Research Institute of
Medical-Bio Convergence

Hallym University

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Medical-Bio Convergence

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Research Institute of Medical-Bio Convergence

Hallym University

Hallym University is emerging as an icon of structural innovation in higher education by proposing a new model and vision for future universities.

At the center of this innovation lies the Research Institute of Medical-Bio Convergence, the flagship brand of Hallym University. The Institute is breaking down academic barriers and bolstering the university's competitiveness across education, research, and industry-academic cooperation.

This Annual Report encapsulates the Institute's accumulated research achievements and challenges it has faced, serving as an opportunity to reflect on the university's social responsibility.

President of Hallym University

Yang-Hee Choi

As one of Hallym University's Flagship Institutes, the Research Institute of Medical-Bio Convergence stands at a pivotal turning point in medical-bio convergence research, connecting the university, the region, and the world. This Annual Report highlights the research achievements and the journey of challenges our Institute has undertaken. This report reflects our Institute's direction and commitment to building a convergence research ecosystem that bridges basic science, clinical medicine, and advanced technology. Connecting research and knowledge across disciplines and technologies, we aim to share our future vision and grow into a global research hub that generates sustainable innovation and public value through an open research platform involving academia, healthcare, and industry.

Director of
the Research Institute of Medical-Bio Convergence

Jae-Jun Lee

VISION

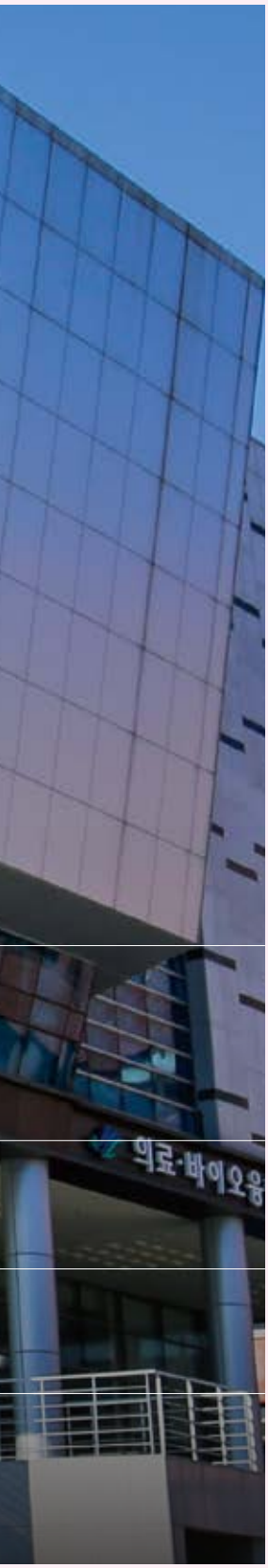
A global research institution innovating medical-bio convergence by bridging research and knowledge across the boundaries of disciplines and technologies

MISSION

Serving as a core research hub overseeing convergence research linking basic science, clinical medicine, and advanced technology

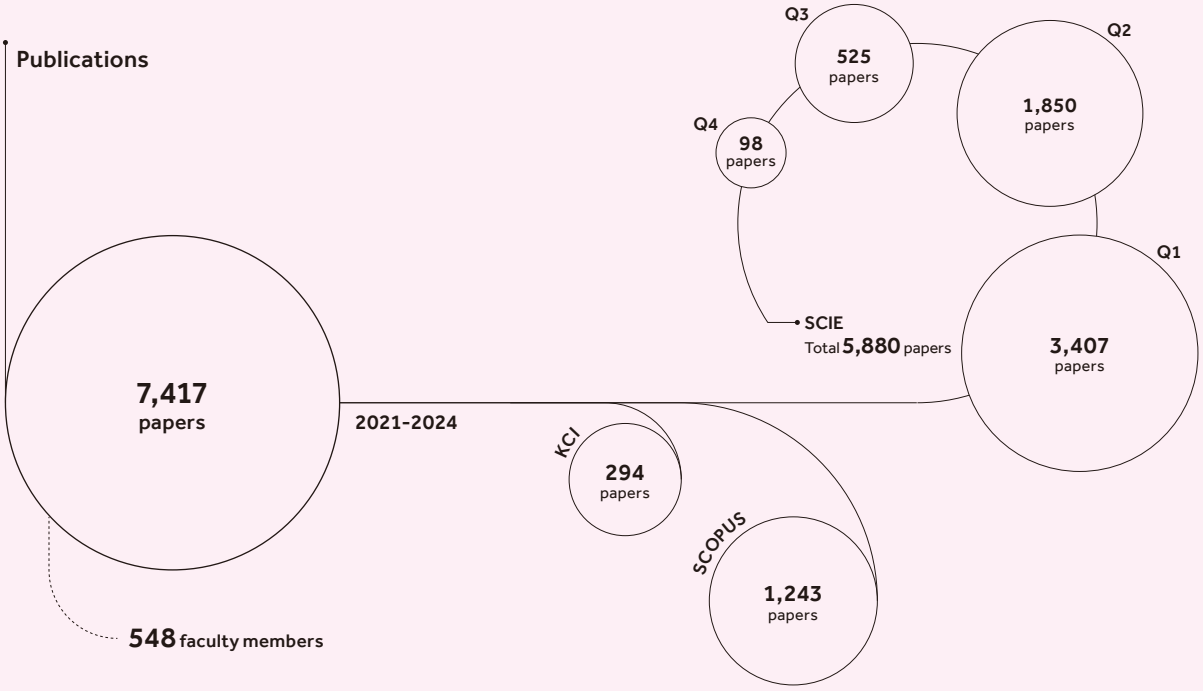
Establishing research governance centered on convergence clusters through the integration and advancement of research resources

Driving the creation of innovative research outcomes by advancing research support systems and strengthening global networks



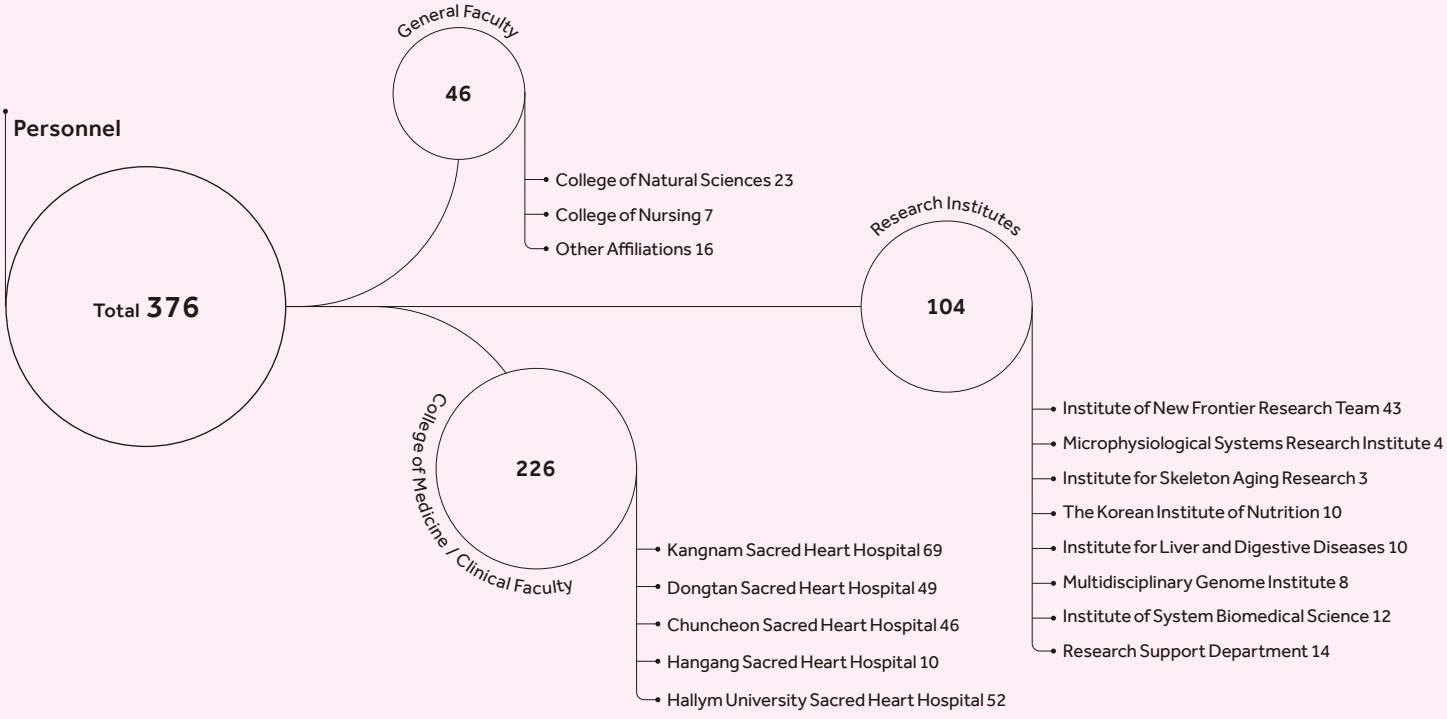
Research Institute of Medical-Bio Convergence

Serving as a hub for medical-bio and healthcare service convergence research, we are expanding regional and national projects and global cooperation. We achieve this by advancing networks across the Colleges of Medicine, Nursing, and Natural Sciences and supporting research capabilities through integrated equipment operation and shared use of high-cost facilities.



Research Funding

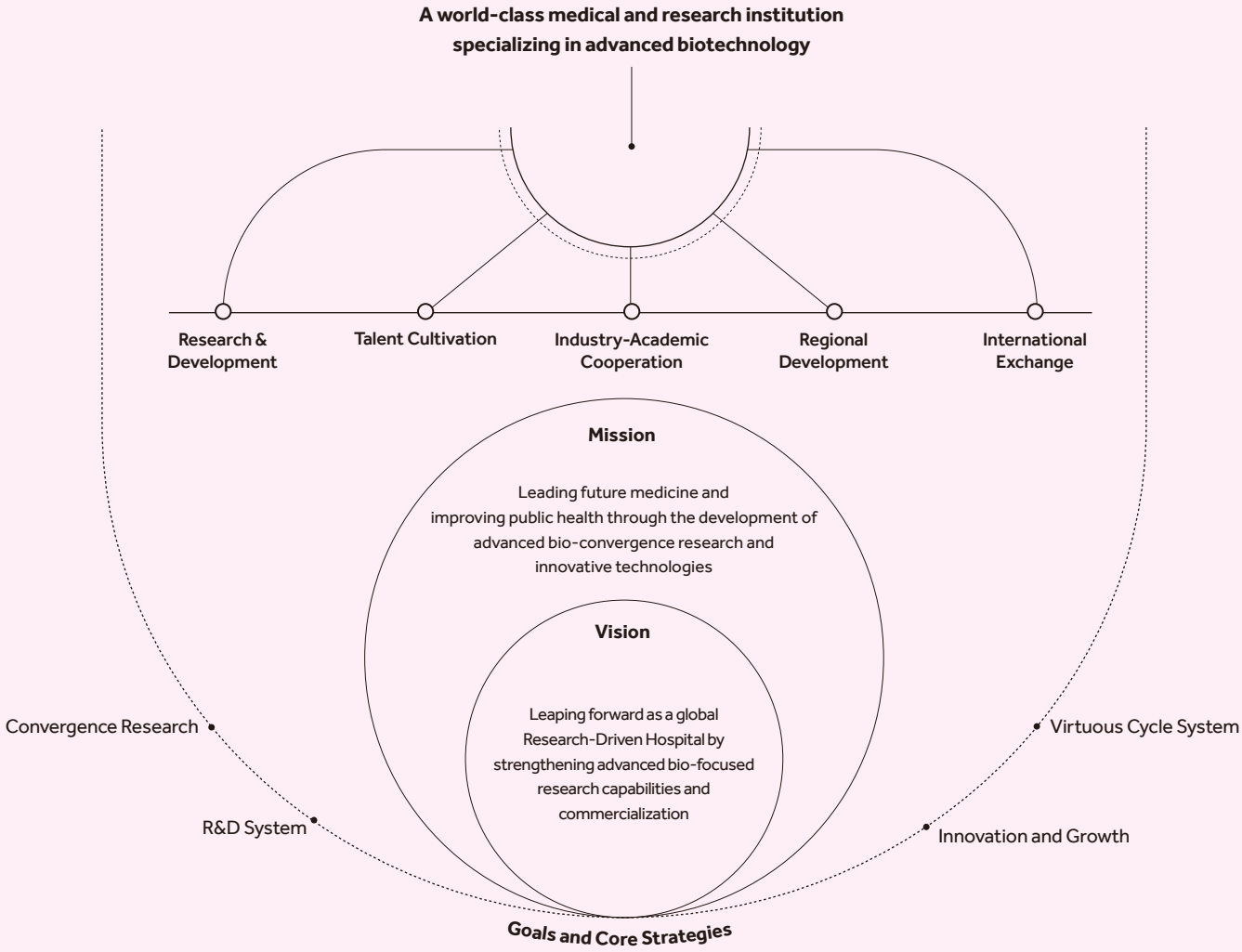
Personnel

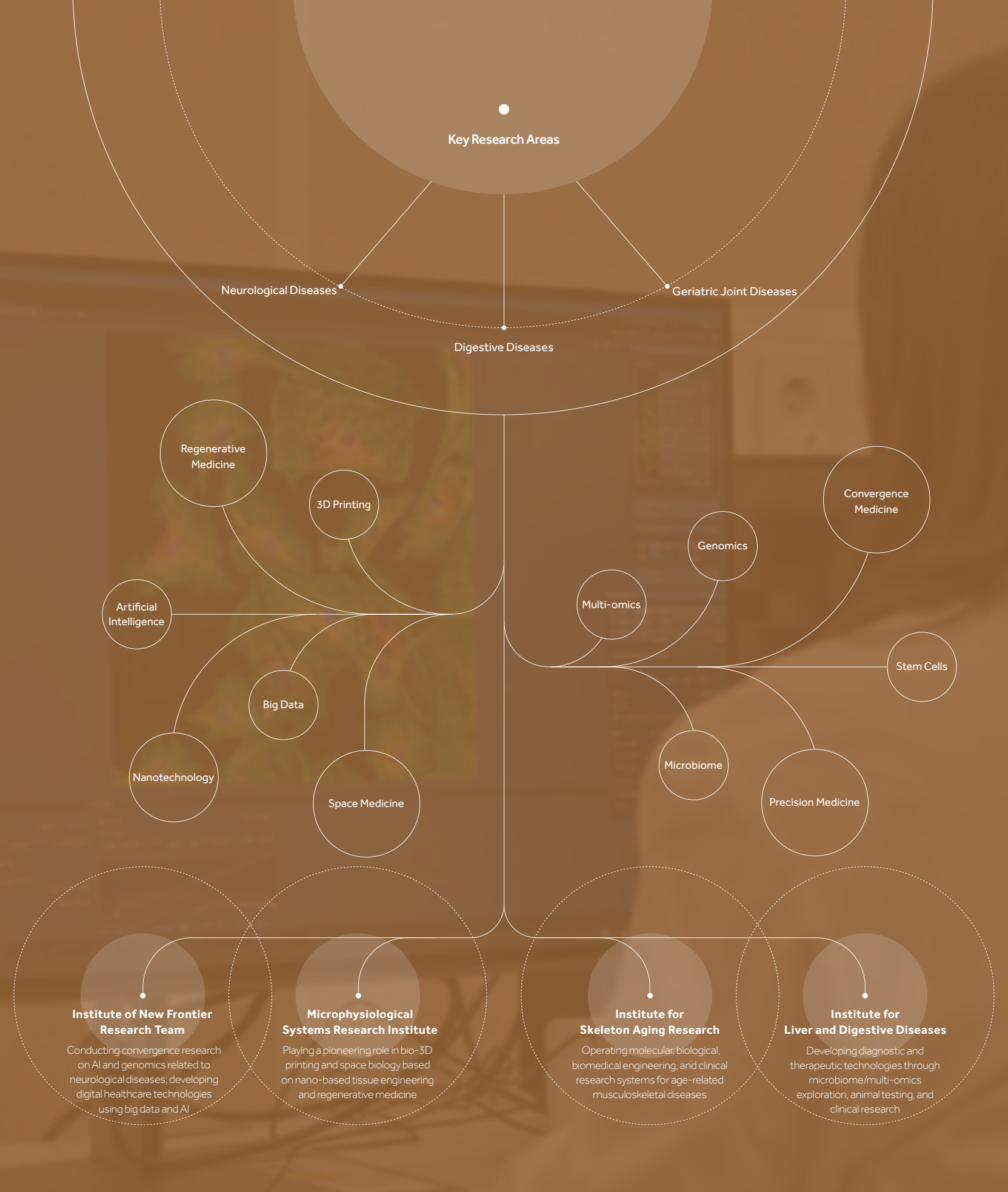


Organization

Research-Driven Hospital

Hallym University Chuncheon Sacred Heart Hospital is the first Research-Driven Hospital in Gangwon State certified by the Ministry of Health and Welfare. It is currently establishing a virtuous cycle ecosystem between clinical practice and research based on advanced bio-convergence research. Building on this ecosystem, we foster a sustainable open cooperation system where research, talent cultivation, and industry-academic cooperation are organically linked. This drives both regional medical innovation and the growth of the bio-health industry, positioning the hospital as a public hub where research outcomes return to clinical settings to create social value.




Key Research Areas
Neurological Diseases
Geriatric Joint Diseases
Digestive Diseases
Regenerative Medicine
3D Printing
Convergence Medicine
Genomics
Artificial Intelligence
Multi-omics
Stem Cells
Big Data
Nanotechnology
Space Medicine
Microbiome
Precision Medicine
Institute of New Frontier Research Team
Conducting convergence research on AI and genomics related to neurological diseases; developing digital healthcare technologies using big data and AI
Microphysiological Systems Research Institute
Playing a pioneering role in bio-3D printing and space biology based on nano-based tissue engineering and regenerative medicine
Institute for Skeleton Aging Research
Operating molecular, biological, biomedical engineering, and clinical research systems for age-related musculoskeletal diseases
Institute for Liver and Digestive Diseases
Developing diagnostic and therapeutic technologies through microbiome/multi-omics exploration, animal testing, and clinical research

Hallym Beyond Limits

Core Research Centers


Research for practical application from the laboratory bench to the patient's bedside in actual clinical settings
Research that extends beyond hospital walls to reach every corner of the community where medical care is needed
Collaborative and global validation research with world-class institutions beyond domestic borders
Research to utilize outer space beyond Earth for the enhancement of human life and health

From Bench to Bedside

Institute of New Frontier Research Team

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Prof. Chul-Ho Kim
Prof. Jin-Pyeong Jeon
Prof. Dong-Ok Won
Prof. Ji-Young Hong
Prof. Sang-Hwa Lee
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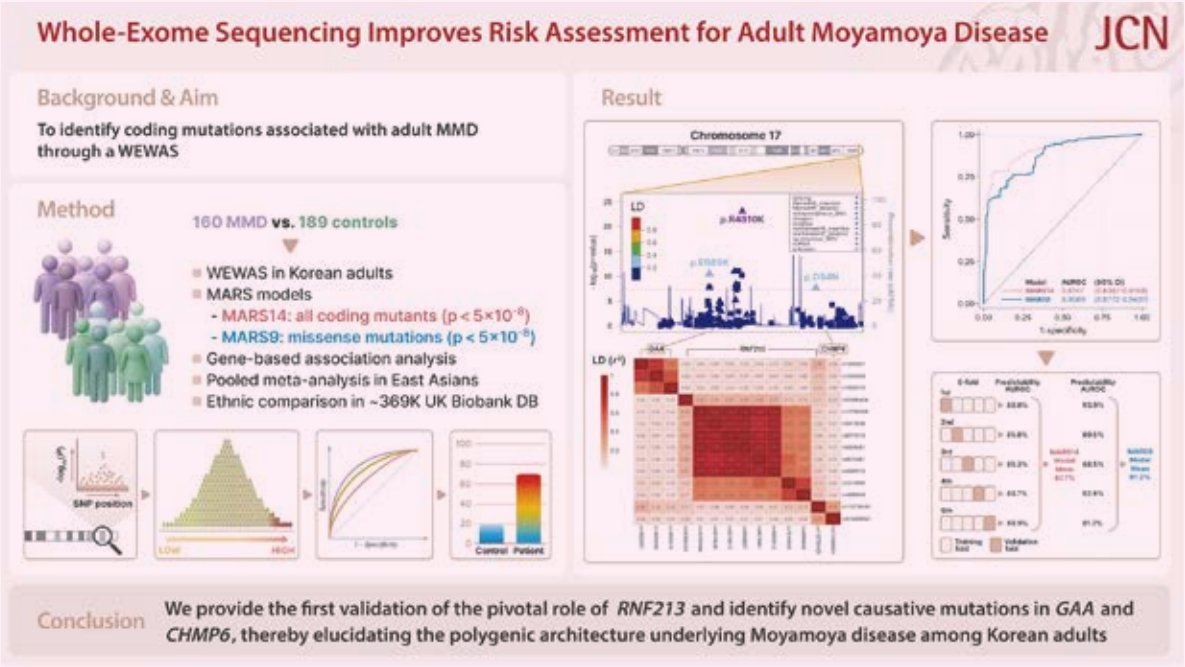
In an era where laboratory discoveries drive changes for patients at the bedside, convergence research combining medicine, biotechnology, and artificial intelligence is no longer a vision of the future but today's reality. To keep pace with the rapidly reshaping medical-bio landscape driven by the expansion of precision medicine and the advancement of digital healthcare and AI technologies, the Institute has established a full-cycle convergence R&D platform. This platform seamlessly integrates AI-based multimodal data research, advanced bio-precision medicine technologies, and clinical field validation. Leveraging this foundation, we are continuously expanding practical research outcomes that create new value in clinical settings. Our focus includes early disease detection and prognosis prediction via precision analysis, development of next-generation biomarkers and diagnostic/therapeutic technologies based on multi-omics, and securing clinical applicability through field validation. In recognition of these research capabilities and innovation, the Institute was honored with the 2025 Hallym University Ilsong Award. We are committed to leading the direction of future medical-bio research through convergence-based frontier research.



Risk Assessment of Adult Moyamoya Disease Using Whole-Exome Sequencing

Development of Genomics and AI-Based Novel Therapeutic Technologies for the Realization of Precision Medicine

Where Genomics Meets AI: A Journey to Find Precision Targets for Intractable Cerebrovascular Diseases

Intractable cerebrovascular diseases are representative high-risk conditions with complex pathogenic mechanisms and varying causes and progression patterns among patients, for which no definitive treatment currently exists. To overcome these limitations, the research team applies a next-generation precision medicine research strategy combining genomics, big data, and AI-based analytical technologies. Beyond conventional approaches that rely on a single gene or clinical variable, the team is uncovering the essence of diseases by integrally interpreting key molecular signals and networks that define them at the multi-omics level.

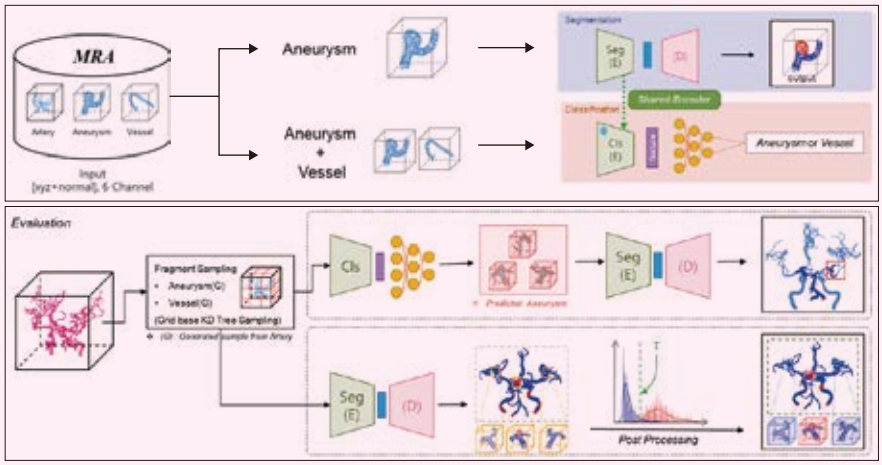
Beyond simple association studies, the research team is building patient databases based on GWAS (Genome-Wide Association Study) and WGS (Whole-Genome Sequencing). By combining these with transcriptomic, proteomic, and metabolomic data, we precisely explore disease-specific genetic variants and regulatory networks. We utilize this data through AI-based network analysis to select high-confidence candidate target genes and molecular pathways directly linked to disease occurrence.

Furthermore, the team identifies the pathological mechanisms of candidate targets and validates their feasibility as therapeutic targets (Mechanism of Action, MOA) using preclinical disease models (cell and animal models) that apply CRISPR/Cas9 gene editing and RNAi-based functional inhibition technologies. Such efforts allow us to identify disease pathways inaccessible to conventional treatments and establish a scientific foundation for developing next-generation therapeutics.

This genomics-AI convergence research precisely redefines intractable cerebrovascular diseases based on fundamental mechanisms and patient characteristics, presenting a new research paradigm that leads to the development of customized treatments and clinical applications.

The Future Predicted by AI: Evolution of Early Diagnosis and Personalized Patient Management Technologies

Cerebral hemorrhage and cerebral infarction are critical conditions where response within the "golden hour" determines survival. The research team advances high-performance AI models that integrate diverse medical data—including Electronic Medical Records (EMR), medical imaging, and biosignals—to perform early



Schematic diagram of a cerebral aneurysm detection model using cerebrovascular twins

diagnosis and prognosis prediction. Notably, AI models for stroke prognosis prediction based on multi-input Deep Neural Networks (DNN), AI for quantifying the risk of adverse drug reactions, and active surveillance patient management algorithms that reflect real-time changes in patient status demonstrate performance surpassing the limitations of conventional diagnostic and treatment systems. Building on these achievements, research is currently underway to further expand the clinical application of AI precision medicine for intractable cerebrovascular diseases by establishing reinforcement learning-based personalized drug recommendation models and multi-center clinical trial support platforms. Furthermore, in the field of obstetrics and gynecology, an AI model for automated preterm birth screening using cervical ultrasound images has been developed. This model establishes a foundation for a personalized prenatal care system by automatically classifying high-risk mothers and standardizing prenatal care protocols according to risk levels. By enabling preemptive treatment before preterm birth occurs, this technology reduces the risk of preterm birth and premature infants, laying the groundwork for improving neonatal outcomes and addressing the low birth rate issue.

Additionally, in the field of upper gastrointestinal disease diagnosis, an AI-based automated gastroscopy image interpretation model was developed, establishing a system capable of automatically diagnosing not only advanced gastric cancer but also minor gastrointestinal disorders. This establishes a foundation for clinical application that enhances the accuracy and speed of medical image interpretation, reduces the workload of medical staff, and supports the formulation of personalized treatment strategies.

These AI-based studies suggest a future direction for medicine that extends beyond diagnosis to prediction, prevention, and personalized treatment, contributing to the realization of patient-centered precision medicine.

Advancing Core Frontier Technologies to Solve Clinical Challenges

Innovative Future Medical Research to Solve Challenges in Neurological Dysfunction

Key challenges persistently raised in neurological clinical settings include the lack of objective assessment for headaches, uncertainty in recovery pathways for traumatic brain injury, limitations in acute neurological emergency response, and management issues for chronic brain diseases leading to cognitive decline and dementia. Supported by the Ministry of Science and ICT's "Project for Fostering Innovative Future Medical Research Centers (2023–2026)," the Institute is establishing a clinical-basic-data convergence research system to solve challenges in neurological dysfunction.

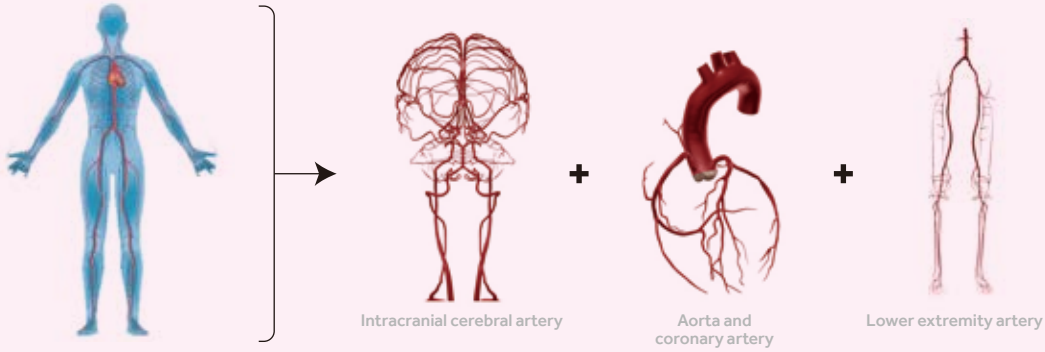
Under this research framework, the Institute advances core research pillars: headache and pain quantification technology, early detection algorithms for cognitive decline and dementia conversion, mechanism identification and prognosis prediction models for traumatic brain injury (TBI), and biomarker discovery based on neuroinflammation and cellular senescence. Furthermore, integrating exosome/stem cell-based neuroregenerative therapies with gut-brain axis microbiome-based precision diagnosis and treatment approaches enables the development of next-generation therapeutic strategies to simultaneously achieve neurological functional recovery and inhibition of disease progression.


This research is conducted through the AI-omics-clinical data integrated infrastructure and the physician-scientist-basic researcher convergence system established under the Project for Fostering Innovative Future Medical Research Centers. It precisely measures and predicts changes in neurological function using an AI analysis system that integrates medical imaging, neurophysiological signals, behavioral/cognitive data, and multi-omics information. Consequently, the Institute continuously advances its precision medicine-centered convergence research capabilities and analysis systems to propose personalized intervention strategies optimized for each patient's pathophysiological mechanism and functional impairment characteristics.

Innovation in Cardiovascular and Cerebrovascular Disease Treatment Strategies: Digital Twin-Based Precision Simulation Technology

Cardiovascular and cerebrovascular diseases are high-risk conditions where subtle structural changes and hemodynamic differences determine treatment outcomes, making technologies that can precisely predict individual patient status essential.

The research team established a cardiovascular and cerebrovascular medical twin technology based on Real-World Data (RWD), creating a full-cycle digital twin pipeline that encompasses automated segmentation, 3D reconstruction, and hemodynamic/multiphysics modeling integrating medical imaging, EMR, and biosignals. This secures a foundation for predicting patient-specific vascular structures and pathological events in advance and quantitatively analyzing treatment strategies and procedural effects in a virtual environment. Currently, high-precision technologies are being developed, including carotid artery stenosis and plaque rupture prediction reflecting Korean characteristics, cerebral aneurysm growth and rupture risk analysis, coronary and aortic procedure simulation, ischemia diagnosis and progression prediction, interventional navigation automation, and haptic guidance based on real-time 3D vascular registration. This platform contributes to non-invasive risk assessment, reduction of procedural complications, and improved safety of treatment strategies.



Major vascular networks of the cardiovascular and cerebrovascular medical twin

Core Research Centers

Telemedicine Research Center

Beyond the Hospital, Into the Community

Development of leading technologies for a cloud-based remote consultation platform equipped with an EMR-linked integrated cerebral hemorrhage solution for the diagnosis and treatment of cerebral hemorrhage patients in medically underserved areas

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As the gap in essential medical services between regions widens, cerebral hemorrhage patients in medically underserved areas face structural risks that make it difficult to receive diagnosis and treatment within the golden hour.

In fact, the average distance to emergency medical care in the Gangwon region is 22 km, significantly longer than in Seoul, making it continuously difficult to reach an emergency room within 30 minutes. In such an environment, patient transport-centered emergency systems and existing chronic disease-focused remote consultation frameworks are limited in responding to severe neurological emergencies. To address this, the research team developed Korea's first cloud-based remote consultation platform equipped with automated cerebral hemorrhage interpretation AI, enabling real-time initial diagnosis and specialist consultation, and proved its effectiveness and technical excellence through actual clinical application. This platform is Korea's only remote consultation system specialized for severe cerebral hemorrhage that integrates AI diagnosis, treatment guides, and specialist consultation, presenting a significant turning point for resolving medical resource imbalances and innovating digital public healthcare.

Establishment of an AI/Cloud-Based Cerebral Hemorrhage Telemedicine System and Realization of Standardized Emergency Response in Medically Vulnerable Areas

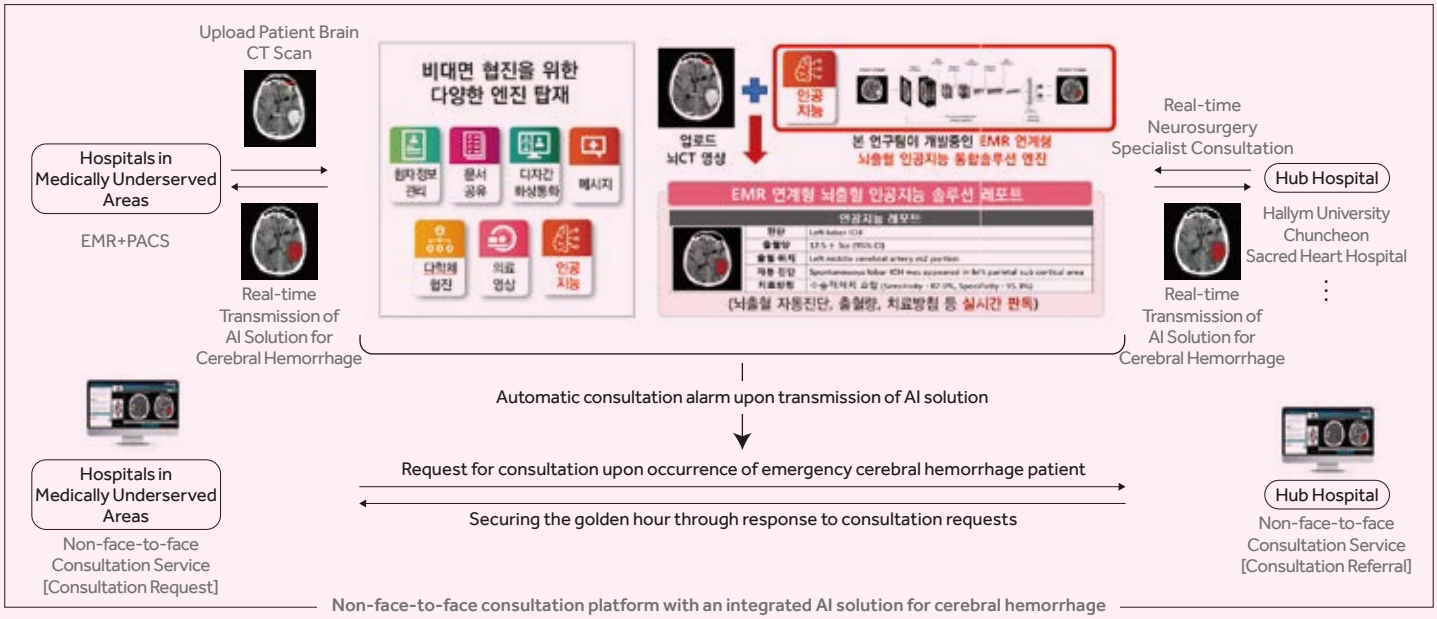
AI-Based Cerebral Hemorrhage Telemedicine Platform for Securing the Golden Hour

The cloud-based remote consultation platform was established as a clinical support solution integrating AI cerebral hemorrhage analysis for CT images and EMR medical information linkage. When CT images taken immediately upon arrival at the emergency room are uploaded to the platform, the AI quickly analyzes them for cerebral hemorrhage and provides primary diagnostic information (approx. 95% accuracy). This is then reviewed by neurosurgery staff at the hub hospital to ensure clinical reliability.

Hub hospital medical staff provide real-time initial treatment guidelines, such as target blood pressure/oxygen saturation and medication criteria, to support optimal decision-making by local medical staff and minimize treatment delays by coordinating immediate transfer decisions when surgery is required. This systematic workflow shortens the time from transfer decision to surgery preparation by more than an hour on average and prevents overcrowding in hub emergency rooms. The organic combination of AI-based analysis and remote consultation functions establishes a practical technical foundation for providing rapid, standardized, and high-quality care to patients with severe cerebral hemorrhage, even in medically vulnerable areas.

Establishing Korea's First Standards for Cerebral Hemorrhage Telemedicine: Innovation in Emergency Response for Medically Underserved Areas

To improve the survival rates of cerebral hemorrhage patients in medically underserved areas,



an AI and cloud-based standard model for remote consultation was developed, gaining recognition for its excellence in multi-center telemedicine platform design and clinical effectiveness. Furthermore, going beyond technological development, the project established practical, non-face-to-face clinical practice guidelines specialized for severe cerebral hemorrhage in underserved areas, presenting the first telemedicine protocol for cerebral hemorrhage that reflects the medical reality in Korea.

Additionally, to strengthen the emergency medical capabilities of on-site medical staff, a pocket guidebook for cerebral hemorrhage treatment was produced. It was structured to allow various medical professionals, including interns and nurses, to follow the step-by-step diagnostic, judgment, and treatment decision-making processes linked to the AI-based consultation platform. This standardized medical system, consisting of clinical protocols and guidebooks, will play a crucial role in enhancing the effectiveness of the consultation platform while creating an environment where local medical staff can respond to severe cerebral hemorrhage patients with greater confidence.

Establishing a Cerebral Hemorrhage Safety Net through Regional Cooperation

For the first time in Korea, an AI and cloud-based telemedicine network for cerebral hemorrhage was established, connecting three regions—Gangwon, Jeonnam, and Jeju—and field demonstrations were conducted. In the Gangwon region, Hallym University Chuncheon Sacred Heart Hospital led the participation of Hongcheon Asan Hospital, Yanggu Sacred Heart Hospital, and Inje Korea Hospital. In the Jeonnam region, Chonnam National University Hospital and Haenam Woori Hospital participated, while in the Jeju region, Jeju National University Hospital and Seogwipo Medical Center established a collaborative system and applied it to actual patient care. A standard protocol was operated where images and clinical information captured in the emergency room were shared via the platform, allowing specialists at tertiary hospitals to provide real-time consultations and readings, and immediately decide on treatment plans and transfer status. As a result, 17 patients with severe cerebral hemorrhage received prompt diagnosis and treatment within the golden hour. This proved that remote consultation in medically underserved areas can contribute to saving lives and bridging regional medical gaps, serving as a foundation for future nationwide expansion. Furthermore, its potential for policy application was confirmed as a practical alternative to improve the efficiency of the emergency medical delivery system and alleviate the imbalance of medical resources between regions.

Beyond the Region, Into the World

Global Frontier Research Center

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Innovation Without Borders: Hallym Medical-Bio's Global Network

The rapid global advancement of medical and artificial intelligence convergence is unlocking new possibilities across clinical settings, including primary care, local communities, and the public health sector.

The Hallym University Global Frontier Research Center was launched to lead global joint research in medicine, nursing, and AI. Its core mission is to foster glocal (global-local) research collaboration with domestic and international institutions and provide systematic support for exchange to build a sustainable research ecosystem.

Strengthening International Research Cooperation with the U.S., a Global Leader in Medical AI and Digital Health

Our strategic collaboration with Harvard Medical School, the University of Massachusetts Chan Medical School, and its School of Nursing drives joint research and global talent development in medical data, AI, digital health, and chronic disease community care. Following the MOU signed with the University of Massachusetts Chan Medical School and Gangwon State, we have shared research outcomes through joint seminars and international symposia, continuously strengthening our cooperative framework across education and research.

Furthermore, joint seminars featuring world-renowned scholars facilitate the sharing of the latest research trends and the identification of specific joint research topics. These exchanges have laid the foundation for long-term research partnerships, moving beyond short-term visits or one-off events.

In addition, the Center regularly hosts seminars and monthly academic events, inviting experts from top international institutions, including the UCSF School of Pharmacy, Stanford University, the University of Cincinnati College of Nursing, the Technical University of Berlin, and Uppsala University. These initiatives are

establishing a sustainable international academic cooperation system, accelerating the creation of a foundation for substantive joint research and the cultivation of the next generation of medical AI talent.

Global Expansion Through Local Validation in the United States

Building on the success of Korea's first remote consultation model for cerebral hemorrhage, the research team is pursuing overseas validation R&D in collaboration with the University of Massachusetts Chan Medical School hospitals. The Gangwon-Boston cooperation network, established by both institutions, is preparing a validation model tailored to the U.S. medical environment by collecting and refining local data, adapting the digital healthcare platform for English-speaking regions (UI/UX improvement), and analyzing patient transfer systems. Furthermore, the team is conducting IRB approval processes, selecting validation hospitals, and training medical staff at U.S. healthcare institutions. These efforts verify the global performance of AI cerebral hemorrhage algorithms and evaluate the technical stability of the remote consultation platform. Such overseas validation demonstrates the scalability of Korea's remote consultation system to international medical environments.

Leading Global Standards for Future Medicine with Uppsala University, the Intellectual Heart of Northern Europe

Hallym University Medical Center has maintained a profound academic resonance that transcends continental boundaries with Uppsala University, Northern Europe's most prestigious institution, founded in 1477. Since establishing a cooperative framework in 2008, this robust alliance, now in its 17th year, has evolved beyond simple exchange to become a core pillar of a global research platform preparing for the future of humanity.

Collaboration between the two institutions has generated convergent academic value spanning clinical and basic medicine. The 14th Hallym-Uppsala International Symposium shared diverse solutions for an aging society and presented a new paradigm for conquering degenerative diseases using cutting-edge AI technology. Notably, the 'HIARC (Hallym International Antibiotic Resistance Center) – UAC (Uppsala Antibiotic Center) Joint Symposium' holds great significance in establishing a global united front against antibiotic resistance, a critical health crisis threatening humanity. These efforts have led to substantive joint research outcomes and the selection of global research projects, cementing the partnership as one of the most successful medical collaborations connecting East and West.

A Hub for Medical Innovation in Asia: A Multidimensional Partnership with Nagoya City University

Hallym University Medical Center has built deep trust with Nagoya City University, a prestigious public institution in Japan, for nearly 20 years since signing an agreement in 2006. As strategic partners setting standards for Asian medical systems, our institutions are opening new horizons for convergent research and medical innovation through knowledge sharing that transcends time and space.

Collaboration with Nagoya City University has simultaneously expanded the scope of academic research and clinical practice. The joint symposium held in Nagoya, Japan, in May 2025, consolidated the infrastructure of 11 hospitals under both institutions (5 from Hallym and 6 from Nagoya). It served as a turning point for mutual convergence, combining Japan's advanced health systems for an aging society with Hallym's sophisticated AI smart hospital solutions (AI, robotics, etc.). Furthermore, we established a unique, field-oriented cooperation model by conducting academic exchanges among faculty alongside practical exchanges between nursing departments. Consequently, Hallym University Medical Center is innovating its research capabilities within the Asian region and completing a partnership that establishes new standards for Asian medicine beyond regional limitations.

Beyond the World, Into Space

Development of a BioCabinet for Medium-Sized Satellites (Stem Cell Bio-3D Printing and 3D Cell Culture System)

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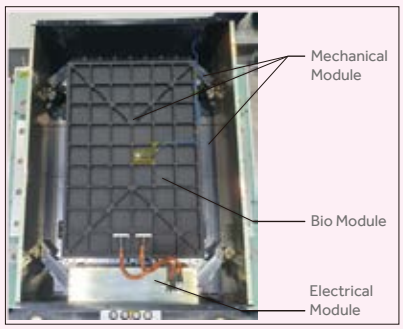
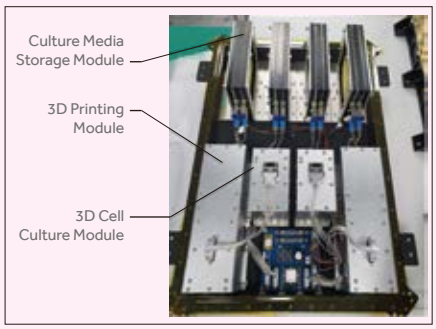
On November 27, 2025, the fourth launch of the Korean space launch vehicle Nuri was successful, and the Next-Generation Medium-Sized Satellite 3 stably entered its target sun-synchronous orbit at an altitude of approximately 600km. This mission is significant as it was pursued not only to verify the satellite's precision observation functions but also to demonstrate bio/biomedical science and technology using the space environment. In particular, the space bio-experiment module 'BioCabinet,' developed by our research team, was loaded onto the satellite to conduct life science experiments in microgravity, achieving Korea's first space bio-validation results. This experiment presents technical possibilities for expansion into space biomedical engineering, tissue engineering, and space long-term stay support technology, marking a new turning point for space bio research in Korea.

Exterior Appearance of BioCabinet



Interior Appearance of BioCabinet



Configuration of BioCabinet Experimental Module

Space Bio Demonstration Achievements of the BioCabinet Onboard the Next-Generation Mid-Sized Satellite 3

On-orbit Operational Verification of BioCabinet as a Space Bio Experimental Platform

The BioCabinet onboard the Next-Generation Mid-Sized Satellite 3 was normally deployed and operated in orbit, successfully verifying the stable operation of core systems for performing space bio experiments in microgravity.

Designed as an integrated space biomedical experimental platform to withstand harsh space environments—including strong vibrations, shocks, radiation, and extreme temperature changes—the device confirmed that major subsystems (power, thermal control, communication, experiment control) operated normally according to planned scenarios. Notably, during initial checks and step-by-step operations in orbit, the system maintained stability without anomalies, and remote command execution and status monitoring linked with ground control proceeded smoothly. This proved the feasibility of performing autonomous, repetitive life science experiments in space and demonstrated that the domestically developed space bio experiment module secured structural stability and operational reliability in an actual orbital environment. These achievements are significant as they establish the technical foundation for more complex biological experiments and long-term missions in the future.

Microgravity-based Cell and Bioprinting Demonstration and Future Potential

The BioCabinet demonstrated the possibility of precise life science experiments in space by maintaining cell survival, controlling biological samples, and performing 3D bioprinting experiments in microgravity. During the experiment, environmental conditions for cell culture were stably maintained, and the feasibility of remote-based space bio experiments was confirmed by adjusting experimental conditions and acquiring real-time data via ground communication. This provides an important technical basis for expansion into repetitive and automated bio-experiments in future long-term space missions. Furthermore, these achievements suggest potential applications in space drug development, tissue engineering-based artificial tissue fabrication, analysis of biological changes in astronauts during long-term stays, and biomedical support technologies. This demonstration through the BioCabinet represents a shift in Korea's space bio research from proof-of-concept to actual orbital experimentation, contributing to strengthened national capabilities and expanded international joint research.

Hallym Breaking Boundaries

Convergence Research Fields


BT+IT
HT+IT
HT+BT
Convergence Research of Medical Technology and Information Technology
Convergence Research of Bio-Technology and Information Technology
Convergence Research of Medical Technology and Bio-Technology

Hallym University Medical Center HERO Research Portal

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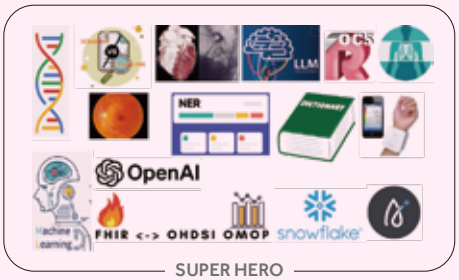
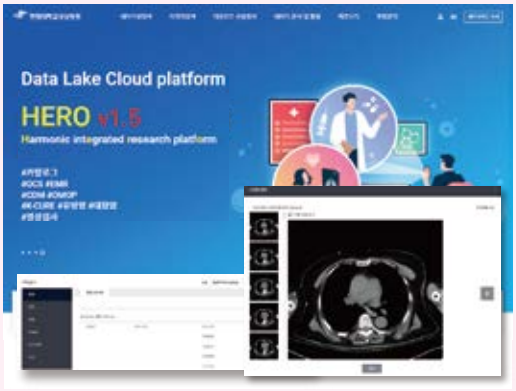


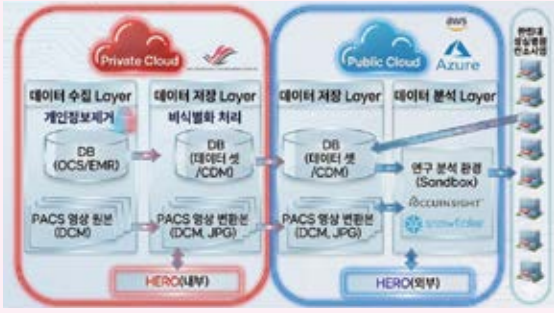


Hallym University Medical Center is successfully leading the Ministry of Health and Welfare's 'Medical Data-Driven Hospital Support Project,' alongside the Doheon Institute for Digital Innovation in Medicine (est. 2021), aligning with the national vision of 'Creating an Innovative Ecosystem for Health and Medical Data Flow.' Led by Young-Kyun Suh, Director of the Big Data Center, we have established the clinical data lake and research portal 'HERO.' This platform is being perfected as a highly versatile, optimal research environment by implementing international data standardization, strict quality control, and a researcher-centered intuitive UI/UX.

Future Connection Platform for Medical Data

Hallym University Medical Center's HERO (Harmonic integrated Research platfOrm, www.hero.re.kr) is a state-of-the-art integrated research portal that presents a new paradigm for clinical research, going beyond a simple data repository. It encompasses core clinical raw data, including patient information, diagnosis, prescriptions, EMR, specific forms, PACS, and integrated images. After a thorough de-identification process of data from 7 million patients (approx. 200TB) and standardization to international standards (CDM, K-CURE, Baseline DB), data is provided to researchers on a D-1 basis.

A powerful hybrid cloud environment accelerates not only internal research but also joint research with industry, academia, research institutes, and hospitals. Furthermore, it leads open innovation through public environments, such as nurturing convergence talent and hosting medical data utilization competitions. Data security is ensured through strict pseudonymization and DRB review in compliance with Ministry of Health and Welfare guidelines. This is proven by achieving the highest external data quality certification (Complex A-Class, Management System Level 5) and maintaining top-class status in national projects. HERO continues to evolve, constantly challenging the forefront of new medical IT technologies by collaborating with leading IT companies to standardize unstructured EMR data, develop medical imaging LLMs, and introduce the latest analysis solutions such as Snowflake.



Hybrid Cloud

From Technology to Digital Medical Devices, Toward Predictive Insight: The Evolution of Medical AI

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Hallym University Medical Center has proven that medical AI is a technology applicable in actual clinical settings through the FDA approval of endoscopy AI and NeuroEars, demonstrating the importance of 'clinical utility' and 'regulatory science.' Building on these achievements, the 'Cerebrovascular Medical Twin' has evolved beyond a static 3D model into a dynamic twin technology that integrates Real-World Data (RWD) with hemodynamic information. This technology enables high-precision prediction of the occurrence and future risks of cerebral aneurysms and strokes and provides precise support for medical decision-making by suggesting optimal treatment paths based on individual patient characteristics. This innovation shifts the medical paradigm from a reactive approach to a proactive, predictive-based precision medicine system.

Medical Artificial Intelligence Reaching the Stage of Digital Medical Devices

For medical AI to transcend laboratory algorithms and become a true tool assisting physicians, targeting unmet clinical needs from development and proving efficacy to regulatory agencies is essential. Professor Chang-Seok Bang of the Department of Gastroenterology at Chuncheon Sacred Heart Hospital seeks to address the clinical hurdle of 'standardizing examination quality' through his endoscopic AI research. By digitizing the polyp diagnosis process—traditionally dependent on examiner expertise—and quantitatively evaluating imaging blind spots and variations in bowel preparation, his work provides a new objective standard for clinical procedures. Furthermore, NeuroEars, founded by Professor Sung-Kwang Hong (Hallym University Sacred Heart Hospital), is a success story that achieved the "universalization of diagnosis." It made dizziness diagnosis—previously requiring expensive equipment—widely accessible through VR and AI, ultimately securing rigorous U.S. FDA approval.

Medical Twin: Beyond Static Simulation Toward Dynamic Prediction

The "Cerebrovascular Medical Twin," newly developed by Professor Chul-Ho Kim's team (Chuncheon Sacred Heart Hospital), aims for "dynamic prediction" beyond static simulation. Unlike existing twin technologies limited to static anatomical simulation, this medical twin is distinguished by its implementation of a living "dynamic twin" integrating Real World Data (RWD) with hemodynamic characteristics. Expanding from cerebrovascular diseases to peripheral and microvessels, this technology uses deep learning survival analysis to predict the risk of future vascular event recurrence and cerebral aneurysm rupture with high accuracy.

Ultimately, the medical twin transcends its role as a mere visualization tool. It is evolving into a powerful Clinical Decision Support System (CDSS) that suggests optimal treatment paths and realizes patient-centered precision medicine, serving as a key driver in innovating the medical paradigm from "reactive response" to "proactive prediction."

Hallym AI-Biohealth R&BD Center

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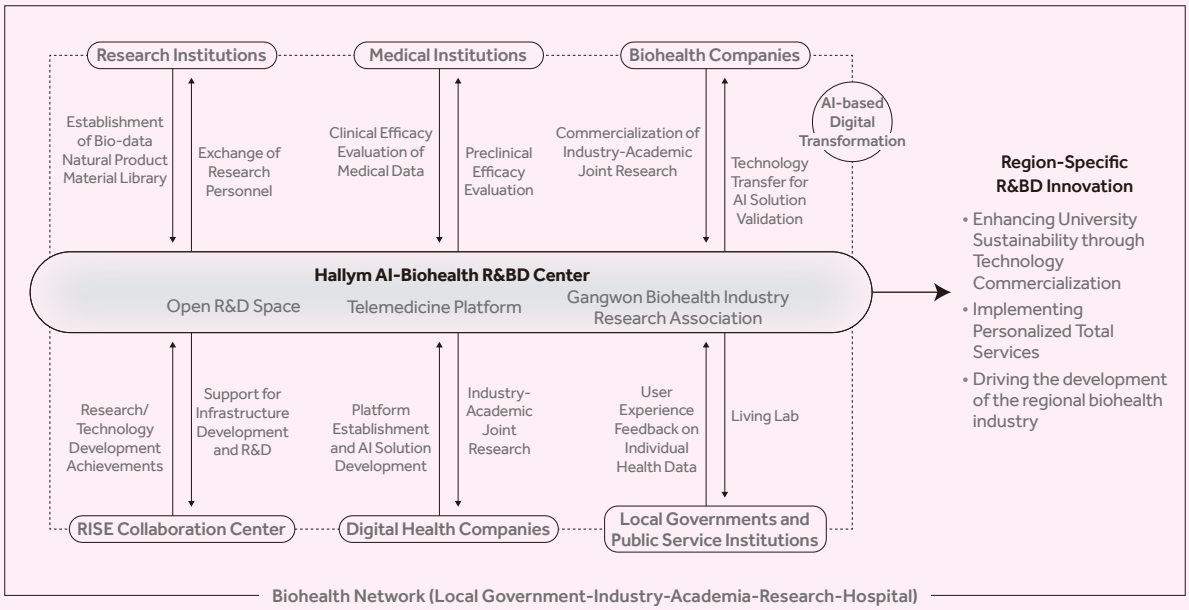

The Hallym AI-Biohealth R&BD Center is establishing an integrated platform that systematically supports the entire R&D lifecycle, using networking as its core engine. In particular, it aims to create an ecosystem where substantial value is generated through industry-academic collaboration by rapidly applying data-driven research outcomes in medical and bio-healthcare fields to clinical and industrial settings.

To realize this vision, the center will: first, provide a physical and institutional environment for collaboration among researchers, industry experts, and clinical staff through the Open R&D Space; second, establish a telemedicine platform to accelerate the validation and dissemination of AI-based diagnostic and therapeutic technologies; and third, continuously revitalize the Gangwon Biohealth Industry Research Association to strengthen organic networks among regional stakeholders, creating a virtuous cycle of joint research and technology transfer.

The center operates the Well-DC (Data Core) and supports convergence research projects. It is also establishing a CRO (Clinical Research Organization) training institution and promoting a public research platform for AI-bio material discovery and utilization. We have completed the formation of a local government-industry-academic consultative body centered on three major Industry coupled Cooperation Centers (ICCs) and are actively signing MOUs with local governments and regional innovation institutes.

The center plans to build a Gangwon-style AI transformation model through the convergence of big data, machine learning, and the metaverse. We will strengthen global R&D capabilities for core bio-healthcare talent linked with ICC-Labs and expand All-SET corporate support to foster regional smart bio-healthcare personnel and establish a growth foundation tailored to regional industrial needs.

Convergence Research Fields

Precision Neuroscience Research

A New Axis for Understanding Neurological Disorders: Convergence Precision Neuroscience

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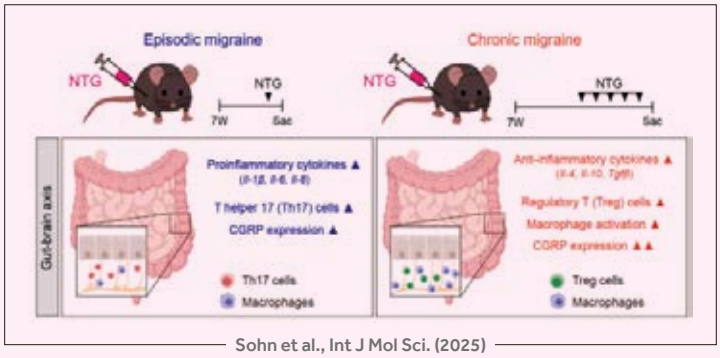
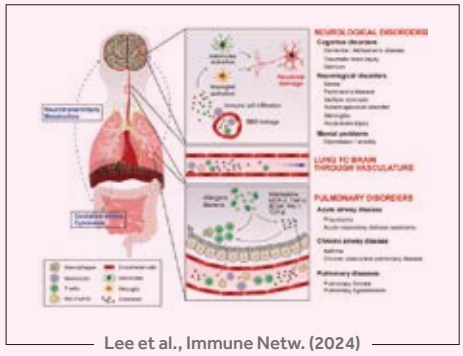


Sohn et al., Int J Mol Sci. (2025)



Lee et al., Immune Netw. (2024)

Professor Jong-Hee Sohn's Precision Neuroscience research team aims to precisely identify the pathology of neurological disorders from the perspectives of immunity, metabolism, microenvironment, and epigenetic regulation, and to discover therapeutic targets. In this project, clinical neurologists and basic/translational researchers collaborated to conduct multi-layered analyses of inflammatory responses, the nerve-organ axis (gut–brain, lung–brain), and microglial dysfunction observed in major neurological disorders such as migraines, Parkinson's disease, ischemic brain injury, and neurodevelopmental/emotional memory abnormalities. This approach connects clinical indicators with molecular and cellular mechanisms, suggesting the potential for precision medicine-based treatment strategies for neurological disorders.

Clinical-based Precision Neuroscience Research Identifying Gut-Brain Axis Abnormalities

Professor Jong-Hee Sohn leads clinical-basic convergence research focusing on migraines and metabolic/inflammatory diseases, identifying the pathophysiological role of the gut–brain axis in neurological disorders. In particular, by utilizing animal models of acute and chronic migraine, the team systematically analyzed differences in gastrointestinal inflammation, immune cell changes, and CGRP expression, proving intensified gut–brain axis abnormalities in chronic migraines. Furthermore, research on metabolic and inflammatory regulation using PDE5 inhibitors demonstrated the impact of immune cell polarity changes and blood flow improvement on systemic metabolism and nervous system homeostasis, expanding possibilities for new therapeutic approaches.

Expansion Strategy for Precision Neuroscience through the Convergence of Circuit, Immune, and Epigenetic Mechanisms

The Precision Neuroscience research team has organically accumulated research on brain circuit function, microglial regulation, epigenetic mechanisms, and anti-inflammatory/antioxidant pharmacology. By investigating the lung–brain axis and microglial lysosomal function, the team identified the impact of systemic inflammation and metabolic status on hypothalamic and neural circuit homeostasis. In ischemic brain injury and neurodevelopmental models, they experimentally proved neuroprotective candidates and imbalances in excitation/inhibition (E/I balance). Furthermore, research on striatal circuit development and REM sleep-based memory regulation established epigenetic regulation and circuit plasticity as core axes in the pathology of neurological and psychiatric disorders. Moving forward, the research team plans to expand into precision diagnostic markers and targeted therapeutic strategies through convergence research that integrates clinical data, circuit analysis, and molecular/immune mechanisms.

Hallym at the Forefront of Innovation
Specialized Research Topics


Specialized Research Centers for the College of Medicine, College of Natural Sciences, and College of Nursing
Medical Care Research to Overcome Diseases
Health Care Research Studying Advanced Life Sciences
Nursing Care Research Seeking Solutions for Clinical Nursing Issues

Development of CAR-T Cell Therapy Targeting Solid Tumor Antigens

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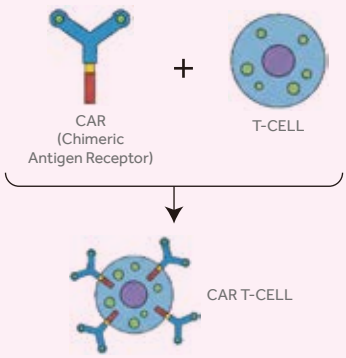

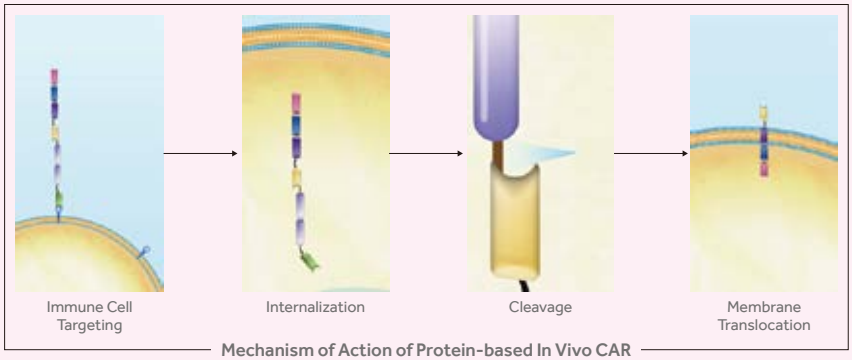

Mechanism of Action of Protein-based In Vivo CAR

Major solid tumors have a high unmet medical need due to low survival rates and a lack of treatable antigens. Additionally, existing CAR-T therapies have limitations such as high costs, long production periods, and low efficacy in solid tumors. Accordingly, the research team is discovering new solid tumor-specific antigens and developing next-generation CAR-T cell therapies based on 'in vivo CAR' technology, which allows for immediate administration and cost reduction, in collaboration with Singular Immune Inc. in the US.

Chimeric Antigen Receptor T-cell (CAR-T) Therapy

BiTE-secreting CAR-T Cell Technology (CAR-T cells in situ secreting BiTE)

CAR-T cells that secrete BiTE (Bispecific T-cell Engager) within the tumor are effective therapeutic agents that can overcome the major limitations faced by existing CAR-T therapies in solid tumors.

Solid tumors exhibit high "heterogeneity," where not all cancer cells express the same antigen. The BiTE secreted by CAR-T cells attracts nearby bystander T cells to induce attacks on adjacent cancer cells that lack the CAR antigen (Bystander effect). This effectively blocks immune evasion caused by antigen loss.

Solid tumors are difficult for cell therapies to penetrate due to physical stromal barriers and complex vascular structures. BiTE, a small protein, can diffuse and penetrate more easily through tumor tissues; delivery efficiency is maximized as CAR-T cells that have infiltrated the tumor tissue act as a "local factory" to continuously produce BiTE.

The environment surrounding solid tumors is hostile, suppressing the activity of immune cells. By designing CAR and BiTE to target different antigens (Dual Targeting), binding affinity to cancer cells can be increased and immunosuppressive signals can be offset. By involving non-specific T cells already present in the body in the attack on cancer cells, the exhaustion of injected CAR-T cells is delayed, and a sustained anticancer effect is maintained.

Protein-based in vivo CAR technology (Protein-based in vivo CAR)

Without the lengthy process of extracting and manufacturing a patient's cells, pre-produced CAR proteins can be administered immediately to patients in need, much like antibody therapies, preventing treatment delays. Since mass production is possible rather than customized small-batch production, overall treatment costs, including production costs, can be drastically reduced, thereby improving patient accessibility.

Specialized Research Areas

Infectious Disease Research Group

Hallym International Antibiotic Resistance Center

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The Hallym International Antibiotic Resistance Center (HIARC) is the first specialized center for antibiotic resistance in Korea established within a hospital, serving as a multidisciplinary convergence organization that bridges clinical and basic research. Leveraging practical research that addresses unmet medical needs and an extensive global network, HIARC is emerging as a global hub providing innovative solutions to overcome antibiotic resistance.

Digital Healthcare-based Personalized Antibiotic Treatment

Systems Life Science Research Integrating Neural, Metabolic, and Environmental Responses

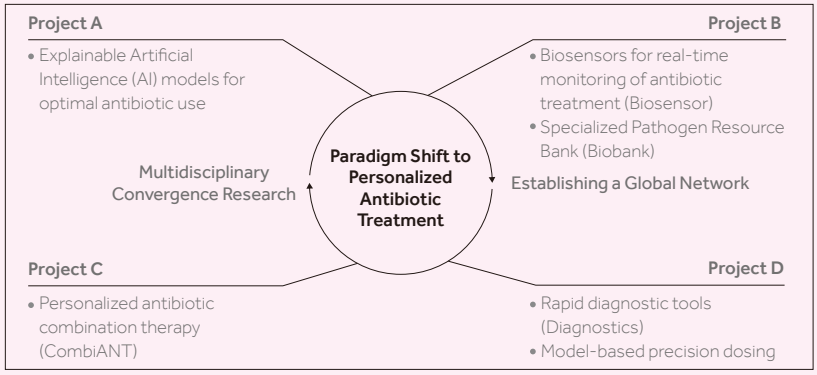
With the goal of realizing digital healthcare-based personalized antibiotic treatment, HIARC is concentrating its research capabilities on its priority project, the A–B–C–D system. This project consists of AI-based optimal antibiotic administration, data infrastructure construction using biosensors and pathogen resource banks, development of personalized antibiotic combination therapy models, and clinical application combining rapid diagnosis and precision dosing strategies.

This convergence research is linked to the government's national management measures to address antibiotic resistance, aiming for a paradigm shift from conventional empirical prescription-based treatment to evidence-based precision medicine. Notably, joint research on rapid diagnostic tool-based personalized antibiotic combination therapy with Uppsala University in Sweden has produced tangible results, serving as a model for international collaborative research leading innovation in antibiotic treatment.

Operation of Korea's only national specialized pathogen resource bank for antibiotic-resistant bacteria

Pathogen resources are key source materials and vital biological resources that support health and medical R&D. In 2024, HIARC was designated as the "Specialized Pathogen Resource Bank for Healthcare-Associated Resistant Bacteria" by the Korea Disease Control and Prevention Agency (KDCA), continuing to strengthen its capabilities in systematic acquisition of high-quality pathogen resources and genomic analysis.

Furthermore, by establishing an integrated platform linking clinical data from five foundation hospitals, HIARC is creating a research environment that organically combines pathogen resources with clinical information. This designation enables HIARC to secure core research infrastructure to lead domestic and international collaborative research while step-by-step establishing a solid foundation for data-driven precision medicine.



Biomarker Research for the Diagnosis and Treatment of Liver Diseases through the Integration of Translational Research and Gut Microbiome Studies

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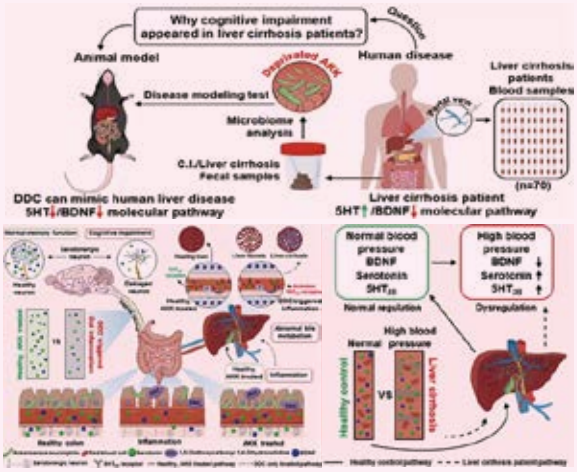
Amid the global demand for innovative diagnostics and therapeutics to address high mortality rates and the public health burden of liver disease, the gut microbiome is gaining attention as a key factor playing a crucial role in the development and progression of chronic liver disease through gut–liver axis interactions. The research team has identified next-generation microbiome-based therapeutics and diagnostic biomarkers, proving their excellence. They aim to select pharmabiotic candidate strains and substances to expand into drug development and diagnostic technologies, ultimately presenting personalized treatment strategies applicable to various diseases.



Regulation of the gut–liver–brain axis and improvement of liver disease through next-generation probiotics

A Priority Research Institute Leading Liver Disease Research through Microbiome Studies

Leveraging its proven expertise in gut microbiome-liver interactions, the Hallym University Institute of Gastroenterology was designated as a Priority Research Institute by the Ministry of Education in 2020, securing 6.3 billion KRW in total funding. The institute is advancing research on the gut-liver-brain axis, focusing on chronic liver disease and hepatic encephalopathy, and has expanded its research scope from identifying pathological mechanisms to developing microbiome-based diagnostic and therapeutic technologies. Notably, the institute has accumulated robust research capabilities to bridge basic research findings with practical therapeutic strategies by identifying pharmabiotic candidate strains and substances, deriving biomarkers, and integrating preclinical and clinical research.

This success suggests a potential paradigm shift in liver disease treatment and serves as a core foundation for personalized medicine research expanding to various diseases.

Identification of Hepatic Encephalopathy Mechanisms Based on the Gut-Liver-Brain Axis and Validation of Next-Generation Probiotic Effects

Hepatic encephalopathy is a neuropsychiatric syndrome occurring in patients with acute or chronic liver disease. Although it is accompanied by cognitive and mental dysfunction, the mechanism between gut microbiota and neurological function has not been clearly identified. To investigate the role of the gut-liver-brain axis, the research team established a cohort of 154 patients with liver cirrhosis and a community cognitive cohort of 80 individuals, and validated cognitive impairment using liver injury mouse models. The results showed that the proportion of the next-generation probiotic Akkermansia muciniphila was significantly reduced in patients with hepatic encephalopathy and cognitive dysfunction. Furthermore, the administration of this strain was confirmed to alleviate liver tissue damage and improve cognitive function. This study suggests the possibility of regulating hepatic encephalopathy through gut microbiota and provides a scientific basis for developing therapeutic strategies based on the gut-liver-brain axis.

Specialized Research Areas

Musculoskeletal Research Group

Integrated Precision Medicine for Age-Related Musculoskeletal Diseases: Control of Periprosthetic Infection Biofilms and Discovery of Genomic-Based Therapeutic Targets for Sarcopenia

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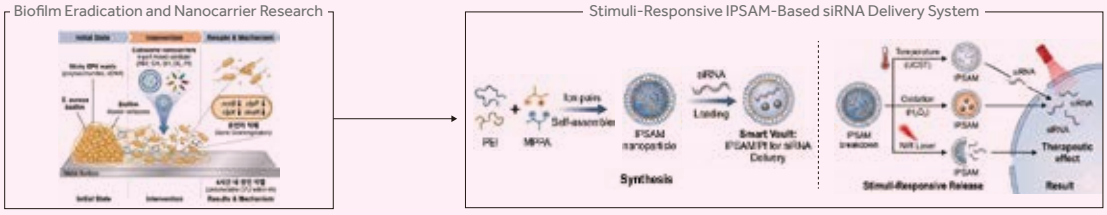

Biofilm Eradication to Smart Delivery

The group conducts research on identifying pathological mechanisms and developing precision treatment strategies for age-related musculoskeletal diseases, such as osteoporosis, fractures, arthritis, sarcopenia, and prosthetic complications, which are increasing due to rapid population aging. By integrating basic and clinical translational research linking molecular biology, nanomedicine, regenerative medicine, bioinformatics, and clinical orthopedics, the group is expanding its research into practical therapeutic technologies, including mechanisms of prosthetic inflammation and osteolysis, candidate factors for regulating bone metabolism, and targeted biofilm removal technology. Furthermore, the group is proposing integrated diagnostic and therapeutic strategies for skeletal aging diseases by discovering transcriptome- and genome-based sarcopenia biomarkers. These research achievements were recognized for their international competitiveness, with researchers being named Highly Cited Researchers (HCR) in 2024.

Development of Precision Diagnostic and Therapeutic Technologies for Age-Related Musculoskeletal Diseases

Advancement of Nanocarrier-Based Periprosthetic Biofilm Removal Technology

The research team developed a four-component mixed removal agent combining calcium hydroxide, sodium hypochlorite, deoxycholate, and an iodine complex, demonstrating powerful anti-biofilm efficacy by removing Staphylococcus aureus biofilms to below the detection limit within four hours. The synergistic effect of each component attacking microbial survival pathways and the EPS matrix through different mechanisms effectively disrupted the structural stability of the biofilm. By encapsulating the agent in cubosome-based nanocarriers, the team simultaneously improved the stability, sustained release, and biofilm penetration of the remover, ensuring consistent removal effects against various strains, including multi-drug resistant bacteria. This technology presents the potential for clinical and industrial application as a next-generation formulation for preventing infections in joint prostheses and medical devices.

Discovery of Precision Diagnostic Biomarkers for Sarcopenia and Osteosarcopenia Based on Integrated Transcriptomic Analysis

To establish early diagnosis and customized treatment strategies for sarcopenia and osteosarcopenia, integrated bioinformatics analysis was performed using public transcriptomic data and Asian cohorts. This analysis identified key sarcopenia-related biomarkers such as PDK4, STAT3, and CCN2, along with hub genes associated with osteosarcopenia such as ADAM8, BECN1, KLF4, and GBP5. These genes reflect age-related pathological mechanisms such as inflammatory responses, autophagy dysfunction, and mitochondrial decline, explaining the simultaneous degeneration of muscle and bone at the molecular level. This study provides a scientific basis for establishing precision diagnostic criteria and targeted therapeutic strategies that reflect the characteristics of Asian populations.

Specialized Research Areas

Systems Biology Research Group

Advanced Systems Biomedical Convergence Research

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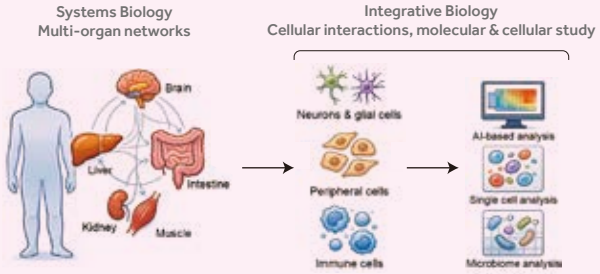
Advanced systems biomedical convergence research focuses on systemic metabolism as a core concept, integrally studying various biological phenomena—including the nervous system, immune system, genome, epigenome, and cellular homeostasis—through cutting-edge life science technologies.

This research aims to identify how interaction networks across the entire organism, beyond individual cells or organs, regulate the onset and progression of diseases. To this end, convergence research is being conducted by combining validation through various genetically modified animal models, precision molecular analysis, advanced genomic analysis models, and omics-based approaches.



Achievements in Advanced Biomedical Convergence Research Considering Systems Metabolism

Systems Life Science Research Integrating Neural, Metabolic, and Environmental Responses

To analyze biological responses to nervous system functions, protein metabolism, and environmental factors, the research team is conducting studies to uncover disease-related biological phenomena at the systems level using various experimental animal models. Research findings on the disruption of neuronal homeostasis and accompanying behavioral changes, biological responses to toxic substances or environmental factors, and the regulatory mechanisms of the nervous system-peripheral tissue axis have been published in top-tier JCR journals, accumulating expertise. Building on these findings, Professor Chan-Hee Lee has presented systemic regulatory mechanisms of the nerve-metabolism axis by publishing research results in Cell Metabolism, Nature Communications, and the Journal of Neuroinflammation over the past five years. Professor Keun-Wook Lee has been awarded mid-career research grants from the National Research Foundation of Korea (NRF) and has been conducting research on anti-cancer immune response regulators based on the identification of cancer cell-immune cell-stromal cell interactions in the tumor microenvironment. Additionally, collaborative research is being conducted based on expertise in various inflammatory diseases, infection animal models, and immune analysis. Notably, joint research on national bio and medical technology development projects with a team of microbiome experts has led to patent filings and paper submissions regarding a novel concept of beneficial microbial combinations and metabolites for improving inflammatory bowel disease. These studies contribute significantly to the integrated understanding of the impact of systemic metabolic states and external stimuli on biological homeostasis.

Research on Identifying Biological Phenomena Based on Cells, Genomes, and Epigenetics

Furthermore, the research team has been conducting research to identify the fundamental principles of life phenomena, focusing on human germ cell development, epigenetic reprogramming, and genomic stability maintenance mechanisms. In particular, studies utilizing human and mouse germ cell models have precisely identified transcriptional regulators and regulatory networks for DNA methylation and hydroxymethylation. In this regard, Professor Sun-Min Lee presented world-class principles of epigenetic regulation in human germ cells and developmental processes through research published in journals such as Nature Cell Biology and Experimental & Molecular Medicine. Professor Gyu-Young Lee expanded the foundation of cellular homeostasis research by continuously publishing findings on genomic stability and DNA damage repair mechanisms in top-tier journals such as Nucleic Acids Research.

Specialized Research Areas

Multi-omics Research Group

Multi-omics-based Systems Biology Convergence Research

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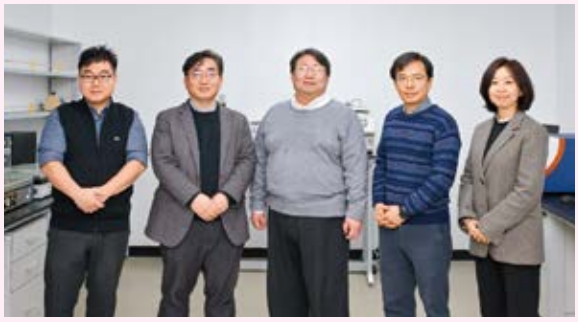

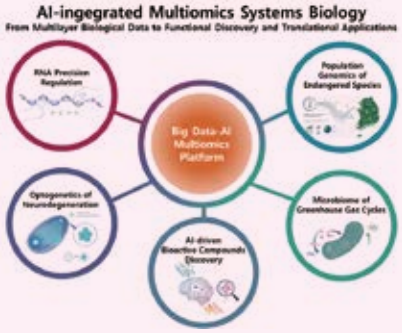

The Multi-omics-based Systems Biology Convergence Research Team is composed of faculty members from the Department of Life Science and is affiliated with the university's Multidisciplinary Genome Institute and the BK21 Multi-omics-based Functional Biomaterials Research Talent Training Team.

Multi-omics is a research field that provides a holistic understanding of biological systems by integrating multi-layered biological data, including genomics, transcriptomics, proteomics, metabolomics, microbiome, and phenomics. Advances in next-generation sequencing (NGS) technology and AI-based analysis have enabled the multi-layered elucidation of complex biological phenomena and disease mechanisms, with their applications rapidly expanding across the bio-industry.

Utilizing this multi-omics approach, the research team is identifying functional biomaterials applicable to the bio-health industry and conducting research to scientifically verify their efficacy at the molecular level.

Holistic Understanding of Biological Systems through Multi-layered Data Integration

Integrated Epitranscriptome-based RNA Precision Control Platform

We develop modules that precisely control the tissue specificity, timing, intensity, and stability of mRNA through AI analysis of epitranscriptome big data based on Next-Generation Sequencing (NGS). We also establish green platforms for optimized mRNA vaccines and the production of high-value metabolites and proteins.

Conservation Strategy for Abeliophyllum distichum Revealed by Omics

We precisely diagnose genetic bottlenecks and habitat fragmentation of Abeliophyllum distichum, a plant species endemic to Korea, using RAD-seq-based population genomics, and provide a genetic blueprint for the conservation of endangered species in the era of climate crisis.

AI-based Development of Antiviral Therapeutics from Native Korean Plants

We identify antiviral candidate substances derived from natural products using AI prediction and big data, and elucidate targets and mechanisms of action through proteomics-based in silico docking.

Optogenetics-based Study on ALS Neurodegeneration Mechanisms

We develop a light-controllable TDP-43 aggregation model to elucidate protein aggregation and neuronal death pathways in neurodegenerative diseases at the molecular and cellular levels.

Discovery of Microbes for Simultaneous Control of Methane and Nitrous Oxide

Using multi-omics, we identify methanotrophs that simultaneously perform methane oxidation and nitrous oxide reduction under hypoxic conditions, suggesting the potential for controlling complex greenhouse gases.

Nanomedical Engineering Research

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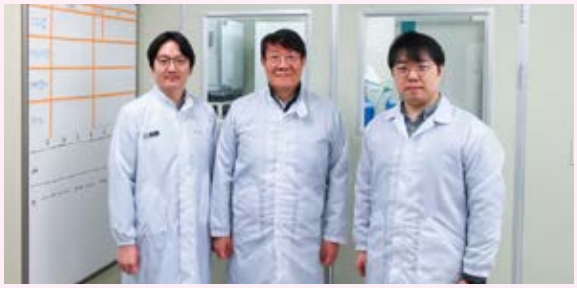
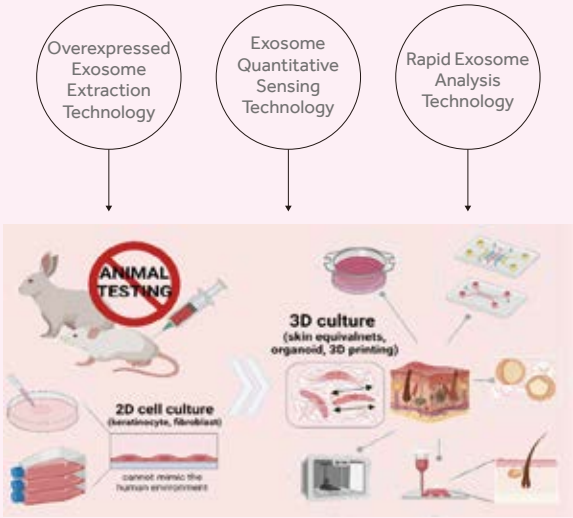


Exosome-based therapeutics are gaining attention as a new alternative for treating intractable diseases; however, practical application has been hindered by the absence of manufacturing and analytical standards and limitations in clinical-level efficacy validation.

Addressing this challenge, the research team designated atopic dermatitis as a target disease and is building a convergence research platform that integrates exosome manufacturing, analysis, and efficacy validation into a single workflow.

This study presents an evaluation system that approaches clinical levels beyond animal testing by linking nanomedical engineering technologies, such as specific miRNA-overexpressing exosome manufacturing, high-sensitivity analysis, and 3D skin tissue chips containing human-derived blood vessels.



Efficacy Validation with Full-Thickness Skin-on-a-Chip Including Human-Derived 3D Blood Vessels

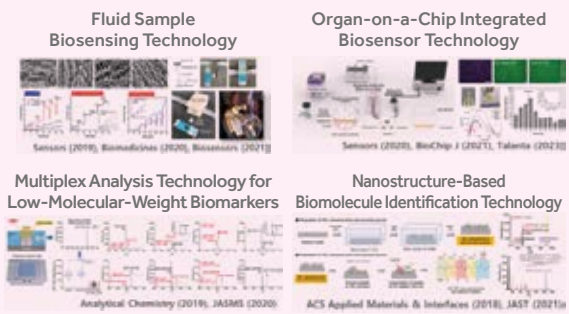
Development of an Exosome Manufacturing, Analysis, and Efficacy Validation Platform for Atopic Dermatitis Exosome Therapeutics

Securing miRNA-Overexpressing Exosome Manufacturing and Precision Analysis Technologies

The research team established a cell-based manufacturing process to stably produce exosomes overexpressing miR-147a, known for its anti-inflammatory effects. These efforts confirmed high productivity and expression characteristics in the exosomes, demonstrating their potential as therapeutic candidates for atopic dermatitis. Furthermore, introducing MALDI-TOF mass spectrometry-based exosome biomarker detection and a sensing concept using synthetic biology-based surface-expressing bacteria significantly enhanced analytical precision.

Implementation of an Efficacy Validation Model Based on Skin Tissue Chips Including Human-Derived Blood Vessels

To evaluate therapeutic effects at a clinical level, the research team constructed a skin tissue chip featuring microvessels. Subsequently, we established an atopic dermatitis disease model using cytokine stimulation. Notably, the HDMEC-based model responds sensitively to inflammatory reactions and accurately reflects pathological characteristics, suggesting its potential for validating exosome efficacy and serving as an alternative to animal testing. This achievement lays a solid foundation for enhancing the reliability of preclinical evaluations in developing exosome therapeutics.



Specialized Research Areas

Medical Nutrition Research Group

Medical-Bio Translational Nutrition Research Center

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With the rapid transition to a super-aged society, aging-related chronic diseases—including cognitive decline, sarcopenia, and hyperlipidemia—are increasingly understood not as independent organ diseases but as common pathophysiological outcomes of systemic metabolic network disruption. Accordingly, integrated intervention strategies regulating systemic metabolic networks are becoming essential to prevent and ameliorate chronic diseases, moving beyond organ-specific or single-disease approaches. Driven by this paradigm shift toward a systemic metabolic network perspective, the Medical-Bio Translational Nutrition Research Center conducts convergence research to elucidate the mechanistic effects of food and nutrition interventions and prevent aging-related chronic diseases.

Prevention of Aging-Related Chronic Diseases Through Systemic Metabolic Network Regulation and Establishment of a Customized Intervention Nutrition Platform

Understanding Chronic Disease Pathology and Establishing Intervention Strategies Based on Systemic Metabolic Networks

The research center conducts convergence research to integrally understand the pathophysiology of chronic diseases across human systems—nervous, musculoskeletal, cardiovascular, and integumentary—from the perspective of systemic metabolic and inflammatory network disruptions, and to establish nutrition-based intervention strategies. In particular, leveraging large-scale nutritional epidemiology cohort data allowed us to identify the impact of dietary patterns and nutritional status on disease onset and present mechanisms of systemic metabolic disruption during aging, focusing on key regulators like immunity, the gut environment, and lipid metabolites. These achievements provide a mechanistic basis for reinterpreting chronic diseases, including geriatric conditions, from the perspective of systemic metabolic network regulation, contributing to the scientific foundation for nutrition-based prevention strategies.

Advancing Personalized Food and Nutrition Intervention-Based Chronic Disease Prevention Platforms

The center defines systemic metabolic network disruption as a controllable pathophysiological process and experimentally verifies changes in systemic metabolism and inflammatory responses following nutritional interventions. By analyzing systemic metabolic changes focused on food materials and key nutrients and evaluating intervention effects using target tissues reflecting systemic status, the center accumulates practical evidence for chronic disease prevention strategies. Future plans include establishing a big data-based research system integrating nutritional epidemiology, omics analysis, and preclinical/clinical trial results, and developing AI-based tools to quantitatively predict relationships between metabolic network changes and disease risks. These initiatives aim to evolve beyond population-level prevention into personalized nutritional intervention designs reflecting individual characteristics, advancing food and nutrition research into a systemic metabolic network-based prevention platform applicable in the medical-biotech field.

Medical-Bio Translational Nutrition Research Center

Prevention of Aging-Related Chronic Diseases Through Systemic Metabolic Network Regulation and Establishment of a Customized Intervention Nutrition Platform

Specialized Research Areas

Convergence Nursing Research Group

Problem-Solving Convergence Nursing Research Integrating Region, Industry, and Data

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The convergence nursing research area at Hallym University College of Nursing conducts problem-solving research integrating healthcare data, AI, digital health, public policy, and community issues, grounded in clinical-centered nursing. With nursing as the core axis, the group structurally analyzes health problems at regional and social levels by converging with data science, IT, public health, and regional policy.

This research utilizes clinical and community healthcare data to systematically analyze health risk factors and design evidence-based intervention strategies, establishing a structure where outcomes expand into education, policy, and institutional systems. Such efforts support data-driven decision-making and region-specific health policy formulation, contributing to sustainable healthcare innovation.

Evidence-Generating Convergence Research Based on Healthcare Data

Hallym University College of Nursing continuously accumulates evidence-based convergence research outcomes leveraging its healthcare data analysis capabilities. It performs multi-layered analyses of health problems at individual, group, and regional levels using national health surveys, administrative/medical data, and clinical/survey data. These studies focus on deriving health risk factors, preventability, and intervention priorities from a nursing perspective.

Furthermore, the research structure advances analysis methodologies through collaboration with data science, epidemiology, and public health fields, ensuring outcomes extend to policy and field applications. This approach ensures scalability, linking nursing research outcomes to digital health intervention design, regional health policy proposals, and educational program development.

Problem-Solving Convergence Research Linked to Regions and Policy

The convergence nursing research area conducts policy-linked, problem-solving research centered on community health issues. It multidimensionally analyzes complex regional issues, such as responses to a super-aging society, youth health risks, regional health disparities, and healthcare accessibility. This research establishes a structure where nursing interventions expand beyond community practice into education, systems, and policies.

Specifically, linking with public health, education, and regional policies enables field-based empirical research, strengthening the feedback loop between research results and policy proposals. These studies demonstrate that nursing research generates practical outcomes contributing to regional innovation and public value creation.

Digital Health and AI-Based Intervention Research

We conduct digital-based intervention research focused on disease prevention, health management, education, and prediction by applying AI, machine learning, VR, and mobile technologies to nursing. This research enhances the efficiency and accessibility of nursing practice while expanding the applicability of digital health technologies in clinical and community settings.

Specialized Research Areas

Specialized Nursing Research Group

Clinical Problem-Solving Research through Specialized Nursing Research Based on Medical Center-Linked Living Labs

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Leveraging close links with the Hallym University Medical Center infrastructure, the College of Nursing is establishing a specialized nursing research system that expands clinical issues into research topics. Notably, continuous cooperation with the five foundation hospitals under Hallym University Medical Center ensures a robust research environment capable of planning, demonstrating, and disseminating clinical-centered research.

This field aims to move beyond simple observation of complex clinical problems, jointly designing and verifying solutions through industry-academic cooperation and the Living Lab approach. These initiatives establish a structure expanding specialized nursing research beyond academic achievements into technology development, educational innovation, and industrial linkage.

Achievements in Medical Center-based Industry-Academic Cooperation Conferences and Living Lab Operations

Strengthening Nursing Research and Education Cooperation Linked to Clinical Settings

Hallym University College of Nursing regularly holds an annual industry-academic cooperation conference with the five foundation hospitals to share clinical-centered nursing research outcomes. This conference serves as a platform where hospital nurses and faculty participate together to develop actual clinical issues into research topics.

Furthermore, the Living Lab Idea Contest fosters a participatory research culture where students, clinical experts, and professors collaborate to solve real-world clinical problems. Ideas generated in this process drive outcomes linked to research project planning, educational content development, and technology commercialization.

Outcomes of Industry-Linked Medical-Bio Technology Development and Digital-Based Specialized Nursing Research

Expanding Technology Commercialization and Digital Demonstration of Nursing Research through Industry-Academic-Research Cooperation

Hallym University College of Nursing continuously carries out joint industry-academic technology development and medical-bio research in cooperation with companies like Gridatech Co., Ltd. and M-Factory Co., Ltd. This collaboration generates practical research outcomes where nursing-based research results link directly to technology development and commercialization. Aligned with the R&D Special Zone's focus on commercialization and demonstration, this structure establishes a system for generating problem-solving research outcomes. Such a structure creates a virtuous cycle where nursing research outcomes lead to sustainable talent cultivation and research dissemination, rather than ending as isolated studies.

Representatively, the 2025 digital twin-based interventional nursing practice platform project implemented ECMO clinical situations in a virtual environment and produced VR-based educational content, including alarm response processes. This establishes a digital-based education and research environment where nursing judgment and intervention skills for high-risk situations can be repeatedly practiced.

Hallym Leading the Future

Cultivating Innovative Talent


Cultivating
AI Convergence Talent
Cultivating
Physician-Scientists
Cultivating
CRO Specialists
Cultivating
Specialized Medical-Bio
Convergence Talent

Education and Research Program for Medical AI Convergence Experts

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The advancement of medical AI technology requires convergence-type talent possessing both medical field understanding and data/technical capabilities. Leveraging educational infrastructure linked to Research-Driven Hospital, Hallym University established a medical AI convergence talent system utilizing clinical environments and data. Building on this, the university aims to foster practical talent capable of applying medical AI technology to clinical practice by strengthening field-based problem-solving and practice-oriented learning.

Cultivating Medical AI-Specialized Convergence Talent Expanding from Education to the Field and the Global Stage

Field-Oriented Medical AI Practice-Based Education Utilizing Clinical Data

The Medical AI-Specialized Convergence Talent Cultivation Project provides education combining theory and practice by utilizing actual medical data. Hallym University established a practice-oriented learning environment where students define clinical problems and design/verify AI models by integrating real-world medical data—such as medical images, EMR, and bio-signals—into the curriculum based on its medical center network. This cultivates medical AI convergence talent equipped with both medical field understanding and data analysis capabilities.

Cultivating Practical Medical AI Talent for Growth in a Global Environment

The Medical AI Specialized Convergence Talent Cultivation Project extends beyond domestic education, providing opportunities to experience global research environments and participate in international collaborative research. Participating students engage in short-term training, international workshops, and joint projects with leading overseas institutions. They study the latest global medical AI research and accumulate practical experience by collaborating with top-tier researchers to address unmet medical needs. This process broadens understanding of medical AI application, regulations, and data environments while strengthening international communication skills and practical expertise. Consequently, students develop into practical medical AI convergence talent with the perspectives and competencies required in global medical settings.

Cultivating Convergence Physician-Scientists

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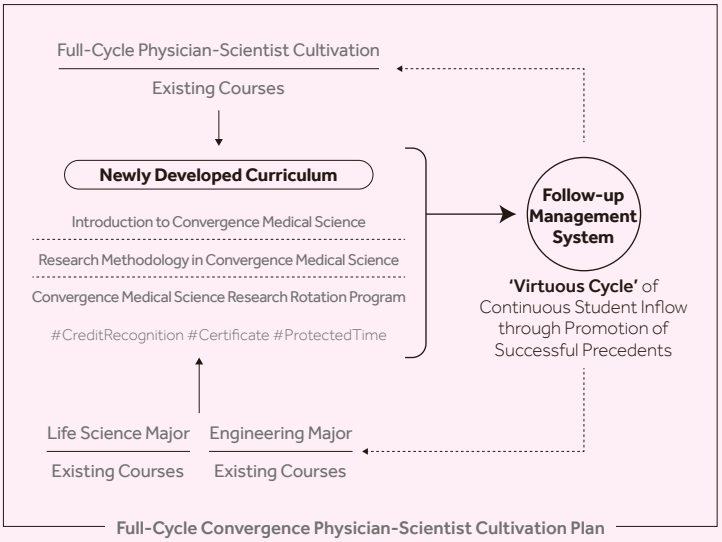
This innovative initiative to expand medical education beyond the clinic to laboratories and future industries is realized through the 'Convergence Medical Scientist Undergraduate Program Support Project.' This project aims to cultivate global convergence talent capable of addressing clinical questions with scientific solutions through bold educational innovation encompassing basic medicine, AI, and life sciences.

Hallym University College of Medicine Accelerates Cultivation of 'AI-Bio Convergence' Physician-Scientists, Leading the Future Medical Education Paradigm

Hallym University College of Medicine drives innovation based on two pillars: 'infrastructure' and 'systems.' Directly linking its unparalleled field infrastructure—five foundation hospitals and the Research Institute of Medical-Bio Convergence—to education supports students in gaining live learning experiences bridging clinical practice and research. In particular, multidisciplinary convergence research involving medical and STEM students, along with immersive lab rotation programs, represents a unique strength of Hallym University College of Medicine.

To cultivate future medical researchers, guaranteeing time and opportunities for research is paramount. Hallym University College of Medicine boldly introduced the 'Protected Time' system, flexibly adjusting schedules to allow undergraduates to concentrate on research. Furthermore, the university supports continuous research activities through systematic mentoring and exceptional measures like full graduate scholarships. Anchored by an education-research model linking infrastructure and systems, Hallym University College of Medicine continuously advances its physician-scientist cultivation system to lead future medical research and the bio-health industry. This initiative contributes significantly to the advancement of the domestic medical field and bio-health industry.



Full-Cycle Convergence Physician-Scientist Cultivation Plan

Cultivating Professionals in Clinical Trial Operations and Management

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In response to growing demand for clinical and health data research, Hallym University College of Nursing is establishing a new "Clinical Trial Management and Operations Major" in the Graduate School of Nursing, starting the first semester of 2026. With the growth of pharmaceutical/bio industries and digital health, demand for professionals capable of managing the entire clinical trial process—planning, operation, monitoring, quality control—is increasing.

Accordingly, Hallym University College of Nursing aims to establish a multidisciplinary education system linking data science and bio-health, centered on nursing, to systematically cultivate high-level clinical trial professionals. Furthermore, connecting with the Gangwon Special R&D Zone, the college plans to strengthen cooperation with regional bio/digital healthcare industries and build a sustainable talent cultivation model linking education, research, and industrialization.

Preemptive Operation of Undergraduate Nano-degree-based Clinical Trial Education

To establish a foundation for cultivating professionals, the "Clinical Trial Manager Nano-degree Program" has operated in the undergraduate curriculum since the first semester of 2025. This program systematically fosters core basic competencies—clinical trial concepts, ethics/regulations, data management, monitoring—at the undergraduate level, linking to the future major. This initiative empowers students to expand career exploration and practical interests early, while educational needs and field demands identified during operation serve as basic data for advancing the curriculum.

Curriculum Development and Establishment of Industry-Academic Cooperation Foundation for the New Major

The steering committee formed for the establishment of the "Clinical Trial Management and Operations Major" analyzed job demands in the clinical research field to derive core competencies required for planning, operation, monitoring, quality, and data management, and structured a curriculum linked in stages of basic, advanced, and practical training based on these. Furthermore, collaboration with CROs and hospital clinical trial centers has established a robust system for field training and internships. We have also finalized the curriculum roadmap and operation plan, completing preparations for the program's launch in the first semester of 2026. These achievements serve as the foundation for building a practical, field-based education system responding to industry demands and clinical environment changes.

Establishment of the College of Medical-Bio Convergence

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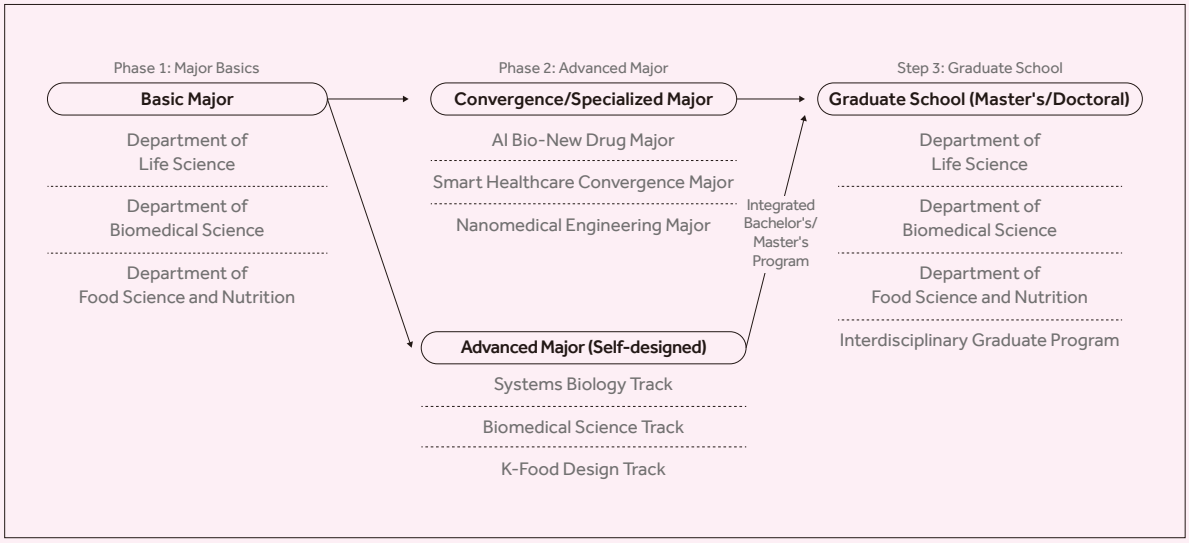
Advancement of Convergence Research and Research Cooperation System through Specialization in Medical-Bio-Health

Our university designated 'Medical-Bio-Health' as a specialized field aligned with regional strategic industries, aiming to enhance global research capabilities and foster flagship academic units, operating various talent cultivation programs for 30 years. Building on this foundation, we established a Medical-Bio-healthcare industry research network involving university researchers, medical center clinical researchers, and related institute researchers. However, academic operations centered on small departments and mandatory double majors have limited the cultivation of talent capable of flexibly responding to rapid industrial changes. Accordingly, the university is reorganizing the academic structure and establishing a curriculum meeting modern needs by integrating similar curricula and opening new advanced courses. Furthermore, establishing an academic organization to support research groups in securing large-scale projects will strengthen the link between education and research.

Establishment of a Medical-Bio Convergence Talent Cultivation System through Academic Structure Reorganization

We will integrate six existing bio-related departments to establish the College of Medical-Bio Convergence and build an integrated system linking education, research, and industry-academic cooperation. Within the college, operating basic and advanced major courses in stages will strengthen basic competencies and expertise, while convergence education transcending boundaries will enhance practical responsiveness. In addition, operating a Fast-Track undergraduate-master's program encourages early research participation, and introducing a convergence specialization major system centers on advanced fields reflecting industrial demands. These initiatives enable the university to cultivate professional talent capable of preemptively responding to Medical-Bio-health industry changes and contribute to strengthening regional and national competitiveness.



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Innovation of the University Operating System:
Hallym University Three Core Convergence Research Institutes

Leaping Forward as a Global Leading University through "Innovation via Deconstruction"

Moving away from the traditional department-centered system, our university has transitioned to an open university operating system centered on the three core convergence research institutes. This is a flexible innovation structure that actively responds to a changing society by dismantling boundaries between majors and organizations and linking education, research, and operations. We strengthen open governance by recruiting external experts and identifying innovative fields, while revitalizing research and education to foster creative talent and solve regional issues based on the free convergence of disciplines.

Centered on the Research Institute of Medical-Bio Convergence, Research Institute for Data Science and AI, and Research Institute of Humanities & Social Science Convergence, we are building a local government-industry-academia cooperation system and leading a global leap where university research outcomes are disseminated throughout society.

Research Institute of Medical-Bio Convergence: Research Hub & Network

Overseeing healthcare convergence research in connection with the Colleges of Medicine, Nursing, and Natural Sciences, and leading the execution of government-funded projects.

Research Institute for Data Science and AI: Fostering AI Specialists

Serving as a comprehensive hub for AI research, centered on the College of Information Science, which integrates the Schools of Software, AI, and Data Science.

Research Institute of Humanities & Social Science Convergence: Regional Coexistence Think-Tank

Presenting policies and visions for the development of local communities and culture by reorganizing humanities and social science research organizations.

Three Core Convergence Research Institutes:
Platforms for Innovating the University Operating System

Establishing an education-research-local government-industry-academia cooperation ecosystem based on the convergence research institutes