(09)

康健永續：CiC 以創新科技解決全球面臨的重大健康福祉挑戰

Sustainable Wellness: CiC Addressing the Significant Global Health Challenges Through Innovative Technology

時　　間：113 年 6 月 22 日(星期六) 08:30~16:30
地　　點：臺北榮民總醫院 醫學科技大樓 1 樓會議室

08:30-09:00	***Registration 報到 & Opening Remarks 開幕致詞***	
09:00-09:25	Tid1 利用創新來應變未來的護理教育跟照護 Tid1 Innovations for Nursing Education Practice in Houston Methodist	陳欣玟助理教授 Hsin-Mei Chen
	座長：林麗華 副主任	
09:25-09:50	***海報發表***	
09:50-10:00	***Coffee Break***	
10:00-10:10	***Welcome Speech***	陳威明教授 Wei-Ming Chen
10:10-10:35	我們與「人」的距離：介於人文與科學之間的「道路」 Modeling Revolution and its Significance in the Consilience of Humanities and Science	陳樹衡教授 Shu-Heng Chen
	座長：陳威明 教授 (Wei-Ming Chen)	
10:35-11:00	數學模型如何用來思考癌症治療 How Mathematical Models are Applied to Consider the Treatment of Cancers	陳政輝副教授 Jeng-Huei Chen
	座長：陸行 教授 (Hsing Luh)	
11:00-11:25	由量化, 模型化, 到自動生成的精準醫學影像 From Quantification and Modeling to the Automated Generation of Precision Medical Imaging	羅崇銘副教授 Chung-Ming Lo
	座長：尹彙文 助理教授 (Huey-Wen Yien)	
11:25-12:00	***海報發表***	
12:00-13:00	***Break Time***	
13:00-13:25	精準醫學與人工智慧 Precision Medicine and Artificial Intelligence	吳致勳助理教授 Chih-Hsun Wu

	座長：蘇建維 教授 (Chien-Wei Su)	
13:25-13:50	微型 RNA 在醫學的應用 The Applications of MicroRNA in Medicine	馬念涵教授 Nian-Han Ma
	座長：王署君 教授 (Shuu-Jiun Wang)	
13:50-14:15	***海報發表***	
14:15-14:40	創新科技與 ESG 的新發展 New Developments in Innovative Technology and ESG	劉致宏顧問 James Liu
14:40-14:55	***Break Time***	
	座長：李政源 助理教授 (Cheng-Yuan Li)	
14:55-15:20	在智慧型手機中使用遷移學習算法診斷中耳疾病 Smartphone-Based Artificial Intelligence Using a Transfer Learning Algorithm for the Detection and Diagnosis of Middle Ear Diseases	陳彥奇醫師 Yen-Chi Chen
	座長：廖文輝 副教授 (Wen-Huei Liao)	
15:20-16:00	***海報發表***	
16:00-16:30	***頒獎 & Closing Remarks 閉幕致詞***	王署君教授 Shuu-Jiun Wang

Tid1 innovations for nursing education practice in Houston Methodist

Tid1 利用創新來應變未來的護理教育跟照護

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With the aging population increasing and medicine advancement, we will need more nurses, especially those who can handle complicated conditions and devices. As the nursing education department manager, I anticipate nurses needing more training. At the same time, it is tough to add more staff to the department. I will need to be more innovative in learning and creating learning lessons that can significantly improve nursing skill knowledge at the bedside, which leads to excellent clinical outcomes.

I worked with my collaborator to create the VR simulation of standardized physical assessment based on our previous two publications to show the benefit of the training. We have recruited nurses from our new-hire orientation since those will be naïve to the training. After consenting to the study, the participants are randomly assigned to 3 groups: traditional LMS, 2D VR, and 360 ˚ VR learning module. After the training, we analyzed their performance on skill validation and asked them to provide us with feedback on the simulation.

We have collected 249 n as of March 27, 2024. Nurses come across diverse backgrounds, specialties, and working experiences. In general, participants felt the VR simulation provided a more realistic experience, which is essential for them to learn the skill (Traditional LMS, 90%; 2D VR, 91%; and 360 ˚ VR, 97%). When validating their skills, the assessment completion rates are comparable (Traditional LMS, 98%; 2D VR, 97%; and 360 ˚ VR, 98%).

The three training groups use the same video footage, but VR provides the learners with different learning experiences with the same content. We are pleased to see the outcome. In addition to the convenience of using VR for future simulation training, VR also allows us to create more interactive content in the future. We plan to expand VR education and explore technology to create realistic simulated experiences for nurses in the hospital.

Modeling revolution and its significance in the consilience of humanities and science

我們與「人」的距離：介於人文與科學之間的「道路」

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Technology has the potential to significantly contribute to enhancing human health, extending lifespans, and fostering a sense of respect for life. However, despite these advancements, it is imperative to explore the underlying motivations behind these pursuits. Why do we inherently desire these improvements, especially if life were devoid of meaning? Would we prioritize a shorter yet more meaningful existence over a longer but potentially mechanized life? These questions naturally lend themselves to ethical and philosophical inquiries, highlighting the intrinsic connection between humanity and scientific progress.

In this discourse, we assert the indispensability of integrating humanities into the evaluation of technological progress. Merely advancing technology does not guarantee a meaningful life. Mary Shelley (1797-1851)'s classic novel, 'Frankenstein,' despite its age, remarkably foreshadowed contemporary ethical dilemmas. Biologist Edward Wilson (1929-2021), a proponent of interdisciplinary collaboration, advocated for the convergence of humanities and science. He followed in the footsteps of earlier pioneers such as Jonathan Swift (1667-1745), whose 'Battle of Books' in the late 17th century also emphasized this connection. Despite centuries of efforts, the fundamental divide between humanities and science persists.

In this discourse, we contend that the interdisciplinary cross between humanities and science faces significant hurdles, chiefly due to the inherent complexity of humanity, particularly its individuality. This individuality poses a formidable challenge to formal language in science, such as Newtonian mathematics or equation-based modeling (EBM). For instance, the intricate interactions among the more than five hundred protagonists in Leo Tolstoy (1828-1910)'s 'War and Peace' highlight the inadequacy of EBM in capturing the nuanced complexities of human behavior.

Approximately three decades ago, Nobel Laureate in Physics Murray Gell-Mann (1929-2019) introduced agent-based mathematics and modeling (ABM) as an alternative approach to tackling the complexities of human behavior. ABM not only enables us to navigate this intricate landscape but also capitalizes on recent advancements in information and communication technology (ICT) and artificial intelligence (AI), including technologies like ChatGPT. In conclusion, we emphasize that ABM is not only well-suited for modern technological applications but also serves as an effective bridge between the humanities and science.

How mathematical models are applied to consider the treatment of cancers

數學模型如何用來思考癌症治療

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Chemotherapy is widely used in the treatment of different cancers. However, resistance caused by the mutation of cancer cells reduces the efficacy of drugs and imposes great challenge to the treatment. To study the resistance problem, in 1979, Goldie and Coldman proposed the first stochastic-based model to relate the drug sensitivity of tumors to their mutation rates. Many scientists have since referred to this pioneering work because of its simplicity and elegance. Its original idea has also been extended and further investigated in massive follow-up studies of cancer modeling and optimal treatment. Goldie and Coldman, together with Guaduskas, later used their model to explain why an alternating non-cross-resistant chemotherapy is optimal with a simulation approach. Subsequently in 1983, Goldie and Coldman provided a rigorous mathematical proof to their earlier simulation work. However, their analytical study of optimal treatments majorly focused on a process with symmetrical parameter settings, and presented few theoretical results for asymmetrical settings.

In this talk, we first provide an introduction to Goldie and Coldman's model, which shows how probabilistic framework is used to describe the mutational behavior of cancer cells. Afterwards, we recast and restate Goldie, Coldman, and Guaduskas' model as a multi-stage optimization problem. With an asymmetrical assumption, the conditions under which a treatment policy can be optimal are derived. Numerical results are also presented to justify the correctness of the theoretical findings. If time permitted, we will also discuss some of our recent progress and related topics on this study. Instead of presenting all mathematical details, the focus of the talk is to demonstrate how mathematical models can be used in studying medical problems and to help clinical practitioners to re-think what are good treatment policies from different viewpoints.

From quantification and modeling to the automated generation of precision medical imaging

由量化 , 模型化 , 到自動生成的精準醫學影像

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"Precision medical images from quantification, modeling to automatic generation" covers the complete process from image acquisition to diagnostic decision-making. As medical images become digitized, a critical next step is quantification, which is the extraction of measurable and precise data from radiological or pathological images. For example, radiomics through image processing technology can be used to obtain detailed information reflecting histological characteristics, which is crucial for lesion analysis and treatment planning.

Diverse quantitative features can be combined through artificial intelligence machine learning or deep learning to establish predictive models to assist diagnosis and treatment. Automatic segmentation and classification can mark and classify normal and abnormal tissues to achieve objectivity, consistency, high efficiency and high accuracy of interpretation.

AI-generated image reports help completely record the entire process. Automatically generated reports provide structured image analysis, including key pathological features and potential quantitative indicators. Embed clinical decision support in reports for faster condition assessment and subsequent treatment planning.

Precision medical imaging enhances the value of medical imaging and makes medical processes more intelligent and customized, thereby providing better patient care. The prognosis of malignant tumors and the assessment of blood vessel quality are used as examples to demonstrate the clinical practicality and feasibility of smart medicine.

Precision medicine and artificial intelligence

精準醫學與人工智慧

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Precision medicine refers to the careful assessment of disease heterogeneity and the separation of patients into different groups in order to develop strategies for disease diagnosis, prevention, and treatment. It is also known as P4 Precision Medicine, encompassing the four principles of Predictive, Preventive, Personalized, and Participatory.

Precision medicine and artificial intelligence (AI) have a close and intertwined relationship. Precision medicine emphasizes personalized healthcare, customizing treatment plans and therapies based on individual factors such as genetics, environment, and lifestyle. AI plays a crucial role in this process, leveraging big data analysis and machine learning/ deep learning techniques to help doctors identify patterns of diseases, predict disease progression, and provide personalized medical recommendations.

The rapid advancement of AI has made the realization of precision medicine more feasible and effective. At the same time, precision medicine provides valuable data and samples that serve as essential inputs for training and improving AI algorithms. This symbiotic relationship drives the continued progress and integration of precision medicine and AI in the medical field. For example, the development of non-invasive AI systems for multiple cancer prediction demonstrates how precision medicine and AI collaborate to advance personalized healthcare.

In summary, precision medicine and AI work closely together, jointly driving the growth of medical technology and providing patients with more accurate and personalized treatment options, while also equipping doctors with more powerful tools to address complex medical challenges.

The applications of microRNA in medicine

微型 RNA 在醫學的應用

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MicroRNAs (miRNAs) have diverse applications in medicine due to their ability to regulate gene expression post-transcriptionally. One key application is their use as biomarkers for disease diagnosis and prognosis, where specific miRNA expression patterns can indicate different disease states. In addition, miRNAs are being explored as therapeutic targets for various diseases. This presentation will demonstrate the several miRNA research as below.

Radiation is one of the main cancer therapies, however, radioresistance leading to recurrence and metastasis remains an unsolvable issue. In our study, miRNA expression in plasma from patients with head and neck cancer was related to radiotherapy. Our results indicated the miRNA enhanced the radiosensitivity of head and neck cancer cells through modulating ITGA5 and prevented radiation-induced bystander effects (RIBEs) activities via exosomes. This study showed a possible novel therapeutic strategy for head and neck cancer.

Long-term Peritoneal dialysis (PD) may cause peritoneal fibrosis. Encapsulating peritoneal sclerosis (EPS) is a rare, but fatal complication in long-term PD. We used a high-throughput real-time polymerase chain reaction (RT-PCR) arrays to screen for differentially expressed miRNAs of PD effluents from the patients with or without EPS. The receiver operating characteristic (ROC) curve analysis of the 5 miRNA-ratios combined with 2 clinical characteristics was shown to distinguish non-EPS and EPS of PD patients with 0.87-0.99 of area under the curve (AUC) in different analysis strategies. Our results indicate that EPS-associated miRNAs could prevent the mesothelial to mesenchymal transition and that miRNA expression profiles in the PD effluents could be an ancillary diagnosis tool for EPS in patients.

Smartphone-based artificial intelligence using a transfer learning algorithm for the detection and diagnosis of middle ear diseases

在智慧型手機中使用遷移學習算法診斷中耳疾病

Yen-Chi Chen, Yuan-Chia Chu, Albert C. Yang, Wen-Huei Liao, Yen-Fu Cheng

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Background: Middle ear disorders pose common challenges for clinicians offering healthcare for pediatrics and teenagers, often leading to delayed or misdiagnosed cases. The integration of deep learning has the capability to enhance clinician support in identifying and diagnosing eardrum disorders through imaging.

Methods: Retrospectively, oto-endoscopic images were gathered from ologists at Taipei Veterans General Hospital between January 1st, 2011, and December 31st, 2019. Those collected images were de-identified and subjected to data pre-processing, augmentation, and splitting before being input into CNN training models. To address the complexity of middle ear disorders, 9 CNN-architectured models were developed for the recognition of these conditions. The most effective models were selected and combined into a compact CNN suitable for mobile phone deployment. The pretrained model was transformed into a smartphone-based application and assessed for its effectiveness in detecting and classifying 10 different middle ear ailments in accordance with oto-endoscopic images.

Results: Totally 2,820 clinical pictures of eardrums were utilized in the training of the model, resulting in the development of a program exhibiting high accuracy in detecting binary outcomes (pass/refer) within oto-endoscopic images, covering 10 distinct disease categories. Following model optimization, the accuracy reached an impressive 98.0%. The program showcased a seamless recognition process, featured a user-friendly interface, and revealed outstanding performance, achieving a classification accuracy of 97.6% across ten categories.

Conclusion: We have effectively created a deep learning model with the ability to identify and categorize eardrum ailments. The utilization of point-of-care diagnostic devices integrated with artificial intelligence-driven automated classification offers pragmatic solutions for real-world medical scenarios, particularly in the diagnosis of middle ear disorders and the implementation of telemedicine.