附件 2、參選說明表

填表日期： 114 年 10 月 30 日

產品或服務名稱	（中文）**以智慧化真實世界數據發展台灣第 2 型糖尿病併發症的預測模型** **Intellectualizing Real-world Data to Develop Taiwan Type 2 Diabetes Complication Model** **高雄醫學大學/附設中和紀念醫院/林明彥教授團隊** **Kaohsiung Medical University/ Kaohsiung Medical University Hopsital/Ming-Yen Lin and iH3 research team** （英文） According to the 2019 Taiwan Diabetes Annual Report, approximately 160,000 new cases of type 2 diabetes develop in Taiwan each year (an incidence rate of 7.4‰), and one in 16 adults aged 20 and over has type 2 diabetes (a prevalence proportion of 6.38%). Because of the significant improvements in care, the cumulative five-year survival rate for newly diagnosed diabetes patients between 2005 and 2009 improved by 2.3% compared to the period between 2000 and 2004. This significant increase in life expectancy for diabetes patients raises an important issue in diabetes complication prevention. In Taiwan, 32.2% of patients with type 2 diabetes develop cardiovascular disease, approximately 7% have a stroke, 14% have kidney disease, 5% have retinopathy, and 1.91% require dialysis. These complications compromise patients' lives and quality of life, placing a significant burden on national health expenditures. Approximately 48,000 diabetic patients in Taiwan undergo long-term dialysis, costing nearly NT$20 billion in National Health Insurance expenditures annually. Therefore, it is urgent to enhance diabetes management and control. Appropriate diabetes care that relies on collaboration between care providers and patients can delay the onset of complications. A decision-support system that facilitates communication between healthcare workers and patients will contribute to effective disease control. The type 2 diabetes complications prediction model represents the team' s first major innovation. It was developed using data from more than 163,000 patients newly diagnosed with type 2 diabetes between 2002 and 2017 in Taiwan, constructing functions through a mathematical framework that integrates both time-fixed and dynamic factors such as age and HbA1c levels. The model allows users to input common patient parameters and effectively generate a possible sequence of diabetic complication incidence. By adjusting these parameters, future complication trends can be visualized, helping physicians and patients make informed care decisions and improving the quality of care. The model was followed for an average of 13.5 years to estimate the probability of first major complications (atherosclerotic heart disease, ischemic stroke, congestive heart failure, limb amputation, kidney disease, eye disease) and death from the time of diabetes diagnosis. This model allows caregivers of patients with type 2 diabetes (including physicians, nurses, and health educators) to input common basic patient information to assess the risk of future complications, providing valuable information for disease management and control. While the model is consistent with relevant mathematical theory, its predictions are intended only as a guide for healthcare decision-making and cannot replace the judgment and outcomes of clinicians. Several key features distinguish this model from previous ones. First, it simultaneously incorporates six major complications, mortality (absorbed state), and their dynamic temporal relationships within a single analytical framework. Second, it establishes and integrates dynamic interactions between age and HbA1c, allowing greater flexibility for real-world applications. **Third**, the underlying mathematical framework has been published in an academic journal (DOI: 10.3390/info12080326), patented by the Taiwan government (Patent No. I827184), and visualized through a computer system (https://weishiang.shinyapps.io/dm_system_final/). Finally, the visualized platform has been evaluated by the Taiwan Society of Diabetes Educators through a large-scale efficacy test.
該產品服務上架時間	2025/1/1

產品或服務創新介紹與應用效益	（中文） 1. 本模型參數取自全國性檢驗數據與健保資料具有亞洲人的足夠代表性。 2. 本演算法採用樹狀結構有別於傳統的計算方式。 3. 本技術同時考量終身不同競爭併發症的預測模型相較於單一併發症預測更符合真實世界狀況。 4. 目前已經由台灣糖尿病衛教學會完成 180 名收案測試，初步可精準區分不同併發症並進行特別衛教。
	（英文） 1. The model parameters are derived from national health insurance data and are representative of Asian populations. 2. The algorithm utilizes a tree-based structure, which differs from traditional calculation methods. 3. This technology simultaneously considers different competing lifelong complications, making the prediction model more realistic than a single-complication prediction equation. 4. The Taiwan Diabetes Education Association has completed testing on 180 patients, demonstrating the ability to distinguish different complications and provide education more precisely.
經營團隊	（中文）簡要說明團隊的特色及能力 iH3（儀器、資訊、智慧、健康、人文、和諧）研究團隊由來自不同領域的專家組成，主要成員來自高雄醫學大學及其附屬醫院，其他成員來自國家儀器科技研究中心、 國立中山大學、國立政治大學和國家衛生研究院。其團隊成員背景專長包含生醫儀器開發, 資訊收集與整理, 數學, 生物統計, 機械學習, 臨床照護, 公共衛生…等(https://ih3.mis.nsysu.edu.tw/)。團隊的核心任務是開發增強健康和照護的決策支援系統。其策略是從全民健保資料庫中提取信息，並將其轉化為智能，從而指導患者獲得更好的健康和生活。
	（英文）The iH^3 (instrument, information, intelligence, Health, Humanities, Harmonization) research team comprises experts from diverse fields, primarily from Kaohsiung Medical University and its affiliated hospitals, with additional members from the National Center for Instrumentation Research, National Sun Yat-sen University, National Chengchi University, and the National Health Research Institutes. The team members' backgrounds and expertise include biomedical instrument development, information collection and management, mathematics, biostatistics, machine learning, clinical care, and public health (https://ih3.mis.nsysu.edu.tw/). The team's core mission is to develop decision-support systems that enhance health and care. The strategy is to extract information from universal healthcare databases and translate it into actionable intelligence, then guide patients to achieve better health and a higher quality of life.

經營績效及未來發展	（中文）過去團隊成員在跨域合作具體成果包含 A. 第二型糖尿病併發症預測模型 1. Wan, T. T., Lin, M. Y., & Wan, H. S. (2025). Theoretical and Methodological Imperatives in Longitudinal Healthcare Design and Research. *Journal of Integrated Design and Process Science*, *28*(3), 176-184. 2. Luh, H., Lin, M. Y., & Wu, P. H. (2023). A single framework of precision surveillance of diabetes disease prognosis for better care with collaboration. Journal of Integrated Design and Process Science, 27(1), 27-39. 3. Lin, M. Y., Liu, J. S., Huang, T. Y., Wu, P. H., Chiu, Y. W., Kang, Y., ... & Luh, H. (2021). Data analysis of the risks of type 2 diabetes Mellitus complications before Death using a Data-Driven Modelling Approach: methodologies and challenges in prolonged diseases. *Information*, *12*(8), 326. 4. Cheng, L. J., Chen, J. H., Lin, M. Y., Chen, L. C., Lao, C. H., Luh, H., & Hwang, S. J. (2015). A competing risk analysis of sequential complication development in Asian type 2 diabetes mellitus patients. *Scientific Reports*, *5*(1), 15687. 5. 國立政治大學 糖尿病之風險評估與防治照護 課程 B. 台灣腎病年報 2015-2024 1. 中文版（https://www.tsn.org.tw/twrds.html ） 2. 英文版（https://www.sciencedirect.com/journal/journal-of-the-formosan-medical-association/vol/121/suppl/S1） C. 台灣首部高精確度膚色儀（中華民國專利 Patent No. I683287） 1. Chen, C. C., Chung, C. Y., Chiu, Y. W., Lin, Y. H., Tse, L. S., Wu, C. Y., ... & Lin, M. Y. (2023). Reliability analysis of a novel measurement system for quantifying human skin color. Skin Health and Disease, 3(1), ski2-182. D. 台灣首部窄波長紫外光 B 照光機經動物實驗 1. Lin, M. Y., Lim, L. M., Tsai, S. P., Jian, F. X., Hwang, S. J., Lin, Y. H., & Chiu, Y. W. (2021). Low dose ultraviolet B irradiation at 308 nm with light-emitting diode device effectively increases serum levels of 25 (OH) D. Scientific reports, 11(1), 2583. E. 未來發展 團隊投入了三年的研究，開發了台灣腎臟疾病模型，以指導更精準的衛生政策決策（https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5311177）。未來將致力於非傳染性疾病的防治並透過儀器，資料，資訊對全生命歷程的健康事件產生精準的決策建議。對個人帶來健康生活，對社會永續生產力，舒緩照護端的壓力，並強化國家人力的韌性與永續性。

	(英文) The specific achievements of the team members in cross-disciplinary collaboration in the past include: A. Prediction model of type 2 diabetes complications 1. Wan, T. T., Lin, M. Y., & Wan, H. S. (2025). Theoretical and Methodological Imperatives in Longitudinal Healthcare Design and Research. Journal of Integrated Design and Process Science, 28(3), 176-184. 2. Luh, H., Lin, M. Y., & Wu, P. H. (2023). A single framework of precision surveillance of diabetes disease prognosis for better care with collaboration. Journal of Integrated Design and Process Science, 27(1), 27-39. 3. Lin, M. Y., Liu, J. S., Huang, T. Y., Wu, P. H., Chiu, Y. W., Kang, Y., ... & Luh, H. (2021). Data analysis of the risks of type 2 diabetes Mellitus complications before Death using a Data-Driven Modelling Approach: Methodologies and challenges in prolonged diseases. Information, 12(8), 326. 4. Cheng, L. J., Chen, J. H., Lin, M. Y., Chen, L. C., Lao, C. H., Luh, H., & Hwang, S. J. (2015). A competing risk analysis of sequential complication development in Asian type 2 diabetes mellitus patients. Scientific Reports, 5(1), 15687. 5. Diabetes Risk Assessment and Prevention Care Course at National Chengchi University B. Taiwan Annals of Nephrology 2015-2024 1. Chinese version (https://www.tsn.org.tw/twrds.html) 2. English version (https://www.sciencedirect.com/journal/journal-of-the-formosan-medical-association/vol/121/suppl/S1) C. Taiwan's first high-precision skin color analyzer (Taiwan Patent No. I683287) 1. Chen, C. C., Chung, C. Y., Chiu, Y. W., Lin, Y. H., Tse, L. S., Wu, C. Y., ... & Lin, M. Y. (2023). Reliability analysis of a novel measurement system for quantifying human skin color. Skin Health and Disease, 3(1), ski2-182. D. Taiwan's first narrow-wavelength ultraviolet B irradiator tested in animals 1. Lin, M. Y., Lim, L. M., Tsai, S. P., Jian, F. X., Hwang, S. J., Lin, Y. H., & Chiu, Y. W. (2021). Low-dose ultraviolet B irradiation at 308 nm with light-emitting diode device effectively increases serum levels of 25 (OH) D. Scientific reports, 11(1), 2583. E. Future Development The team members have further devoted their three-year research to developing a Taiwan Kidney Disease Model for guiding more precise health policy decisions (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5311177). In the future, we will focus on preventing and caring for non-communicable diseases, utilizing instruments, data, and information to inform accurate decision-making recommendations for health events throughout the life course. The action will contribute to healthy lives for individuals, sustainable productivity for society, alleviate pressure on caregivers, and strengthen the resilience and sustainability of the government.

對應之淨零策略／SDGs 目標（請勾選）						
	1.消除貧窮		2.終止飢餓	v	3.建康與社福	
	4.優質教育		5.性別平權		6.淨水與衛生	
	7.可負擔的潔淨能源		8.適合的工作及經濟成長		9.工業化、創新與基礎建設	
	10.減少不平等		11.永續城鄉		12.責任消費及生產	
	13.氣候行動		14.保育海洋生態		15.保育陸域生態	
	16.和平、正義及健全制度		17.多元夥伴關係			
	1.風能/光能		2.氫能		3.前瞻能源	
	4.電力系統與儲能		5.節能		6.碳捕捉利用及封存	
v	7.運具電動化及無碳化		8.資源循環零廢棄		9.自然碳匯	
	10.淨零綠生活		11.綠色金融		12.公正轉型	

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