KI impact case studies

Submitted to the Swedish Research Council's assessment of Basic Medicine 2024

Karolinska Institutet

Nr	Title/Impact summary	Contact	Subject
1	**Title:** Preventing skin sensitization and allergic contact dermatitis through stronger regulations and public health recommendations	Carola Lidén	Immunology Toxicology

Impact summary:
Professor Carola Lidén's team at Institute of Environmental Medicine (IMM) at Karolinska Institutet (KI) has significantly strengthened EU regulations by advancing knowledge on skin sensitizers like nickel, preservatives, and fragrance allergens. The research has led to stricter EU regulations, especially by lowering exposure and classification limits for isothiazolinone preservatives and ensuring allergen labeling. Moreover, the studies have shaped safety guidelines protection of consumers and workers, and reduced risks for allergic contact dermatitis. By developing and validating methods for exposure assessment and compliance verifications, now widely used by researchers and authorities, their work has enhanced public health, helped sensitized individuals to avoid exposure, reduced healthcare costs, and supported efficient disease prevention across health care, industries and regulatory bodies.

2	**Title:** Rapid results to guide public health strategies against SARS-CoV2 and its emerging variants	Benjamin Murrell	Immunology

Impact summary:
Throughout the SARS-CoV-2 pandemic, new variants of the virus repeatedly emerged and spread, prompting rapid global assessment to understand their risks and guide decisions on monoclonal antibody treatments and vaccine strategies. Organizations like the World Health Organization (WHO) and European Centre for Disease Prevention and control (ECDC) regularly invited scientists with early, often unpublished findings on variant characteristics to inform their responses. Among these experts, Daniel Sheward and Ben Murrell at Karolinska Institutet (KI), were invited to present their research at multiple international meetings, where they contributed with essential data and insights to discussions on SARS-CoV-2 variants and strategies for vaccines and monoclonal antibody therapies.

3	**Title:** Starting the single-cell transcriptome-sequencing revolution	Rickard Sandberg Sten Linnarsson	Biochemistry & Molecular Biology Cell Biology

Impact summary:
Professors Richard Sandberg and Sten Linnarsson have developed innovative techniques and protocols to analyze transcriptomes at the single-cell level and have advanced biological and biomedical research by making single-cell RNA sequencing widely accessible. This approach has enabled the systematic identification of cell types across tissues in humans and model organisms. It has also become essential for uncovering disease-specific cellular changes, including those within the tumor microenvironment. During the COVID-19 pandemic, single-cell RNA sequencing was used to identify virus receptorexpressing cells and tracking immune response alterations, such as hyperactive macrophages and exhausted T cells, thus providing crucial insights into viral impact on tissues and mechanisms of spread. This technology will be used to uncover more precise mechanisms underlying health and disease and pave the way for groundbreaking diagnostic and therapeutic strategies.

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4	**Title:** Dopamine transporter PET Imaging for the diagnosing Parkinson´s disease	Andrea Varrone	Medicinal Chemistry Neurosciences Physiology

Impact summary:
Karolinska Institutet researchers have developed a groundbreaking positron emission tomography (PET) imaging agent called Fluorodat to more accurately detect Parkinson's disease and monitor its progression. Fluorodat markedly improves on older imaging techniques by offering clearer visualization of dopamine transporter proteins (DAT) without interference from common medications like antidepressants. Since its clinical implementation in 2021, Fluorodat has replaced older SPECT-based imaging methods in some European hospitals and streamlined in-house production and delivered more timely diagnoses. As a result, clinicians can now better track Parkinson's progression and provide patients with faster and more precise care while reducing healthcare costs.

5	**Title:** Unravelling pathogenetic mechanisms in metabolic diseases identified by whole genome sequencing	Anna Wedell Anna Wredenberg	Biochemistry & Molecular Biology Genetics & Heredity

Impact summary:
A first step in the transition towards precision medicine is represented by whole genome sequencing (WGS) for diagnosis of rare diseases. Professor Anna Wedell and professor Anna Wredenberg at Karolinska Institutet (KI) have created a strong, translational environment combining cutting-edge basic science, highthroughput genomics and highly specialized clinical medicine in the area of inborn errors of metabolism. As a result, new groups of patients receive correct diagnoses and treatment in early disease stages, and novel pathogenetic mechanisms are unravelled by detailed mechanistic investigations in model systems. This paves the way for studies to further improve diagnostics and develop individualized treatments.

6	**Title:** Rapid RNA-Extraction-Free COVID-19 Testing: Expanding Diagnostic Capacity for Global Health Impact	Björn Reinius	Biochemistry & Molecular Biology

Impact summary:
During the emergence of the COVID-19 pandemic, Associate Professor Björn Reinius at Karolinska Institutet (KI) pioneered the development of RNA-extraction-free molecular diagnostics, which hugely impacted COVID-19 clinical testing and alleviated global reagent shortages. By heat-based inactivation and optimized reaction chemistry, Reinius' approach enabled samples to go directly into clinical RT-PCR assay without further processing, increasing test capacity by up to 500%. The method was used in over three million tests in Sweden, became widely adopted internationally, accelerated COVID-19 diagnostics, and aided variant tracking – including real-time Omicron monitoring during its surge at turn of 2021/2022. Reinius' innovative method became one of Sweden's most widely adopted academic contributions to clinical pandemic diagnostics, demonstrating an exceptional "real-world" impact for an academic initiative.

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7	**Title:** AI-driven precision diagnostics for enhanced cancer treatment and patient outcomes	Mattias Rantalainen Johan Hartman	Physiology

Impact summary:
Karolinska Institutet researchers Johan Hartman and Mattias Rantalainen have developed Stratipath Breast - the first EU regulatory compliant (CE-IVDD) AI-based solution for breast cancer risk assessment which enables more precise and affordable diagnostic precision than traditional molecular testing. Developed through collaborative basic and translational research between KI's pathology and AI experts, Stratipath's deep learning technology analyzes digitized cancer tissue and provides timely insights for chemotherapy decisions. This cloud-based diagnostic tool, already integrated into healthcare in several Swedish regions, eliminates expensive equipment and accelerates healthcare. With ongoing expansion, Stratipath democratizes access to precision oncology and fosters equitable healthcare while also saving time and resources.

8	**Title:** Uncovering cellular interactions and complexity in tissue biology	Jonas Frisén	Biochemistry & Molecular Biology Immunology Neurosciences

Impact summary:
Professor Jonas Frisén's group at Karolinska Institutet (KI) played a crucial role in developing the breakthrough technique of spatial transcriptomics. This method maps the spatial expression of all genes within a tissue and markedly enhances our ability to study cellular interactions in health and disease. Early commercialization through Spatial Transcriptomics AB and its acquisition by 10x Genomics in 2018 as Visium Spatial Gene Expression facilitated global access to the technology. Widely adopted, spatial transcriptomics now accelerates biomedical research and advances personalized medicine, thereby influencing both science and economy.

9	**Title:** Measuring drug-protein interactions with the cellular thermal shift assay (CETSA)	Pär Nordlund	Biochemistry & Molecular Biology Cell Biology Medicinal Chemistry

Impact summary:
Cellular Thermal Shift Assay (CETSA) has had a significant impact on early drug development globally as the first broadly applicable method to measure direct interactions of a drug with its target protein in intact cells. Therefore, the method solves a critical challenge in drug development, to make sure that a drug hits its anticipated protein target in a physiological context, as well as to optimize its binding to this target. Also, the method provides the means to identify off-targets and other cellular effects that contribute to a drug's mechanism of action as well as toxicity.
The method is now broadly applied in the pharmaceutical industry at different stages of drug development.

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10	**Title:** New synthetic lethal combination therapy for metastatic castrationresistant prostate cancer	Thomas Helleday	Biochemistry & Molecular Biology Cell Biology

Impact summary:
Professor Thomas Helleday at Karolinska Institutet (KI) pioneered the development of a new treatment for castration-resistant prostate cancer (mCRPC), by combining poly (ADP-ribose) polymerase (PARP) inhibitors like olaparib with androgen deprivation therapy (ADT). This approach leverages ADT's ability to block a specific type of DNA repair in cancer cells which makes them highly susceptible to PARP inhibition. Clinical trials have already demonstrated significantly improved progressionfree survival, and has led to regulatory approvals by the European Medicines Agency (EMA) and U.S. Food and Drug Administration (FDA) in 2022 and 2023, respectively. In Sweden, the Dental and Pharmaceutical Benefits Agency recently expanded the use of these treatments, and they are now included in the national care program. Helleday's combination therapy offers a new, tolerable treatment option and sets a new standard for the care of patients with mCRPC.

11	**Title:** Pioneering veterinary vaccine development and expanding animal health solutions	Jan-Ingmar Flock	Immunology Microbiology

Impact summary:
Professor Jan-Ingmar Flock's group at Karolinska Institutet was instrumental in developing Strangvac - the world's first effective vaccine against strangles in horses. Strangvac addesses a major challenge and provides over 90% protection against this highly contagious and potentially fatal disease, impacting an estimated 18 million horses across Europe and the US. The research led to the founding of Intervacc AB, a Nasdaq-listed company that now also develops vaccines for other animal infections, including Staphylococcus aureus in cows and Streptocuccus suis in piglets. Intervacc's efforts thus promotes effective and accessible veterinary vaccines, and supports animal health and industry.

12	**Title:** Transforming perceptions of nitrate: from suspected toxin to athletic enhancer and cardiovascular protector	Jon Lundberg	Biochemistry & Molecular Biology Pharmacology & Pharmacy Physiology

Impact summary:
Professors Jon Lundberg and Eddie Weitzberg at Karolinska Institutet redefined dietary nitrate, once deemed an inert byproduct, as an important source of nitric oxide (NO) with notable health benefits. Their discovery of the nitrate-nitrite-NO pathway revealed that nitrate from food, e.g., beetroot and leafy greens, could potentially improve cardiovascular health. Since their discovery, the field has grown significantly and influenced both dietary guidelines and product development for endurance athletes. Moreover, ongoing clinical trials suggest that dietary nitrate as a promising intervention for cardiovascular disease.

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13	**Title:** Transforming prostate cancer diagnostics and screening	Martin Eklund	Medicinal Chemistry Genetics & Heredity

Impact summary:
Prostate cancer is the most common cancer in men. Researchers at Karolinska Institutet (KI) have developed advanced methods combining protein biomarkers, genetics, clinical data, and imaging to improve the early detection and screening of prostate cancer. These methods have proven to be superior to traditional PSA testing and significantly reduces overdiagnosis of indolent prostate cancer, unnecessary biopsies, and health costs. This research has been validated across diverse populations, affected European and US guidelines, and has been commercialized by A3P Biomedical to bring improved prostate cancer testing to the market to help patients in clincal routine.

14	**Title:** Developing the world's first Chikungunya virus vaccine	Peter Liljeström	Immunology Microbiology

Impact summary:
Professor Peter Liljeström at Karolinska Institutet (KI) pioneered the research underlying the development of the world's first licensed chikungunya vaccine, Ixchiq, now produced by the French biotech company Valneva. This vaccine addresses a major public health need by preventing chikungunya virus infections, a debilitating mosquito-borne illness that spreads globally, but particularly in tropical and subtropical regions. Since its approval in the United States, Canada, and Europe, the vaccine has gained momentum for additional approvals and broader applications, supported by international collaboration through European Medicines Agency's OPEN initiative. Valneva is also expanding Ixchiq's availability in low- and middleincome countries.

15	**Title:** Revolutionizing cervical cancer prevention: from HPV screening and vaccination to cancer elimination strategies	Joakim Dillner Karin Sundström	Biochemistry & Molecular Biology Microbiology

Impact summary:
Professor Joakim Dillner's research at Karolinska Institutet (KI) has led to transformative advancements in cervical cancer prevention through HPV screening and vaccination strategies. His team pioneered the use of PCR-based HPV screening and has shown that it is more reliable than traditional Pap smears and now forms the backbone of Sweden's national program. Their research also supported the rollout of school-based HPV vaccination in girls, extended to boys in 2020, enhancing population-wide immunity. These initiatives have contributed to Sweden's leadership in Human Papillomavirus (HPV) elimination which has the potential to eliminate HPV-associated cancers in the near future.

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