Taiwan Association
for Aerosol Research

台灣氣膠研究學會

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TAAR Newsletter is a quarterly publication by the Taiwan Association for Aerosol Research

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Chih-Wei Lin, Wei-Ren Ke, Pei-Ying Cai

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President's 2025 New Year Greetings

Dear friends of the TAAR,

Greetings to you all!

As we enter 2025, TAAR has entered its 33rd year. Thanks to everyone's contribution, TAAR is now a pivotal hub for aerosol research in Asia and has secured a seat in the international aerosol research arena. To enhance TAAR's visibility, we have revised our logo by incorporating the society's name in both Chinese and English, as shown in the attached image. We kindly ask everyone to start using this new logo from now on.

President's 2025 New Year Greetings

I am deeply grateful for your support in electing me as the President last year. During my two-year term, I aim to invigorate the operation of our committees, broaden participation, and nurture new talent. All the chairpersons of our committees have now assumed their roles, and we will continue inviting new members to join. If you receive an invitation, I sincerely hope you can participate. By diversifying our team, we can learn from one another, spark new ideas, and grow together as a community.

In recent years, the emergence of novel technologies has injected fresh momentum into aerosol research, with the application of Artificial Intelligence (AI) becoming a focal point. This September, the International Aerosol Conference 2025 in National Cheng Kung University, Tainan, will center on "Aerosol Investigation and Artificial Intelligence (Double AI)." Taiwan is a pioneer in information and communication technology; we must take advantage of this opportunity. TAAR will host forums or training courses to accelerate AI applications in the aerosol field, which we believe will lead to groundbreaking advancements.

While looking toward the future, we also cherish the memory of the past. Our beloved founding President and Honorary Chairman, Dr. Chiu-Sen Wang, passed away last October, leaving us with profound sorrow. We will publish a special memorial issue in honor of Dr. Wang in an upcoming newsletter.

President's 2025 New Year Greetings

The passing of Honorary Chairman Dr. Chiu-Sen Wang further reminds us to cherish the esteemed senior scholars we have with us today. To provide mid-career and young scholars with opportunities to learn from and seek guidance from experienced pioneers in aerosol research, we will launch a new lecture series titled "The Academic Journey of Outstanding Aerosol Scholars." The series will adopt a hybrid format, allowing in-person and online participation. The first lecture is scheduled for March, and we eagerly look forward to your participation.

As we embark on this new year, I wish you all success and prosperity in the Year of the Snake!

May your days be fulfilling, your months progressive, your work (and publications) reach all corners of the world, and your reputation shine far and wide!

Warm regards,
Shih-Chun Candice Lung
President, Taiwan Association for Aerosol Research

17th Working Committee

• President	Shih-Chun Lung
• First Vice President	Ta-Chih Hsiao
• Second Vice President	Lin-Chi Wang
• Secretary General	Yen-Ping Peng
• First Deputy Secretary General	Yu-Chieh Ting
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• Finance Committee/Chairman	Sheng-Hsiang Wang
• Southeast Exchange Committee/Chairman	Kai Hsien Chi
• Education Committee/Chairman	Ming-Yeng Lin

Calendar of Events

Date
24–29 August, 2025

Conferences
22nd International Conference on Nucleation and Atmospheric Aerosols (ICNAA)

Location
Vienna, Austria

Website
https://icnaa2025.univie.ac.at/home/

Date
31 August–5 September, 2025

Conferences
2025 European Aerosol Conference (EAC 2025)

Location
Lecce, Italy
Bandung, Indonesia

Website
https://eac2025.iasaerosol.it/

Calendar of Events

Date
13–17 October, 2025

Conferences
American Association for Aerosol Research (AAAR) 43rd Annual Conference

Location
Buffalo, New York

Website
https://www.aaar.org/meetings-events/meetings-and-events/

Date
August 30-September, 2026

Conferences
12th International Aerosol Conference (IAC 2026)

Location
Xi'an, China

Website
https://iac2026.csp.org.cn/?sid=3742&mid=954&v=100#!c/showNews/a/index/id/14364/label/2616

Exclusive Interview with AVerMedia

AVerMedia Technologies has adopted "AI-driven products" and "product AI-ization" as its core strategies, actively promoting the application and integration of AI technology into its offerings. For product AI-ization, AVerMedia is committed to enhancing the intelligence of all its products by integrating AI processing and features. Notable achievements include the successful development of software solutions like "Streamer Central," which opens up a wide range of application scenarios. In the field of AI-driven products, AVerMedia has introduced edge computing solutions powered by NVIDIA Jetson Orin modules, focusing on industrial applications. Collaborating with partners, the company has developed intelligent detection systems, deepening the practical applications of AI technology while offering innovative solutions for the industrial sector. Through the implementation of these dual strategies, AVerMedia demonstrates its dedication to advancing AI technology and its diversified potential applications, laying a solid foundation for the company’s future growth. Examples and Directions of AVerMedia's AI Applications

Exclusive Interview with AVerMedia

1. Smart Agriculture and Technological Integration

AVerMedia combines AI-powered image recognition technology to develop an AI model which is capable of precisely identifying plants and weeds for agricultural machinery. This innovation enables accurate pesticide application and weeding, reducing pesticide usage by up to 95%, lowering costs, and preserving soil health while fostering organic farming practices.

Additionally, the machinery is equipped with 24 cameras and high-performance computing devices, allowing real-time crop scanning and analysis to predict yield. For crops like grapes and strawberries, AVerMedia has developed intelligent mildew-removal technology using UV-C light for targeted sterilization. By integrating AI and autonomous vehicle capabilities, the company further enhances agricultural efficiency and safety.

2. AI and Image Recognition Technology in Diverse Applications

AVerMedia applies image recognition technology across various sectors, including food service and environmental monitoring, offering high-efficiency solutions. In the food industry, the technology reduces food waste by analyzing the type and weight of kitchen waste, generating reports to optimize procurement decisions, helping clients cut costs and lessen their environmental impact.

In workplace and environmental monitoring, AVerMedia integrates AI with cameras to provide air quality and dust concentration monitoring solutions. This approach significantly reduces the high costs associated with traditional monitoring equipment while ensuring efficient oversight and maintenance.

AVerMedia partners with NVIDIA to utilize hardware platforms like Jetson for AI model development and hardware customization, becoming a key technological partner in the agricultural and industrial sectors. By providing robust computational power and hardware support, the company helps its collaborators achieve intelligent solutions in agricultural machinery and industrial automation.

AVerMedia also emphasizes the importance of industry-academia partnerships to accelerate the commercialization of academic innovations. Through these collaborations, AVerMedia aims to transform academic research into viable commercial solutions, fostering win-win outcomes for both the corporate and academic sectors.

Exclusive Interview with AVerMedia

AVerMedia leverages remote teaching technologies to address the lack of educational resources in rural areas. By employing live-streaming equipment and virtual background technology, students can interact in real-time with teachers in different areas, ensuring equal educational opportunities.

This technology played a pivotal role during the COVID-19 pandemic and continues to support educational equity post-pandemic. The company is also dedicated to integrating its technologies into ESG (Environmental, Social, and Governance) initiatives, emphasizing the positive societal and environmental impacts of its innovations.

AVerMedia plans to explore further applications of AI and image recognition technologies in agriculture, environmental monitoring, educational technology, and beyond. It aims to deepen business collaborations and expand its societal impact. Future initiatives include collaborations in the aerosol field to enhance air quality monitoring accuracy and utility using AI and image recognition technology.

By combining advanced spectral technologies with intelligent analytical tools, AVerMedia envisions more effective monitoring of dust, aerosol concentrations, and pollutant distribution, providing real-time alerts to support environmental protection and public health initiatives.

Personal Profile: Wei-Ren Ke

Dr. Wei-Ren Ke

Assistant Professor, National Taiwan University School of Pharmacy

Affiliation

National Taiwan University School of Pharmacy

Education

- **Bachelor's Degree, Department of Respiratory Therapy, Chang Gung University**
- **Master's Degree, Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University**
- **Ph.D., School of Pharmacy, University of Sydney, Australia**

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Dr. Wei-Ren Ke earned his bachelor's degree from the Department of Respiratory Therapy at Chang Gung University, with a professional background in respiratory care and therapy, including pulmonary function assessment, pulmonary rehabilitation, and critical respiratory care. During his clinical internship, Dr. Ke noticed a gap between the techniques of aerosol therapy and academic theories, particularly the underappreciation of aerosolized medications' effectiveness in clinical applications. This observation inspired his strong interest in pulmonary drug delivery and initiated his research journey in this field. To deepen his understanding of aerosol technology and deposition mechanisms in the lungs, Dr. Ke pursued a master’s degree at the Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University.

His research focused on the deposition mechanisms of airborne particles in the lungs and corresponding respiratory protective measures. Under the supervision of Professor Chih-Chieh Chen, he completed his master's thesis, gaining extensive experience in aerosol characterization techniques. He also participated in several research projects combining aerosol technology with respiratory therapy. To further explore the development and evaluation of inhalable drug formulations, Dr. Ke pursued his Ph.D. at the School of Pharmacy, University of Sydney, specializing in the development and characterization of inhalable formulations. Supported by state-of-the-art laboratory facilities, he mastered comprehensive research methodologies and techniques during his doctoral studies. Despite the challenges posed by the COVID-19 pandemic, he remained focused on his studies and successfully completed his degree within a shortened timeframe. After returning to Taiwan, Dr. Ke joined the National Taiwan University School of Pharmacy, initially as a postdoctoral researcher. In 2021, he was promoted to Assistant Professor. His research focuses on pulmonary drug delivery and formulation development, aiming to bridge academic research with clinical practice and provide more effective treatment options for patients.

Dr. Ke's research focuses on pulmonary drug delivery, a critical route of drug administration that has gained significant attention in the post-COVID era. Pulmonary drug delivery involves dispersing medications into appropriately sized aerosol particles, which are then delivered to the lungs for absorption. The large surface area and dense capillary network of the alveoli allow inhaled drugs to rapidly enter systemic circulation while bypassing first-pass hepatic metabolism. As a result, inhaled medications offer the advantages of rapid absorption and high bioavailability. This delivery method is not only used for localized treatment of pulmonary diseases but is also increasingly recognized as a promising platform for systemic drug delivery.

Based on formulation design and delivery methods, inhaled drug delivery devices are categorized into four major types: nebulizers, metered-dose inhalers (MDIs), soft mist inhalers (SMIs), and dry powder inhalers (DPIs). Dr. Ke's research emphasizes improving the design and performance of these devices to overcome existing technological challenges and enhance the efficiency and clinical applicability of pulmonary drug delivery.

Through the efforts of his research team, Dr. Ke has achieved several innovative milestones. These include the development of spray-dried inhalable powders with improved stability, low hygroscopicity, and excellent dispersibility; the design of a vibrating mesh nebulizer that functions independently of handheld orientation, improving usability for bedridden patients; and the creation of a soft mist inhaler adapter for high-flow nasal cannula systems, significantly improving drug delivery efficiency. Dr. Ke's work integrates aerosol science with pulmonary drug delivery innovation, aiming to address current technological limitations and expand the clinical and industrial applications of these advancements.

1. Formulation Development – Inhalable Dry Powders Using Spray Drying Technology

Dry powder inhalers (DPIs) play a crucial role in the clinical application of inhalation therapies due to their high formulation stability and user-friendly nature. However, the physicochemical properties of dry powder formulations significantly affect their delivery efficiency. Micronized drug particles typically exhibit high cohesion and poor flowability, posing challenges to formulation uniformity and delivery performance.

Spray drying is a particle engineering technique that transforms liquid feeds into dry powders. By optimizing spray and drying parameters, particles with specific physicochemical properties (e.g., particle size, morphology, crystallinity, and hygroscopicity) can be produced. Our team has developed an innovative particle engineering platform based on spray drying. This technique involves suspending micronized lactose crystals in isopropanol containing hydrophobic drugs, which are then spray-dried. This approach effectively prevents the amorphization of lactose and coats hydrophobic drugs onto the lactose crystal surfaces. The resulting particles exhibit reduced interparticle cohesion, improving flowability and dispersibility.

Our research demonstrates that spray-dried particles prepared using this technique exhibit improved powder stability, low hygroscopicity, low surface energy, and superior dispersibility. These particles have been successfully applied in the development of inhalable dry powder formulations for bronchodilators, anti-tuberculosis antibiotics, and pulmonary fibrosis treatments. Additionally, we utilized optical photothermal infrared (O-PTIR) spectroscopy to verify the uniformity and crystallinity of the formulations, further validating the potential of this particle engineering technique for innovative applications in dry powder inhalers.

2. Device Design - Direction-Free Vibrating Mesh Nebulizer (VMN)

Vibrating mesh nebulizers (VMNs) use piezoelectric crystals to vibrate a mesh with micro-perforations, atomizing drug solutions into fine, uniform droplets that enhance deep-lung drug deposition. However, current VMNs require continuous contact between the drug solution and the mesh. Improper handheld angles can hinder drug output or reduce delivery efficiency.

To address this limitation, our team designed a VMN device that utilizes capillary action to actively transport the drug solution to the mesh. This innovation eliminates angle dependency, allowing stable nebulization across 0° to 180°, making it particularly suitable for bedridden patients. The device consistently produces droplets of uniform size at any angle. This design was patented in the United States in 2022, with findings published in international journals.

3. Drug Delivery - Optimizing Soft Mist Inhalers (SMIs) for Ventilator Systems

Soft mist inhalers (SMIs) are innovative inhalation devices that use spring-driven mechanical force to atomize drug solutions into fine droplets, replacing traditional propellants and reducing greenhouse gas emissions. SMIs feature low spray velocity and extended spray duration, minimizing drug waste caused by hand-breath coordination issues. They are widely used for delivering long-acting anticholinergic medications.

To enable mechanically ventilated patients to benefit from these medications, our team developed an SMI adapter optimized for ventilator circuits. We investigated the placement of SMIs and the timing of drug delivery within the circuit, analyzing their effects on delivery efficiency and particle size distribution. Our findings indicate that positioning the SMI near the patient end of the inspiratory limb and delivering drugs during the late expiratory phase achieves optimal drug delivery efficiency. In 2022, we further developed an SMI adapter for high-flow nasal cannula systems, significantly enhancing drug delivery performance in these systems.

Expert Profile: Chia-Hua Lin

Chia-Hua Lin

Current Position

Department of Biotechnology/Office for Sustainability and Social Responsibility, National Formosa University
Professor/Dean

Qualification

Department of Environmental Engineering, National Chung Hsing University
PhD

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Dr. Chia-Hua Lin currently serves in the Department of Biotechnology at National Formosa University. His research encompasses environmental engineering, biomedical science, and materials science, culminating in numerous interdisciplinary projects uniting environmental engineering with biomedical technology. His recent research topics include: (1) Mechanistic investigation of the biological toxicity of airborne particulate matter; (2) Health risk evaluation of micro- and nano-scale plastic particles; (3) Safety assessments of nanomaterials; (4) Synthesis and applications of multifunctional nanomaterials. In the future, Dr. Lin will persist in advancing academic progress and practical applications through interdisciplinary research and innovation, contributing to environmental sustainability and health technology.

Between 2019 and 2024, Dr. Lin published a total of 37 international journal articles, with 32 of them featuring him as the first or corresponding author. These publications include leading journals such as *Journal of Hazardous Materials, Science of the Total Environment, Chemical Engineering Journal, Environmental Pollution, Environmental Science: Nano,* and *Process Safety and Environmental Protection*.

1. Mechanistic investigation of the biological toxicity of airborne particulate matter

Atmospheric particulate matter can remain suspended in the air for extended periods, entering the human respiratory system upon inhalation and exerting far-reaching health effects. The impact is particularly pronounced in vulnerable populations, including children, pregnant women, and the elderly, making it essential to elucidate the biological toxicity mechanisms of $PM_{2.5}$ to safeguard public health. In recent years, Dr. Lin has concentrated on examining the toxicological effects of atmospheric particulate matter of differing sizes. His team has shown that particles generated in paint factories can provoke pulmonary toxicity, with PM_1 posing the greatest threat to the integrity of the pulmonary epithelial barrier. Furthermore, they have demonstrated that $PM_{2.5}$ exposure in tire manufacturing facilities affects the epithelial differentiation of human umbilical mesenchymal stem cells via the Wnt/β-catenin pathway. Investigations into PM_1 in school environments reveal that primary sources include coal combustion and vehicular emissions, which may trigger respiratory diseases through the accumulation of oxidative stress. In metal-cutting facilities, the team's research on airborne oil mist droplets suggests that PM_1 exposure could heighten the risk of chronic obstructive pulmonary disease (COPD). Committed to mitigating these threats, they continue conducting health risk assessments in specific workplace settings. Their findings have been published in journals such as *Science of the Total Environment* and *Process Safety and Environmental Protection*. Currently, Dr. Lin's group remains dedicated to exploring how particulate matter of various sizes and in different settings impacts human health, aiming to enhance public preparedness against atmospheric pollution.

2. Health risk evaluation of micro- and nano-scale plastic particles

Microplastic pollution has emerged as a pressing global concern, with plastic particles accumulating in various environments and living organisms. Recognizing the urgency of this issue, Dr. Lin began evaluating the potential health risks of plastic particles and investigating their biological mechanisms in 2018. His team's findings have shown that polystyrene microplastics can exert varying degrees of toxicity on human lung, kidney, and vascular endothelial cells, potentially heightening the risks of renal and cardiovascular diseases. Moreover, the group has demonstrated that polystyrene nanoplastics can swiftly infiltrate lung cells, triggering autophagy to mitigate inflammatory responses. These results have been published in journals such as *Journal of Hazardous Materials* and *Science of the Total Environment*, with one of the 2020 papers in *Journal of Hazardous Materials* already cited nearly 500 times. Currently, Dr. Lin's team is examining how environmental pollutants and aging processes influence the toxicity of plastic particles, hoping that these insights will guide future regulations on plastic use, inform environmental remediation, and aid in managing related diseases—ultimately enhancing our capacity to address plastic particle pollution.

3. Safety assessments of nanomaterials

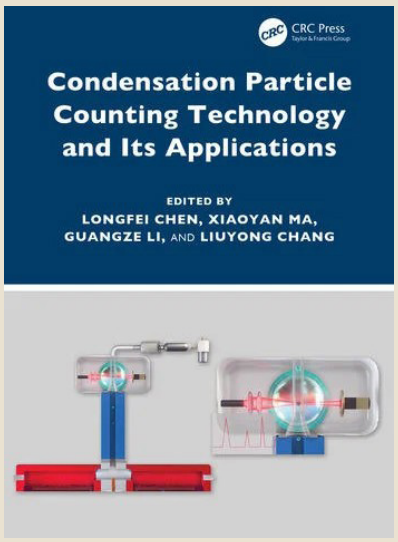
With the growing utilization of nanomaterials, concerns have arisen regarding their potential effects on human health. Owing to their ultra-small particle size, substantial surface area, and high reactivity, nanomaterials can penetrate biological barriers, enter the bloodstream, and accumulate in various organs—possibly triggering toxic responses. Since 2007, Dr. Lin has conducted risk assessments on how nanomaterials may harm human health and, in recent years, has broadened his investigations to include emerging nanomaterials such as carbon quantum dots, biochar, and metal-organic frameworks. Through his research on carbon quantum dots, Dr. Lin's team found that those possessing a mildly positive surface charge exhibit excellent biocompatibility and bio-labeling efficiency. Tobacco-stem-derived nano-biochar only demonstrates toxicity to lung cells at extremely high concentrations, while the toxicity of micron-scale biochar closely correlates with its pyrolysis temperature. Furthermore, in studying aged ZIF-8 (a metal-organic framework), the team observed a reduced capacity to induce pro-inflammatory cytokines and influence COPD-related gene expression, thereby lessening the risk of exacerbating COPD pathogenesis. These findings have been published in the *Journal of Hazardous Materials* and *Environmental Science: Nano*. Going forward, Dr. Lin will continue assessing the toxicity and environmental impact of emerging nanomaterials, striving to mitigate the risks that advancements in nanotechnology may pose to human health.

4. Synthesis and applications of multifunctional nanomaterials

Owing to their distinctive physicochemical properties, nanomaterials have been extensively applied in healthcare, cosmetics, food packaging, and environmental remediation. In recent years, Dr. Lin has embarked on developing multifunctional nanomaterials and exploring their potential for pollutant degradation, detection, as well as targeted cancer therapy and diagnostics. In the field of environmental monitoring, his team has created multifunctional micro/nanomaterials based on graphene and carbon quantum dots to detect both environmental contaminants and specific bacteria. Dr. Lin has also devoted himself to synthesizing multifunctional micro/nanomaterials endowed with photothermal and photodynamic properties for anticancer and antimicrobial applications, some of which possess additional capabilities for cancer imaging. Regarding pollutant treatment, his group has successfully developed metal-organic frameworks (MOFs) for degrading various contaminants, including 5-hydroxymethylfurfural. These findings have been published in journals such as *Chemical Engineering Journal* and *Colloids and Surfaces B: Biointerfaces*, while several publications in *ChemMedChem* and *Nanomaterials* were featured as cover articles. Looking ahead, Dr. Lin will continue expanding the applications of nanomaterials in environmental engineering and biotechnology.

New Books on Aerosols

Condensation Particle Counting Technology and Its Applications



Publisher : CRC Press
Publication date : September 20, 2024
Print length : 170 pages
ISBN : 9781032729503
Edited By Longfei Chen, Xiaoyan Ma, Guangze Li, Liuyong Chang

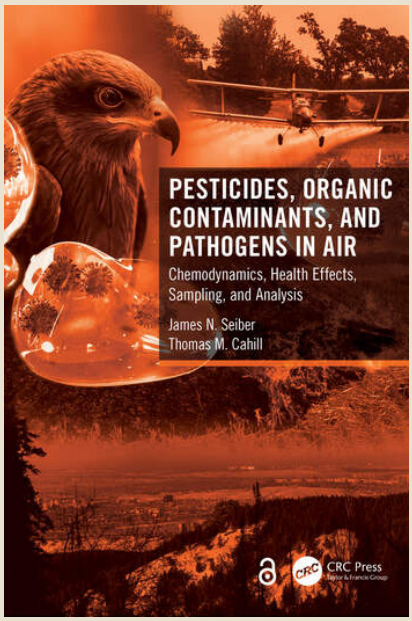
Edited by Longfei Chen, Xiaoyan Ma, Guangze Li, and Liuyong Chang, this book, published on September 20, 2024, provides an in-depth exploration of condensation particle counting technology and its various applications in aerosol science.

Biomass Burning in South and Southeast Asia, Two Volume Set

Publisher : CRC Press
Publication date : May 27, 2024
Print length : 660 pages
ISBN : 9781032013831
Edited By Krishna Prasad Vadrevu, Toshimasa Ohara, Christopher Justice

Edited by Krishna Prasad Vadrevu, Toshimasa Ohara, and Christopher Justice, this comprehensive two-volume set, published on May 27, 2024, examines the impact of biomass burning on air quality and climate in South and Southeast Asia.

Pesticides, Organic Contaminants, and Pathogens in Air: Chemodynamics, Health Effects, Sampling, and Analysis



Publisher : CRC Press
Publication date : May 27, 2024
Print length : 260 pages
ISBN : 9781032108940

By James N. Seiber, Thomas M. Cahill

Authored by James N. Seiber and Thomas M. Cahill, this book, published on May 27, 2024, delves into the dynamics, health effects, and analytical methods related to airborne pesticides, organic contaminants, and pathogens.

Announcements

The second joint meeting of the 17th Board of Directors and Supervisors has been held on November 23, 2024. During this meeting, there were approvaled 9 applications for membership, including 4 life-time memberships and 5 junior members. Welcome to join Taiwan Association for Aerosol Research!

Permanent Individual Member

Jia-Yin Lin

Assistant Professor

Academy of Circular Economy, National Chung Hsing University

Pei-Yi Wong

PhD Student

Department of Environmental and Occupational Health, National Cheng Kung University

Kcn-Lin Chang

Professor

Institute of Environmental Engineering, National Sun Yat-sen University

Nai-Tzu Chen

Assistant Professor

Department of Public Health, China Medical University

Announcements

Junior Member

Chia-Yi Lin

College Student

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Chueh-Jung Hou

College Student

Department of Public Health, Kaohsiung Medical University

Chia-Chi Cheng

College Student

Department of Public Health, Kaohsiung Medical University

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