PERSIMUNE CENTRE OF EXCELLENCE FOR PERSONALISED MEDICINE OF INFECTIOUS COMPLICATIONS IN IMMUNE DEFICIENCY

PERSIMUNE Newsletter

January 2023

Dear all,

Another year has passed and on behalf of PERSIMUNE leadership, Riia and myself are happy to share with you another PERSIMUNE newsletter, which highlights some of the activities from across the PERSIMUNE network. We have continued on our mission to better understand mechanisms of disease and to improve clinical outcomes for patients with varying degrees of immune dysfunction. In 2022, a total of 60 manuscripts that reference the PERSIMUNE Danish National Research Foundation grant (DNRF126) have been published and eight people have completed research theses in collaboration with PERSIMUNE. We have highlighted a few of these activities below, and you can find a full list of 2022 publications at the end of this newsletter. If you have published work that should be on this list, please let us know.

In addition to these research outputs, PERSIMUNE continues to work hard to promote various aspects of precision medicine. There were a number of research events hosted at PERSIMUNE, ongoing research was presented at conferences near and far, and several research projects were disseminated via short videos (more below). We even hosted three “erhvervspraktik” students on their work experience week, with all three now convinced a career in bioinformatics is for them.

We would like to thank you all for your continued commitment to engaging with PERSIMUNE and wish you

all and your families a happy and healthy 2023. We look forward to seeing you soon at an upcoming research presentation and/or colloquium and wish you good luck with your research and clinical activities in the meantime. To stay up to date with ongoing and upcoming PERSIMUNE research activities, do not forget to follow PERSIMUNE on Twitter.

Finally, we want to thank everyone who contributed to the newsletter — it was a great collaborative effort.

Sincerely,
Daniel Murray
Deputy Centre Leader – PERSIMUNE

Riia Karoliina Sustarsic
Project Coordinator – PERSIMUNE

Contents of the newsletter

Research Highlights

There have been a number of excellent research outputs in 2022. A full list of manuscripts published can be found **below** (and is always kept updated on the **PERSIMUNE website**), but we wanted to take this opportunity to highlight some specific projects and the excellent work they are doing in certain patient populations.

Microbiome

The PERSIMUNE microbiome group continues to expand on sample collection and methodologies. We have now collected more than 2400 fecal samples from more than 1200 patients across 12 departments at Rigshospitalet.

In a 2022 paper (**Haematologica**), Tereza Faitova – PhD student in Carsten Niemann's group and co-supervised by PERSIMUNE-based Mette Jørgensen– captured a specific bacterial signature in gut microbiome of chronic lymphocytic leukemia (CLL) patients. Now Tereza is expanding and validating this study in a larger cohort and aims to compare bacterial signatures across multiple patient cohorts and healthy controls. However, microbiome analysis is sensitive to bias introduced during sample collection, sequencing, or the downstream bioinformatic analysis. To overcome the analysis bias and avoid spurious conclusions, she is working on novel machine learning (ML) based tools together with PERSIMUNE bioinformatician Ramtin Zargari Marandi. Previously, Ramtin has built a ML pipeline for taxonomical classification of metagenomic data. This together with different statistical methods and ML methods was used to construct a model to classify patients in risk of developing acute graft vs. host disease (aGvHD) based on fecal samples obtained pre-transplant (published in **Cells**).

It has been a long-term goal in the microbiome group to venture into functional analysis of the microbiome. Essentially asking "what does the microbiome do" instead of "what bacteria are present". Using metagenomic data, which is available for all the PERSIMUNE sequenced samples, this is possible. This approach led to a publication (**Int J Mol Sci**) by Mette Jørgensen on how a harsher conditioning regimen in hematopoietic stem cell transplant (HSCT) patients lead to the depletion of numerous metabolic functions of the gut microbiome. Another bacterial functionality we are currently investigating is that of antibiotic resistance. This is a rapidly increasing issue across the globe and poses a threat, especially to our immunocompromised patients. To explore this challenge in the PERSIMUNE cohorts, Mette Jørgensen and PhD student Jens Christian Nørgaard built the PERSIMUNE Gut Profiler, a bioinformatics pipeline that can map out the resistome (entire pool of genes conferring antibiotic resistance in bacteria) in the metagenomic data. Combining these data with the PERSIMUNE data warehouse, Jens Christian was able to assess the impact of antibiotic treatment on the gut microbiome and its resistome. The result of this study was that antibiotic treatment increases levels of antibiotic resistant bacteria *in vivo* in an unprecedented resolution (under review in **Journal of**

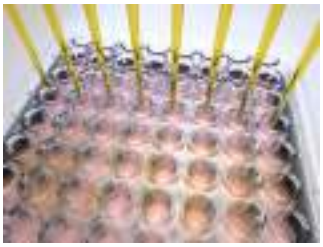
Infectious Diseases) providing crucial knowledge to inform antibiotic stewardship. Next step is to expand on this and investigate how these genotypic resistance profiles relates to clinical infections and phenotypic antibiotic resistance.

The Microbiome research group also welcomed back Emma Ilett who started her BRIDGE postdoc in 2022. Emma will be working at both PERSIMUNE and with Associate Professor Mani Arumugam at the Novo Nordisk Foundation Center for Basic Metabolic Research, KU, to further knowledge on the microbiome of aHSCT patients, with a view to inform interventional trials that aim to improve the microbiome and reduce clinical outcomes in this patient population.

Infections in lung transplant recipients

As the body of data on the lung transplant recipients in PERSIMUNE is gradually growing, research projects on the cohort are increasingly initiated and completed. In 2022, a **study on Achromobacter** infections was published, being the first to elucidate the burden of this rare bacteria in a general lung transplant cohort.

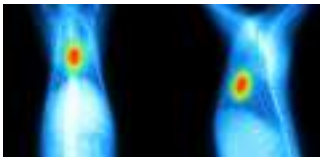
Another **study on anemia** following lung transplantation was published, concluding that anemia is a substantial problem seen in 75% of patients one year after transplantation. Both publications stand on the shoulders of the robust data collection from the nationwide microbiological and biochemical data sources available in PERSIMUNE. Several activities on fungal infections with Aspergillus in the lung transplant recipients are ongoing. Results on the protective effect of two antifungal prophylaxis guidelines were presented in an oral **abstract at IDweek**, Washington. Another **abstract** made it to Washington with results on the association of two commonly seen pathogens, Aspergillus and CMV, and received positive feedback from interested listeners. A collaboration with the transplant infectious disease unit at Toronto General Hospital was strengthened, as Cornelia Crone visited the group on her PhD-exchange, where she worked on the now submitted abstract on statins' potential antifungal effect. Studies on the immunological challenges of transplantation, often resulting in chronic organ rejection in the lung transplant cohort, have also been initiated during 2022, focusing on tissue type (HLA) matching, led by the Department of Clinical Immunology. We hope for a prosperous 2023 towards further international and interdisciplinary collaborations that can lead to improved treatment of this group of complex patients.



Immune profiling via Truculture

In 2022, work continued on the analysis of TruCulture data from the various immune dysfunctional patient groups studied in PERSIMUNE.

Previously, work has been published on the use of these methods to better understand immune response to various pathogens in **haematopoetic** stem cell transplant recipients and **Whipple** surgery patients. In 2022, work was published describing both the baseline and induced immune response for patients with infectious **spondylodiscitis**. Further, as part of the work on analysing TruCulture data within PERSIMUNE, PhD student Adrian Zucco, together with researchers from Institute Pasteur and Milieu Interieur, developed novel bioinformatics methodologies for the analysis of the complex, multi-dimensional data generated using this methodology. These methods used unsupervised learning approaches coupled with statistical methods to account for longitudinal data. As a result of this work, the diverse diseases cohorts from PERSIMUNE were able to be compared to the healthy controls from Milieu Interieur, providing a more in-depth picture of the immune dysfunction present in these patients. Principal component analysis and Uniform Manifold Approximation and Projection (UMAP) were used for dimensionality reduction, showcasing diverse patterns of immune response that could be assessed through generalized linear mixed models against variables and outcomes of interest. The intent is for this methodology to be used to study the various immune dysfunctional cohorts studied within PERSIMUNE and a manuscript describing this work and the method developed is now under preparation.



Tracer project

Several publications on different aspects of tracer development and testing have been published in 2022, and they can be found in the **full publication list below**.

Lot of resources have gone into peptide development. While commercially available libraries have poor consideration of unspecific binding and propagation ability, an alternative approach relying on phage display, NGS and bioinformatic analysis has shown to be much more powerful (**Sloth AB et al.**). The method uses a lot of computational resources, and the tracer group is now collaborating with the bioinformatics team at PERSIMUNE to use the analytical infrastructure available at CHIP (**link to Analytical servers below**). CRISPR-KO cell lines are working great for in vitro testing, and 8-10 candidates will be selected for testing in a humanized mouse model.

First clinical trial "64Cu-DOTATATE PET/CT-scan to diagnose macrophage infiltration in the heart valves of patients with infective endocarditis" started in April 2022 at a rate of ca. 2 patients per week. A second trial is expected to start early this year.

CLASS

In order to conduct high quality precision medicine research, it is crucial to have high quality clinical outcome classification. Mortality, clearly an extremely important clinical outcome, is often a difficult outcome to study in real world data as it is not consistently or reliably included in clinical records. Determining causes of death in transplant recipients, where patients have undergone highly specialized and complex treatment for long periods of time, can be a particularly challenging discipline, leading to registration of uncertain and imprecise causes. To overcome this difficulty, PERSIMUNE researchers (Neval Wareham, Andreas Søborg and others) recently developed a novel methodology utilising data within the PERSIMUNE data warehouse as well as clinical expertise to classify cause of death for haematopoetic and solid organ transplant recipients. This methodology has been used to provide a clear picture of the trends in causes of death in transplant recipients (**Søborg et al.**) and has been independently validated in a Swedish cohort (**Gjesdal et al.**).

Further, this is an important example of how data within the PERSIMUNE data warehouse can be enriched, as the data generated for this study has been returned to the data warehouse and is being utilised for other PERSIMUNE research projects studying these patients (e.g. **Dos Santos et al.**, **Abdulovski et al.**). This important project will continue to use the developed methodology to prospectively classify causes of death in transplant recipients, while also exploring possibilities to apply the same approach to other patient groups.

Operational Updates

Data catalogue

While Danish health data is amongst the best in the world, it is contained within disparate sources, each with their own strengths, limitations, documentation as well as cleanliness of the data within, meaning it is unapproachable to all but those with intimate knowledge of a specific source. One of the major aims of PERSIMUNE is to not only bring these disparate data sources together, but also to make these data more approachable for the clinical experts with the most understanding of the specific patient populations. With this in mind, in 2022 a data catalogue was developed to provide an overview of the various data available from national and local hospital sources, but also to collect and collate all the important lessons learnt by PERSIMUNE researchers over the years for analysing these data. For example, infectious outcomes (e.g. viral PCR tests) for PERSIMUNE patients can be performed at various hospitals across Denmark (depending on where that patient lives and is followed up). Each of these hospitals uses their own laboratory to test for various viruses and each of these laboratories reports to the relevant registry – often using different codes, analysis names, units of measurement etc. While recent efforts have been made to standardise the reporting of these lab results (e.g. through the use of NPU codes), when looking through the data it is clear these codes only capture a subset of the relevant data (particularly for historic data), meaning that research only using these codes could underestimate incidence of infections and/or miss vital data for studying a specific outcome. This same principle applies to other data types (e.g. biochemistry data). These learnings, while developed as part of individual PERSIMUNE projects, have broader value for the entire Danish research environment and are captured and explained in the data catalogue.

The data catalogue will be uploaded to the PERSIMUNE website shortly but can already be requested by contacting us at **persimune.rigshospitalet@regionh.dk**.

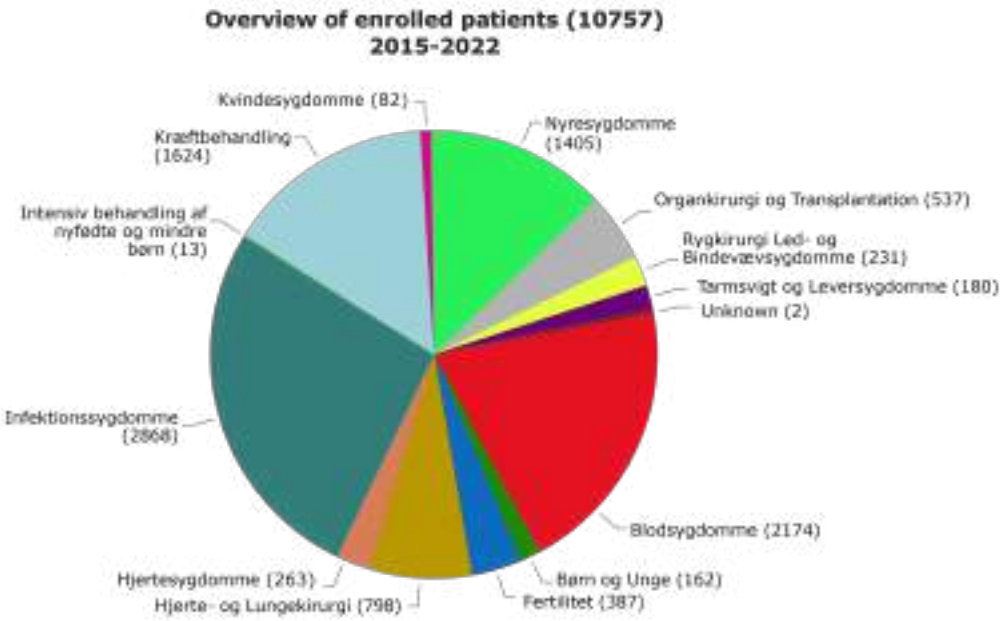
Analytical servers

In order to increase computational power for various PERSIMUNE projects, CHIP recently purchased five Linux servers each with 256 CPUs and four of them with 2 graphical processing units (GPUs). In the last couple of months more researchers have been using them and enjoying the benefits of having our own servers. The servers are used for all our computationally intensive tasks like machine learning and single nucleotide polymorphism imputations. Currently command line programs can be run using Docker, and CIMT is working on getting our RStudio installation up and running. Hopefully we will have RStudio Workbench and RStudio Connect running in the beginning of this year. RStudio connect can be used to easily and safely share plots, reports and interactive apps with collaborators, and we look forward to having this available soon.

If you have a computational task that you think would benefit from more computer power than your PC can provide, please contact us at **persimune.rigshospitalet@regionh.dk**.

Update from PERSIMUNE Biobank

Almost 11,000 patients have been enrolled in the PERSIMUNE biobank (see graph below). The majority of the samples are whole blood and plasma, but faeces, saliva, BAL and sputum (ekspektorat) are also collected. We also have DNA extracted from a subset of PERSIMUNE feces samples available for research. If you would like to know what is available for a specific patient cohort, please submit a **Feasibility request** and we will prepare an overview of relevant samples in the biobank. PERSIMUNE biobank will also soon be listed in the National Biobank Register, **www.biobanks.dk**, where one can search for samples based on a wide array of criteria, including ICD10 codes. At the moment, we have several ongoing biobank projects investigating tick-transmitted infections, and samples will soon be sent to France for analysis of a new biomarker for post-transplant lymphoproliferative disorders (PTLD).



Funding News

- **Neval Ete Wareham** has received a Region H postdoc grant for her project "Virus transcription factor, ZEBRA, som prædiktor for Posttransplantations lymfoproliferative sygdom (PTLD)"

- **Christina Ekenberg** has received a Region H postdoc grant for her project "Cytomegalovirusinfektion hos lungetransplanterede: fordele og ulemper ved henholdsvis kort- og langvarig valganciclovirprofylakse".

- **Ivan Vogelius** has received a Forskningsprojekt 2 grant from the Independent Research Fund Denmark (DFF): "Self-supervised artificial intelligence for large scale analysis of longitudinal images in oncology".

- **Kjeld Schmiegelow** has been awarded the Novo Nordisk Foundation Distinguished Investigator Award in Clinical and Translational Research: "PREDICT: Predispositions Revisited – Exploring Diagnostics, Interventions for Cure & Toxicity (childhood cancer as a Rare Disease prototype)".

- **Christian Møller Jensen and Lena Specht** have received a Region H skolarstipendium for their project "Radiation-induced lymphopenia and its clinical impact among patients with head & neck cancer receiving curative intent radiotherapy, stratified by HPV status - a Danish multi-center cohort study".

- **Jens Ulrik Stæhr Jensen** has received a Forskningsprojekt 1 grant from the Independent Research Fund Denmark (DFF): "THERM-A-LUNG: "Investigator initiated, randomized, controlled

study on THERMotherapy Against infections in persons with severe chronic LUNG disease".

Awards

- In 2022, **Jens Lundgren** was knighted with the Order of Dannebrog (Ridder af Dannebrogordenen). Furthermore, he has received the Erhoff Award as well as Danica Pension's Honorary Prize.
- **Lena Specht** received a Lifetime Achievement Award at the 2022 European Society for Radiotherapy and Oncology (ESTRO) Conference. **You can read her interview here.**

Graduations

- **Cynthia Terrones Campos** successfully defended her PhD thesis titled "Radiation-induced lymphopenia: Risk factors and clinical impact". Cynthia was supervised by Jens Lundgren, Lena Specht, Ivan Richter Vogelius, Marie Helleberg and Bruno Ledergerber.
- **Lars Klingen Gjærde** successfully defended his PhD thesis titled "Vitamin status and acute graft-versus-host disease after allogeneic hematopoietic cell transplantation". Lars was supervised by Henrik Sengeløv and Sisse Rye Ostrowski.
- **Migle Gabrielaite** successfully defended her PhD thesis titled "Genomics of microbial pathogens in chronic infections". Migle was supervised by Finn Cilius Nielsen and Rasmus Lykke Marvig.
- **Adrian Gabriel Zucco** successfully defended his PhD thesis titled "Explainable Machine Learning for Precision Medicine of Patients with Infectious Diseases". Adrian was supervised by Jens Lundgren, Ole Winther and Cameron MacPherson.
- **Maria Vinh Thuy Tien Ta** successfully defended her MSc thesis titled "Analysis and Visualization of genetic correlation of successful repurposing drugs". Maria was supervised by Cameron MacPherson, Mette Jørgensen and Preston Leung as well as Anders Gorm Pedersen from DTU.
- **Christian Møller Jensen** successfully defended his MSc thesis titled "Development, assessment, validation, and predictive capabilities of a chest x-ray-based quantification tool for patients hospitalized with COVID-19 pneumonia: The MBrixia Score". Christian was supervised by Jens Lundgren, Marie Helleberg and Kasper Sommerlund Moestrup.
- **Malene Kronborg** successfully defended her MSc thesis titled "Relationship between the gut microbiome and risk of cardiovascular disease – Implications for people living with HIV". Malene was supervised by Daniel Murray and Lars Peters.

- **Harald Vindahl Andersen** successfully defended his MSc thesis titled "Superinfections in COVID-19 patients receiving extracorporeal membrane oxygenation support". Harald was supervised by Jens Lundgren and Marie Helleberg.

New Staff and Students

- **Maja Milojevic**, Bioinformatician at PERSIMUNE
- **Ernesto Gargiulo**, PERSIMUNE guest researcher hosted by Carsten Niemann
- **Alisa Timiryasova**, PhD student in cohort studies at CHIP
- **Anja Dahl**, MATCH doctor and PhD student at PERSIMUNE

Please forgive us and let us know if we missed someone!

Past and Future Events

- **PERSIMUNE Retreat** – after one retreatless year and one postponement, the PERSIMUNE community was able to get together in April 2022 for the Annual Retreat in Snekkersten. The 2023 Retreat is just around the corner – we will return to Snekkersten 9-10 February to discuss the final two years of PERSIMUNE and plans for the future.
- **PERSIMUNE Research Presentations** – internal research presentations for ongoing PERSIMUNE associated research, next one scheduled for **13 January**, 14:00-16:00
- **PERSIMUNE Basic and Translational Research Colloquia** – presentations that aim to improve connections between basic and translational researchers, next one is preliminarily scheduled for 23 March, 16:00-17:00, with Sisse Ostrowski presenting on large-scale genetic cohorts.

Please encourage staff at your department to attend PERSIMUNE events and let us know if you have ideas for future presenters.

PERSIMUNE conference stories – IDWeek in DC

Infectious Disease Week (IDWeek) is an annual event run by the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA), the HIV Medicine Association (HIVMA), the Pediatric Infectious Diseases Society (PIDS), and the Society of Infectious Diseases Pharmacists (SIDP). In October this year, Wendy Bannister, Ramtin Zargari Marandi, Signe Marie Wulff, and Jens Lundgren travelled to Washington DC to attend. A whole

range of topics were covered including COVID-19 vaccination and treatment, updates on the monkeypox and polio outbreaks, antifungals and antibiotics, HIV treatment, and a new vaccine for hepatitis B.

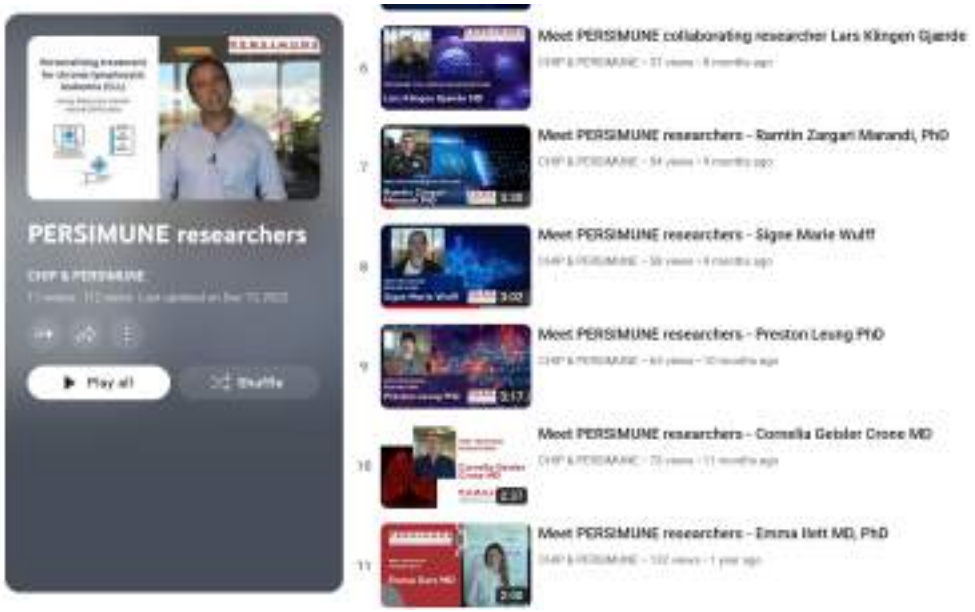
The conference opened with an interesting panel discussion on the challenge of communication during the COVID-19 pandemic, providing perspectives from medical and journalism fields. The audience was then treated to a preview performance of a musical about Alexander Fleming and the discovery of antibiotics!

During the course of the 5-days of talks and workshops, Signe gave an oral presentation on a PERSIMUNE project, comparing the effect of different strategies for antifungal prophylaxis (universal versus targeted) on incidence rates of invasive aspergillosis among lung transplant recipients. Jens participated in a session on adaptive platform trials, which introduced trial design and methodology for evaluating multiple treatments across different populations. Our PERSIMUNE representatives also presented posters on using a data-driven machine learning approach to predict plasma leakage in patients with suspected dengue infection, the association between invasive aspergillosis and cytomegalovirus, and association of side effects from COVID-19 vaccination and immunological response.

Find out more about the conference here: **https://idweek.org/**

Meet PERSIMUNE researchers

A video series featuring PERSIMUNE researchers was launched in 2021 and now we have a series of 11 videos available on **Youtube**.



Feel free to distribute this newsletter and to send us potential

news items and other ideas for the next one.

PERSIMUNE publications 2022

*Please let us know of any missing publications at **persimune.rigshospitalet@regionh.dk**.*

1. **Hyperimmune immunoglobulin for hospitalised patients with COVID-19 (ITAC): a double-blind, placebo-controlled, phase 3, randomised trial.** ITAC (INSIGHT 013) Study Group.
   Lancet. 2022:S0140-6736(22)00101-5. **Abstract**

2. ***Achromobacter* spp. in a Cohort of Non-Selected Pre- and Post-Lung Transplant Recipients.** Crone CG, Rezahosseini O, Schultz HHL, Qvist T, Johansen HK, Nielsen SD, Perch M.
   Pathogens. 2022;11(2):181. **Abstract**

3. **Pneumocystis jirovecii pneumonia in liver transplant recipients in an era of routine prophylaxis.** Andreasen PB, Rezahosseini O, Møller DL, Wareham NE, Thomsen MT, Houmami R, Knudsen AD, Knudsen J, Kurtzhals JAL, Rostved AA, Pedersen CR, Rasmussen A, Nielsen SD.
   Immun Inflamm Dis. 2022;10(1):93-100 **Abstract**

4. **Integrative Lipidomics and Metabolomics for System-Level Understanding of the Metabolic Syndrome in Long-Term Treated HIV-Infected Individuals.** Olund Villumsen S, Benfeitas R, Knudsen AD, Gelpi M, Høgh J, Thomsen MT, Murray D, Ullum H, Neogi U, Nielsen SD.
   Front Immunol. 2022;12:742736. **Abstract**

5. **Identifying patients with chronic lymphocytic leukemia without need of treatment: End of endless watch and wait?** Brieghel C, Galle V, Agius R, da Cunha-Bang C, Andersen MA, Vlummens P, Mattsson M, Rosenquist R, Smedby KE, Herling CD, Bahlo J, Hallek M, Lundgren JD, Offner F, Niemann CU.
   Eur J Haematol. 2022. Epub ahead of print. **Abstract**

6. **Prospective phase II trial of prognostication by 68Ga-NOTA-AE105 uPAR PET in patients with neuroendocrine neoplasms: Implications for uPAR targeted therapy.** Carlsen EA, Loft M, Loft A, Berthelsen AK, Langer SW, Knigge U, Kjaer A.
   J Nucl Med. 2022:jnumed.121.263177. **Abstract**

7. **Activity Dose Reduction in 64Cu-DOTATATE PET in Patients with Neuroendocrine Neoplasms: Impact on Image Quality and Lesion Detection Ability.** Loft M, Carlsen EA, Johnbeck CB, Jensen CV, Andersen FL, Langer SW, Oturai P, Knigge U, Kjaer A.
   Mol Imaging Biol. 2022. Epub ahead of print. **Abstract**

8. **Social distancing in relation to severe exacerbations of COPD - a nationwide semi-experimental study during the COVID-19 pandemic.** Saeed MI, Sivapalan P, Eklöf J, Ulrik CS, Browatzki A, Weinreich UM, Jensen TT, Biering-Sørensen T, Jensen JS.
   Am J Epidemiol. 2022:kwab292. **Abstract**

9. **Persistence and genetic adaptation of Pseudomonas aeruginosa in patients with chronic obstructive pulmonary disease.** Eklöf J, Misiakou MA, Sivapalan P, Armbruster K, Browatzki A, Nielsen TL, Lapperre TS, Andreassen HF, Janner J, Ulrik CS, Gabrielaite M, Johansen HK, Jensen A, Nielsen TV, Hertz FB, Ghathian K, Calum H, Wilcke T, Seersholm N, Jensen JS, Marvig RL.
   Clin Microbiol Infect. 2022:S1198-743X(22)00041-6. **Abstract**

10. **Posttransplantation Diabetes Mellitus Among Solid Organ Recipients in a Danish Cohort.** Dos Santos Q, Hornum M, Terrones-Campos C, Crone CG, Wareham NE, Soeborg A, Rasmussen A, Gustafsson F, Perch M, Soerensen SS, Lundgren J, Feldt-Rasmussen B, Reekie J.
    Transpl Int. 2022;35:10352. **Abstract**

11. **Risk of Bacterial, Viral, and Fungal Infections in Patients With Solid Malignant Tumors Treated With Curative Intent Radiation Therapy.** Terrones-Campos C, Ledergerber B, Specht L, Vogelius IR, Helleberg M, Lundgren J.
    Adv Radiat Oncol. 2022;7(6):100950. **Abstract**

12. **Patients with CLL have lower risk of death from COVID-19 in the omicron era.** Niemann CU, da Cunha-Bang C, Helleberg M, Ostrowski SR, Brieghel C.
    Blood. 2022:blood.2022016147. **Abstract**

13. **The gut microbiome in patients with chronic lymphocytic leukemia.** Faitová T, Svanberg R, Da Cunha-Bang C, Ilett EE, Jørgensen M, Noguera-Julian M, Paredes R, MacPherson CR, Niemann CU.
    Haematologica. 2022. Epub ahead of print. **Abstract**

14. **Increased incidence rates of positive blood cultures shortly after chemotherapy compared to radiotherapy among individuals treated for solid malignant tumours.** Roen A, Terrones C, Bannister W, Helleberg M, Andersen MA, Niemann CU, Daugaard G, Specht L, Mocroft A, Reekie J, Lundgren J.
Infection. 2022. Epub ahead of print. **Abstract**

15. **Pre-transplantation vitamin E levels and acute graft-versus-host disease after non-myeloablative allogeneic hematopoietic cell transplantation.** Gjærde LK, Ostrowski SR, Jørgensen NR, Schierbeck F, Andersen NS, Friis LS, Kornblit B, Petersen SL, Schjødt I, Sengeløv H.
Transpl Immunol. 2022;74:101650. **Abstract**

16. **Development and Validation of a Risk Score for Post-Transplant Lymphoproliferative Disorders among Solid Organ Transplant Recipients.** Dos Santos Q, Wareham NE, Mocroft A, Rasmussen A, Gustafsson F, Perch M, Sørensen SS, Manuel O, Müller NJ, Lundgren J, Reekie J.
Cancers (Basel). 2022;14(13):3279. **Abstract**

17. **Early- and late-onset posttransplant lymphoproliferative disorders among adult kidney and liver transplant recipients.** Abdulovski R, Møller DL, Knudsen AD, Sørensen SS, Rasmussen A, Nielsen SD, Wareham NE.
Eur J Haematol. 2022. Epub ahead of print. **Abstract**

18. **Validation of cause of death classification after heart transplantation and cause-specific life expectancy compared to the general population.** Gjesdal G, Lundgren J, Czuba T, Wareham NE, Gustafsson F, Nilsson J, Smith JG, Braun OÖ.
Clin Transplant. 2022:e14756. Epub ahead of print. **Abstract**

19. **Trends in underlying causes of death in solid organ transplant recipients between 2010 and 2020: Using the CLASS method for determining specific causes of death.** Søborg A, Reekie J, Rasmussen A, Cunha-Bang CD, Gustafsson F, Rossing K, Perch M, Krohn PS, Sørensen SS, Lund TK, Sørensen VR, Ekenberg C, Lundgren L, Lodding IP, Moestrup KS, Lundgren J, Wareham NE.
PLoS One. 2022;17(7):e0263210. **Abstract**

20. **Tixagevimab-cilgavimab for treatment of patients hospitalised with COVID-19: a randomised, double-blind, phase 3 trial.** ACTIV-3–Therapeutics for Inpatients with COVID-19 (TICO) Study Group.

Lancet Respir Med. 2022:S2213-2600(22)00215-6. **Abstract**

21. **Responses to a Neutralizing Monoclonal Antibody for Hospitalized Patients With COVID-19 According to Baseline Antibody and Antigen Levels : A Randomized Controlled Trial.** ACTIV-3/TICO Bamlanivimab Study Group, Lundgren JD, Grund B, Barkauskas CE, Holland TL, Gottlieb RL, Sandkovsky U, Brown SM, Knowlton KU, Self WH, Files DC, Jain MK, Benfield T, Bowdish ME, Leshnower BG, Baker JV, Jensen JU, Gardner EM, Ginde AA, Harris ES, Johansen IS, Markowitz N, Matthay MA, Østergaard L, Chang CC, Goodman AL, Chang W, Dewar RL, Gerry NP, Higgs ES, Highbarger H, Murray DD, Murray TA, Natarajan V, Paredes R, Parmar MKB, Phillips AN, Reilly C, Rupert AW, Sharma S, Shaw-Saliba K, Sherman BT, Teitelbaum M, Wentworth D, Cao H, Klekotka P, Babiker AG, Davey VJ, Gelijns AC, Kan VL, Polizzotto MN, Thompson BT, Lane HC, Neaton JD.
Ann Intern Med. 2022;175(2):234-243. **Abstract**

22. **Efficacy and safety of two neutralising monoclonal antibody therapies, sotrovimab and BRII-196 plus BRII-198, for adults hospitalised with COVID-19 (TICO): a randomised controlled trial.** ACTIV-3/Therapeutics for Inpatients with COVID-19 (TICO) Study Group.
Lancet Infect Dis. 2022;22(5):622-635. **Abstract**

23. **Evaluating Primary Endpoints for COVID-19 Therapeutic Trials to Assess Recovery.** Douin DJ, Siegel L, Grandits G, Phillips A, Aggarwal NR, Baker J, Brown SM, Chang CC, Goodman AL, Grund B, Higgs ES, Hough CL, Murray DD, Paredes R, Parmar M, Pett S, Polizzotto MN, Sandkovsky U, Self WH, Young BE, Babiker AG, Davey VJ, Kan V, Gelijns AC, Matthews G, Thompson BT, Lane HC, Neaton JD, Lundgren JD, Ginde AA; ACTIV-3/Therapeutics for Inpatients with COVID-19 (TICO) Study Group.
Am J Respir Crit Care Med. 20227. Epub ahead of print. **Abstract**

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