(15)

急重症醫學之智慧醫療新進展

Smart Healthcare Advancements in Emergency and Critical Care Medicine

時　　間：113 年 6 月 22 日(星期六) 08:40~12:30
地　　點：臺北榮民總醫院 長青樓護理館會議室
共同主辦單位：國立陽明交通大學急重症醫學研究所、
臺北榮民總醫院新生兒醫療中心、重症醫學部
急診醫學部、胸腔外科、感染科、胸腔部、心胸麻醉科

08:40-08:50	***Opening Remarks***	李建賢教授 Chen-Hsen Lee 林永煬副院長 Yung-Yang Lin
	座長：鄭玫枝 教授 (Mei-Jy Jeng) **許瀚水 教授 (Han-Shui Hsu)**	
08:50-09:20	2030 機智加護中心 Double SMART ICU 2030	尹彙文醫師 Huey-Wen Yien
09:20-09:50	從概念到商業化：加護病房急性腎損傷預測模型的全方位發展之旅 From Concept to Commercialization: The Comprehensive Journey of Developing an ICU Acute Kidney Injury Prediction Model	黃俊德醫師 Chun-Te Huang
09:50-10:20	從預測到行動：臺北榮總重症醫學部的分享 From Prediction to Action: Sharing from CCM of Taipei VGH	江東鴻醫師 Dung-Hung Chiang
10:20-10:30	Discussion	
10:30-10:40	***Coffee Break***	
	座長：侯重光 教授 (Chorng-Kuang How) **陽光耀 教授 (Kuang-Yao Yang)**	
10:40-11:10	分秒必爭：外傷重症影像智能化判讀應用 Time Matters: The Application of AI in the Critical Care and Trauma Imaging	鄭啟桐醫師 Chi-Tung Cheng
11:10-11:40	臺北榮總麻醉部資訊系統改良經驗談 Anesthesia Department Information System Improvement, experiences of VGH Taipei	蘇府蔚醫師 Fu-Wei Su
11:40-11:45	Discussion	

座長：林邑璁 教授 (Yi-Tsung Lin)
劉嘉仁 副教授 (Chia-Jen Liu)

11:45-12:00	重症研究經驗分享及未來智慧加護病房研究方向 Experience Sharing of Critical Care Research and Future Directions in Smart ICU	陳威志醫師 Wei-Chih Chen
12:00-12:10	預測血液透析期間血管通路流量閾值：發展與驗證一個機器學習模型 Development and Validation of a Machine Learning Model for Predicting the Vascular Access Flow Threshold in End-Stage Renal Disease Patients during Hemodialysis	陳範宇醫師 Fan-Yu Chen
12:10-12:20	嬰兒智慧監測系統 Smart Wireless Monitoring for Infants	周佳穗醫師 Chia-Sui Chou
12:20-12:30	Discussion	

Double SMART ICU 2030

2030 機智加護中心

Huey-Wen Yien

尹彙文

Medical Artificial Intelligence Development Center, Surgical ICU, Taipei Veteran General Hospital, Taipei, Taiwan, ROC.

臺北榮民總醫院 醫療人工智慧發展中心 外科加護中心

In the era of digital transformation, the concept of "ICU without wall" can fix the unmet demand during the critically-ill patient journey which includes both critical and concierge care for the patients and families.

We propose the new model of critical care by AIR(AI and Robotics) to transform the delivery of continuity and comprehensive care in the paradigm shift of digital generation. The term of "**Double SMART**" represents both physical and digital dimensions, that is "**S**ervice, **M**anagement, **A**rchitecture, **R**esearch, **T**echnology" and "**S**afe/save, **M**obile, **AI**, **R**obotics, **T**rust/touch". We design a high performance process to de-load the low-value care, especially while facing the challenge of burnout and shortage of ICU staffs.

In Mercy Virtue hospital, the world's first facility dedicated to telehealth, they propose the "**Hospital without beds**" project. Physician staffs can "see" patients where they are. Another example is the "Journey with ***Guided Care***" in Cleveland Clinic Medical Center showing their great core value, "Every patient deserves world-class care. "

In conclusion, we are facing the great challenges in our traditional model of delivering low value care during patient journey including burnout of staffs, shortage of workforce, and finally collapse of the non-resilient medical care system. We are now on the AIR way to double SMART ICU 2030.

From concept to commercialization: The comprehensive journey of developing an ICU acute kidney injury prediction model

從概念到商業化：加護病房急性腎損傷預測模型的全方位發展之旅

Chun-Te Huang

黃俊德

Nephrology and Critical Care Medicine, Department of Internal Medicine and Critical Care Medicine, Taichung Veterans General Hospital, Taichung, Taiwan, ROC

臺中榮民總醫院 內科部 腎臟科 重症部 重症內科

Acute Kidney Injury (AKI) is a critical concern in ICUs, with a 30% prevalence and severe long-term consequences. Addressing this, our collaborative effort with Tunghai University and Advantech Technology led to a pioneering predictive model for AKI, forecasting incidents 24 hours in advance with remarkable accuracy. Through external validations at four medical centers and enhancements via federated learning, our model has been patented in Taiwan and the USA, and certified as a software medical device by Taiwan's FDA in December 2023. We are now moving towards clinical trials, aiming for broader clinical implementation and inclusion in Taiwan's National Health Insurance. This journey from concept to potential commercialization embodies a significant leap in ICU patient care, showcasing the power of collaboration, innovation, and perseverance in tackling healthcare challenges

From prediction to action: Sharing from CCM of Taipei VGH

從預測到行動：臺北榮總重症醫學部的分享

Dung-Hung Chiang

江東鴻

Department of Critical Care Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC.

臺北榮民總醫院 重症醫學部

"Prediction AI" refers to artificial intelligence systems that utilize machine learning, statistical analysis, and data mining techniques to predict future events, trends, or outcomes. Such AI systems predict future developments by analyzing past and present data, learning the patterns and correlations within.

"Actionable AI" refers to artificial intelligence systems capable of directly supporting decision-making and concrete actions. These AI systems go beyond mere data analysis or prediction; they provide specific recommendations, solutions, and can even autonomously execute particular tasks.

In recent years, the Department of Critical Care Medicine at Taipei Veterans General Hospital has also been committed to the development of intelligent critical care medicine. This presentation will introduce the department's achievements in developing prediction models and the progress towards implementing actionable AI.

Time matters: The application of AI in the critical care and trauma imaging

分秒必爭：外傷重症影像智能化判讀應用

Chi-Tung Cheng

鄭啟桐

Department of Trauma and Emergency Surgery, Chang Gung Memorial Hospital, Linkou Chang Gung University, Taoyuan, Taiwan, ROC

林口長庚紀念醫院 外傷急症外科

Trauma constitutes a critical medical scenario that often poses an immediate threat to life, necessitating rapid intervention to secure patient survival and the swift identification of affected organs. Physicians operating within such a high-stakes environment are tasked with the rapid assimilation and interpretation of a voluminous array of information and imaging, all within stringent time constraints. The efficacy of deep learning technologies has been substantiated across a spectrum of medical imaging domains, encompassing the identification of hemorrhages in brain CT scans, the detection of fractures in chest and pelvic X-rays, and the recognition of fluid in ultrasonography.

At the Trauma Department of Linkou Chang Gung Memorial Hospital, our aim is to harness deep learning algorithms across a diverse range of critical trauma imaging modalities, thereby advancing the development of a sophisticated computer-aided diagnosis (CAD) system. Our team has achieved notable success in formulating models for the detection of pelvic fractures in X-rays, the identification of rib fractures in chest X-rays, and the delineation of spleen injuries in abdominal computed tomography scans.

Looking forward, our ambition is to seamlessly integrate this CAD system within the existing clinical information system and to incorporate these models into the trauma imaging alert system. This integration is envisioned to furnish an automated diagnostic support for critical injuries in trauma patients across multiple healthcare facilities. By enabling the early diagnosis of severe injuries, our initiative stands to significantly enhance the caliber of trauma care, thereby preserving patient lives and optimizing recovery outcomes.

Anesthesia department information system improvement, experiences of VGH Taipei

臺北榮總麻醉部資訊系統改良經驗談

Fu-Wei SU
蘇府蔚
Department of Anesthesiology,Taipei Veterans General Hospital, Taipei, Taiwan, ROC
臺北榮民總醫院 麻醉部

Taipei Veterans General Hospital ranks as the twelfth largest hospital in the world by bed capacity. The high complexity in operating room management necessitates a process to reduce errors, maximize efficiency, and alleviate healthcare worker burnout. This preoperative preparation process for surgical patients involves coordination among multiple personnel and patients themselves.

Anesthesia evaluation begins at the early stage of preoperative preparation. We tried to develop an evaluation platform and use artificial intelligence to reduce the workload of anesthesiologists, to facilitate OR schedule management, and to reduce perioperative complications.

Experience sharing of critical care research and future directions in smart ICU

重症研究經驗分享及未來智慧加護病房研究方向

Wei-Chih Chen

陳威志

Department Chest Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

School of Medicine, College of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, ROC

臺北榮民總醫院 胸腔部

陽明交通大學 醫學系

Critical care research is paramount in advancing our understanding of critical care medicine and facilitating enhanced patient care within the intensive care unit (ICU). The evolution of new technologies and electronic medical records has streamlined data collection processes for researchers, enabling them to acquire more data efficiently compared to previous methods. However, effectively harnessing the vast amounts of data generated by various ICU machines for precise analysis remains a significant challenge.

My research journey began during my residency, where I started at the process of topic exploration, securing institutional review board approval, designing case report forms, transitioning from hard copy to electronic database, utilizing statistical software for analysis, crafting figures and tables, manuscript composition, reference management, English editing, and the submission and revision process, including handling rejections.

The vision of a ‘smart ICU’ holds promise for revolutionizing clinical studies by offering unparalleled convenience. Additionally, establishing a nationwide network of ICUs holds immense potential for uncovering clinically significant insights that may not be apparent within single-center studies. In the current insurance system, hospital administrations are not willing to invest in ICU improvements due to less reimbursement from daily clinical care. However, the advancement of the ‘smart ICU’ is intrinsically tied to overall quality enhancement and improved patient outcomes. Hence, policymakers within governmental and hospital administration boards must allocate more resources and provide ample encouragement to ICU professionals to facilitate this progress.

Development and validation of a machine learning model for predicting the vascular access flow threshold in end-stage renal disease patients during hemodialysis

預測血液透析期間血管通路流量閾值：發展與驗證一個機器學習模型

Fan-Yu Chen
陳範宇
Division of Nephrology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan, ROC
臺北榮民總醫院 腎臟科

Taiwan currently faces the highest global incidence and prevalence rates of end-stage renal disease (ESRD). The number of dialysis cases has risen significantly from 10,179 in 2010 to 12,346 in 2018, reflecting a 28.9% increase in individuals undergoing dialysis treatment, which escalated from 65,610 to 84,615 patients over the same period. Effective vascular access is imperative for the well-being and longevity of hemodialysis (HD) patients. Both the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guidelines for Vascular Access and European guidelines advocate for arteriovenous fistula (AVF) as the preferred form of permanent vascular access for HD patients. Despite previous research indicating higher survival rates among AVF users compared to those with arteriovenous grafts (AVG) or central venous catheters (CVC), AVF may encounter functional decline and reduced blood flow over time due to vascular remodeling-associated inflammatory changes. These alterations often lead to stenosis, subsequent thrombosis, and eventual AVF failure, significantly impacting patient survival, morbidity, and quality of life. The KDOQI guidelines also stress that individuals with AVF access flow (Qa) <500 ml/min, AVG Qa <600 ml/min, or a 25% decrease in Qa over 3 to 6 months face heightened risks of stenosis or thrombosis. However, conventional measurement techniques like Doppler ultrasound and magnetic resonance angiography are operator-dependent, costly, and susceptible to errors. Taipei Veterans General Hospital, a leading medical institution in Taiwan, relies on the HD03 hemodialysis monitor (Transonic®) for quantitative hemodialysis surveillance, measuring Qa every three months during sessions. This monitor employs the ultrasound dilution method, also known as the Krivitski method, which involves injecting a saline bolus to measure intra-access flow rates. Nevertheless, many ESRD patients in Taiwan receive HD treatment at local clinics, where access to the HD03 monitor for routine Qa evaluation may be limited. To address this, our study utilizes an artificial intelligence-driven machine learning approach, leveraging routinely collected data, to predict occurrences of Qa <500 ml/min events for AVF during hemodialysis. By developing and validating a machine learning-based risk model, our research aims to facilitate personalized surveillance strategies, enabling risk stratification without burdening healthcare professionals further.

Smart wireless monitoring for infants

嬰兒智慧監測系統

Chia-Sui Chou

周佳穗

Neonatal Medical Care Center and Section of Neonatology, Department of Pediatrics, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

臺北榮民總醫院 兒童醫學部 新生兒醫療中心

Over the years, the government has continuously promoted baby-friendly hospitals, including implementing rooming-in for mothers and infants. During rooming-in, newborns stay with their mothers in postpartum wards without constant medical supervision nearby. This raises concerns about the timely detection of unstable vital signs in newborns. Using this smart wireless monitoring system for rooming-in newborns allows for real-time remote monitoring of their vital signs, enhancing the level of medical service and safety of hospitalized newborns.

The system is applied in the postpartum wards and baby rooms of Taipei Veterans General Hospital, utilizing devices approved by the Ministry of Health and Welfare. These devices monitor the newborns' blood oxygen saturation level, heart rates, and body temperatures, with the data collected and transmitted in real-time via 4G/5G networks to the monitoring platform. The data is displayed on medical station computer screens, enabling healthcare providers to constantly monitor the newborns' physiological conditions.

After implementing this system, newborns' vital signs can be monitored at any time and uploaded to the monitoring platform via the internet. This allows families in postpartum wards to be informed about the newborns' vital signs, while other healthcare personnel can remotely grasp the situation of rooming-in newborns, significantly reducing the pressure on healthcare providers and families, improving newborn safety, and enhancing the level of medical service and family satisfaction.

Using the smart wireless monitoring system for infant ensures the safety and health of rooming-in newborns, improves the quality of medical care, and addresses concerns about healthcare providers' inability to constantly visually monitor them.