

Samples

- From these patients, we collected and stored 876 sample types including: serum, plasma, white blood cells, stool samples, tumour and background tissue from resection and transplants.

Research

- We distributed just over 200 samples to four new research projects throughout the year.
- We made maximum use of our precious collection, collaborating with two research colleagues to ensure they were able to share samples for their individual projects.
- We continued to support projects approved in 2020 and 2021, supplying them with samples on a regular basis or in bulk, depending on their individual requirements
- We also released 14 Biobank samples for diagnostic requirements, which ensured that the children in question did not need to come back to King's for additional blood tests.

Last year, Liver Biobank Manager Tom Dowe, Biobank Scientist Dr Munther Hussain and Data and Quality Manager Linda Steward also welcomed Biobank Technician Marwa Habarwaa to the team. With more hands on deck, we will now be able to support more research.

Future plans for the Biobank

Over the next 12 months, we aim to highlight specific cohorts within our collection to different research groups, both internally and externally, to help facilitate more research work.

We will continue to explore ways to annotate biobank samples with clinical data collected by King's. The hospital has a wealth of diverse data, which is standardised and recorded in a regular and reliable format. We want to investigate ways which will enable us to access and make full use of this valuable resource. This work will support our long term aim of eventually developing a new bespoke Biobank database and website.

THANK YOU

2022 was another successful year for our dedicated research teams and biobank colleagues. Together, we made exciting breakthroughs, uncovered significant insights, tested potentially game-changing hypotheses and shared our expertise. We are proud of our collective achievements and eager to advance our studies, which have the potential to propel cell therapy into an exciting new era.

Research requires patience and resilience, but we are driven by our shared determination to solve problems and develop new treatments to help transform the lives of children and young people with liver disease.

Collaboration is key and we simply would not be able to progress without the generous support of our donors. Your continued support enables us to innovate with creativity – to keep on seeking solutions to ensure that children with liver disease in the UK and across the globe can enjoy brighter futures. Thank you.

> The MowatLabs exist for one purpose – to transform the lives of young people with liver disease through pioneering research excellence. Sustained by our generous supporters, we will continue to collaborate and innovate – and together we will find new treatments for the children we serve.
>
> **Professor Anil Dhawan**
> Director of Research & Innovation
> King's College Hospital

If you would like any further information about our work, or have any questions, please contact Louise Richards, Head of Philanthropy & Partnerships at louiser@supportkings.org.uk or on +44 (0)7506 293428.