

Cost Analysis of Cold Plasma for Wound Care Among Patients with Type 2 Diabetes Mellitus in Thai Community Hospitals

Utoomporn Wongsin¹, Kwanpracha Chiangchaisakulthai^{2*}, Passakorn Suanrueang³, Patchanee Thumwanna⁴, and Nutnitima Changprajuck⁴

¹ Department of Public Health Administration, Faculty of Public Health, Mahidol University, Thailand.

² Health Academic Bureau, Ministry of Public Health, Thailand.

³ Department of Health Education and Behavioral Sciences., Faculty of Public Health, Mahidol University, Thailand.

⁴ Foundation for Research Institute on Social Protection and Health (FRoSPaH), Nonthaburi, Thailand

Corresponding author: Kwanpracha Chiangchaisakulthai, Email: kwanpcc@gmail.com

Original article

OPEN ACCESS

Citation: Wongsin, U., Chiangchaisakulthai, K. ., Suanrueang, P., Thumwanna, P. ., & Changprajuck, N. . (2026). Cost Analysis of Cold Plasma for Wound Care Among Patients with Diabetes Mellitus type 2 in Thai Community Hospitals.: Cost of Cold Plasma for Wound Care Among Patients with DM . *Journal of Health Policy, Law and Administration*, 12(2). retrieved from https://so05.tci-thaijo.org/index.php/journal_law/article/view/288576

Received: 12 April 2026

Revised: 21 April 2026

Accepted: 24 April 2026

Abstract

This study estimated unit cost of cold plasma wound care for Type 2 Diabetes Mellitus (T2DM) patients in Thai community hospitals. Utilizing a retrospective cross-sectional design, we analyzed 2025 cost data from four representative facilities from the provider's perspective. The hospital cost information consisted of wound care service data, hospital statistics, and cost information. We used the codes from the 10th revision of the International Classification of Diseases (ICD-10) to identify diagnosis code of T2DM. Applied Activity-Based Costing: ABC were used to estimate average cost per visit and cost per person.

The results indicated that labor cost was the majority of total cost, while material and capital costs varied between hospitals. The unit cost of wound care using cold plasma per visit for patients with T2DM in 2025 was between THB 519 and THB 939. The unit cost of wound care using plasma per person for patients with T2DM was between THB 4,436 and THB 9,176. Considering in each hospital, Hospital C reported the highest total cost (THB939), followed by Hospital A (THB 794), Hospital B (THB 676), and Hospital D (THB 519). Our cost analysis was based on real-world cost data, offering valuable insights to support budgeting and resource management for cold plasma wound care among patients with T2DM at community hospitals.

Keywords: Cost analysis; Cold Plasma; Wound Care; Diabetes Mellitus; Community hospitals

Introduction

Type 2 Diabetes Mellitus (T2DM) remains a significant global public health challenge, placing substantial pressure on healthcare infrastructure, particularly in low- and middle-income nations. (International Diabetes Federation, 2025; Sun et al., 2022). One of the most serious and costly complications of diabetes is chronic wounds, especially diabetic foot ulcers, which are associated with prolonged treatment, frequent hospital visits, risk of infection, and potential amputation (Armstrong et al., 2017; Edmonds et al., 2021). In Thailand, community hospitals and primary care units function as the main entry point of the health system and are responsible for delivering care to the majority of patients, particularly those with chronic conditions such as diabetes (Arruzzoli et al., 2025; Kitreerawutiwong et al., 2017; Puangpet et al., 2022). Given the substantial burden of diabetes and its complications, effective and cost-efficient management strategies, including wound care, are critically important (Kunsathian et al., 2025).

Standard wound care services which included debridement, dressings, and antibiotic therapy (Diabetes Association of Thailand under The Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn, 2026). These services often require a prolonged treatment duration and may result in suboptimal healing outcomes in complex cases such as diabetes issues. Besides, chronic wounds also contribute significantly to healthcare expenditures and resource utilization (Díaz-Herrera et al., 2025; Eriksson et al., 2022; Frykberg & Banks, 2015). As a result, innovative technologies have been explored to enhance wound healing while reducing overall healthcare costs. Cold plasma or Cold Atmospheric Plasma (CAP) has emerged as a promising adjunctive therapy, recognized for its potent antimicrobial properties and its ability to accelerate tissue regeneration without causing thermal damage (Bhatt et al., 2025; Braný et al., 2020; Dubey et al., 2022). Hence, the cost for providing wound care using cold plasma among patients with T2DM in community hospital level in Thailand warrants further investigation.

Despite increasing clinical interest in cold plasma, evidence regarding its economic impact in real-world healthcare settings remains limited. Previous studies have demonstrated its effectiveness in reducing bacterial load and improving wound healing outcomes (Tonaree et al., 2025; Yousefian et al., 2023), yet data on cost remain scarce in

particular in Thailand context. There is only one study in Thailand concerning cost-effectiveness of wound care using cold plasma in public hospital (Supasit Pannarunothai et al., 2022). The result showed that unit cost per visit was about THB 1,915 and an incremental cost was THB 18,746 per 0.0252 QALYs compare with standard approach was THB 74,441 per QALYs. Significantly, wound care services using cold plasma Care services using cold plasma were shown to reduce the number of patient visits, lengths of hospital stay, and non-medical expenses from the patient's perspective (*Cold Plasma against Chronic Wounds - Www.Max-Planck-Innovation.Com*, 2023; Supasit Pannarunothai et al., 2022). However, this study was conducted in public university hospitals, where resources are more readily available than at the community level. Moreover, there is a lack of real-world cost data at the community hospital level in Thailand, where resources are most critical, and healthcare providers must balance clinical effectiveness with affordability. This highlights a critical gap in the literature regarding cost of wound care using cold plasma in community hospital level. Therefore, this study aimed to estimate unit cost of wound care using cold plasma among patients with a primary diagnosis of T2DM at community hospitals in Thailand. The findings are expected to support healthcare providers and policymakers in optimizing wound care strategies for diabetic patients in resource-limited settings.

Methods

Data

This cross-sectional retrospective study used wound care service activity using Cold plasma and cost information in fiscal year 2025. Data were obtained from four community hospitals, selected by purposive sampling. The inclusion criteria were community hospitals whose data are ready and willing to join. Exclusion criteria were community hospitals where data are not available. At first, we approached a total of five community hospitals. Of them, one community hospitals declined to participate the study. The remaining four hospitals were included in the current study because they provided required information (i.e., service data, hospital statistics, and expenditure information) to estimate average cost and cost per visit.

In this study, we focused on community hospitals because they were the main hospitals providing outpatient care after intensive inpatient care in Thailand and playing a vital role as a

gatekeeper among three main types of hospitals (i.e., community hospital, general hospital, and regional hospital) (Aujirapongpan et al., 2020).

Data from patients with a diagnosis of T2DM were included in the analysis. The 10th revision of the International Classification of Diseases (ICD-10) (2019) was used to identify diagnosis code of diabetes, which included E11.5 Non-insulin-dependent diabetes mellitus type 2 at with peripheral circulatory complications. The final sample size was 207 individuals having a primary diagnosis of T2DM from four community hospitals.

Cost analysis

The operational costs for outpatient wound care utilizing cold plasma included labor cost, material cost, and capital cost following the guideline of useful life of the asset (years) from Ministry of Finance in Thailand (Ministry of Finance, Thailand, 2021). Labor costs included salary, compensation, OT and fringe benefits which paid by hospitals. Material costs were used to provide care and support hospital's management (e.g., material supplies, maintenances,). Capital costs was the purchase price of asset divided by useful life of the asset (years), considering annual depreciation and amortization using straight line depreciation method.

Unit cost was estimated from provider perspective and focused on direct medical care cost using applied Activity-Based Costing (ABC) (William N. Zelman et al., 2003) (Cooper & Kaplan, 1992). We estimated the total hospital operational costs of wound care using cold plasma, cost per visit, and average cost per person.

The procedure consisted of the following steps:

- 1) reviewing wound care activities by research team members which include a medical doctor and a nurse, and cost information by a researcher with an accounting license. Besides, all data were cross-checked with original hospital records, and inconsistencies were reconciled through consensus.
- 2) adopting a provider perspective, this study utilized applied Activity-Based Costing (ABC) to isolate direct medical care cost. Labor costs were determined by multiplying staff time-per-case by total compensation rates, while material costs accounted for medical supplies and argon gas

consumption. To calculate maintenance, divide total amount of maintenance per year by total number of visits. For capital cost, multiply the depreciation per minute by the time per visit. In term of cold plasma machine, we used depreciation per year divided by total number of visits,

3) summing total cost of each hospital including labor cost, material cost and capital cost,

4) calculating the unit cost of wound care using cold plasma per visit of each hospital by dividing the total cost by a total number of visits,

5) calculating average cost of wound care using cold plasma per person by dividing the total service cost of each hospital by total number of wound care using cold plasma visits.

Ethical considerations

This research has approved by The Ethics Committee of Institute for the Development of Human Research Protections (HRP). Concerning on scientific, ICH-GCP and ethical issues, the committee has approved for the implementation of the research study. Date of Approval: October 28, 2024 (COA No. IHRP2024158. IHRP No. 124-2567). Written informed consent was obtained from all respondents who participated in this study.

Results

Characteristics of the participants

Across all hospitals, most participants with diabetes were male, with an average of 61 year olds. In total, there were 207 cases of patients and 2108 visits utilized wound care using cold plasma. The average number of wound care service visits using cold plasma varied across wound conditions. Service utilization peaked among patients with diabetic foot ulcers, who averaged 8.53 visits (SD=2.86). Patients with infected wounds had a mean of 7.70 visits with no variation (SD = 0.00). Burn and other wound conditions showed a moderate level of service visits, with a mean of 5.33 visits (SD = 1.31). Similarly, pressure ulcers had a comparable mean of 5.35 visits, but with higher variability (SD = 2.70) as shown in table 1

Table 1: An average of healthcare utilization stratified by wound volume reduction

Unit: Visits

Wound conditions	Hospital A	Hospital B	Hospital C	Hospital D	Mean	Standard deviation (SD)
Burn/Others	3.8	4.6	5.6	7.3	5.33	1.31
DM Foot	7.7	6.5	6.5	13.4	8.53	2.86
Pressure	3.4	6.8	9	2.2	5.35	2.70
Infected		7.7			7.70	0.00

*Note: The SD of 0.00 for "Infected" wounds reflects an N=1 (data available only from Hospital B), precluding variance analysis.

Regarding clinical outcomes, the percentage of wound reduction after completing the program, measured by the median. Overall, it showed generally high across all hospitals. Hospital A showed the highest median wound reduction

(93.47%), followed by Hospital D (92.41%) and Hospital B (88.47%). Hospital C had a lower median reduction (65.22%) compared to the others as shown in Figure 1.

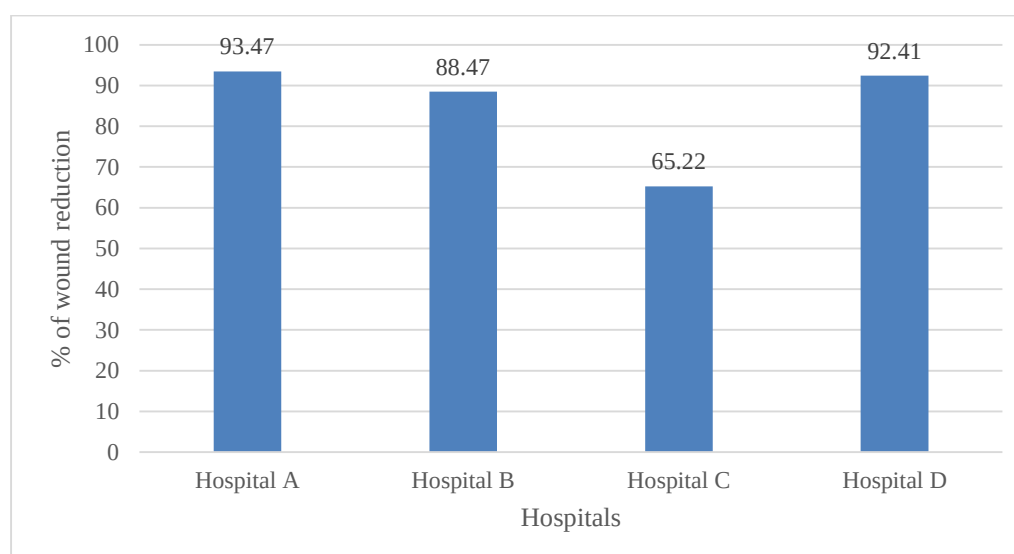


Figure 1: Percentage of wound reduction after completed program (median)

The total service cost of wound care using cold plasma significantly by facility. The highest total service cost was observed in Hospital B (THB 656,143), followed by Hospital D (THB 330,324) and Hospital A (THB 235,116), while Hospital C had the lowest total cost (THB 185,892).

When considering cost per person in each hospital, Hospital D had the highest average cost (THB 9,176 per person), followed by Hospital B (THB 7,372) and Hospital C (THB 6,410). Hospital A reported the lowest cost per person (THB 4,436). The mean cost per person across all hospitals was THB 6,849 (SD = 1,710.39), with a median of THB 6,891 as shown in Table 2.

Table 2: Total Service Cost and cost per person

Hospitals	Total Service Cost (THB)	Total Person	Total cost per Person (THB)
Hospital A	235,116	53	4,436
Hospital B	656,143	89	7,372
Hospital C	185,892	29	6,410
Hospital D	330,324	36	9,176
Maximize	656,143	89	9,176
Minimum	185,892	29	4,436
Median	282,720	45	6,891
Mean	351,868	52	6,849
Standard Deviation (SD)	183,184.68	23.21	1,710.39

The average cost per visits of wound care services using cold plasma varied across hospitals, reflecting differences in resource utilization. The total service cost ranged from THB 519 to THB 939 units per visit. Hospital C reported the highest total cost (THB939), followed by Hospital A (THB 794), Hospital B (THB 676), and Hospital D (THB 519).

Labor cost was the majority cost of total cost in most hospitals, while material and capital costs varied between hospitals. In hospital A, B, and D, labor cost was the highest hospital expenditure, followed by material cost, and then capital cost. In hospital C, capital cost was the highest cost, followed by labor cost and material cost, accordingly as shown in Figure 2.

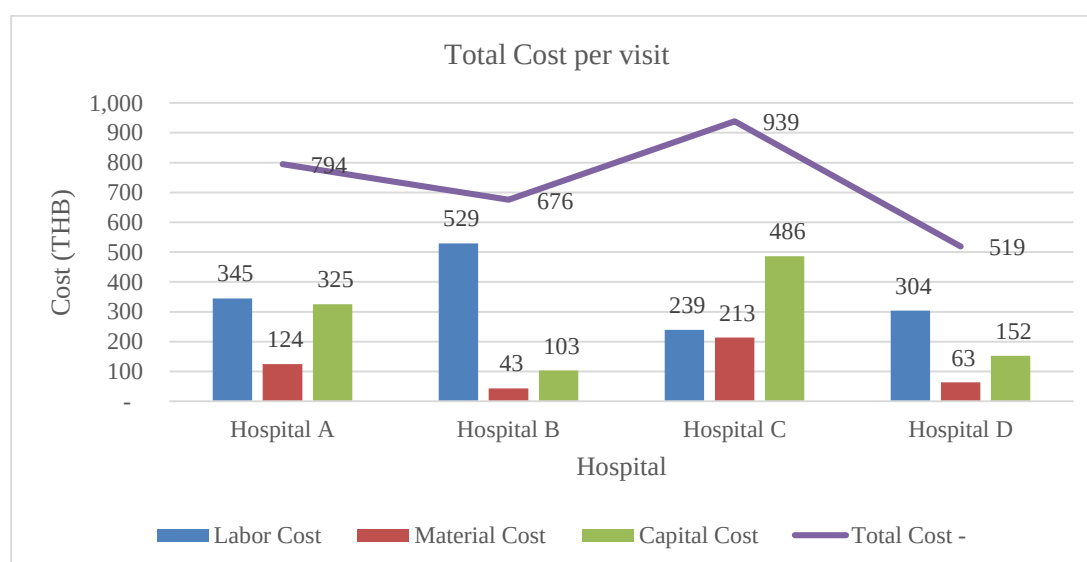


Figure 2: Total cost per visit stratified by community hospitals and cost components.

Discussion

This study aimed to estimate unit cost of wound care using cold plasma among patients with

a primary diagnosis of T2DM at community hospitals in Thailand. The result revealed that the percentage of wound reduction after completion of the program was high across all hospitals. This

variation comes from differences in patient characteristics, wound conditions at baseline, a number of visits, and specific context of each setting. It highlights the importance of standardized implementation and monitoring to achieve optimal clinical outcomes across settings. In addition, the finding indicated that the unit cost of wound care with cold plasma per outpatient visit for individuals with T2DM at community hospital level ranged from THB 519 to THB 939. Among the hospitals, Hospital C showed the highest overall cost at THB 939, followed by Hospital A at THB 794, Hospital B at THB 676, and Hospital D at THB 519, accordingly.

The majority of hospitals attributed greater costs to labor costs than to materials and capital. Regarding labor cost, this is line with other studies showing that labor cost was majority of total cost in Thai hospital services delivery (Utoomporn Wongsin et al., 2023; Witvorapong et al., 2022). One possible reason is that variations in a number of staff who provides specific care, staff seniority, service intensity, and resource utilization across settings. In this study, the majority of care providers are senior nurses who receive a high monthly salary. To further decrease direct medical care costs, several strategies can be considered. Potential strategies could be implementation strategies in which optimizing resource utilization, integrating cold plasma into existing wound care protocols to avoid duplication of services, training junior nurses to provide wound care, and increasing the number of patients. Such an approach has resulted in reducing direct medical care costs, in particular fixed costs (i.e., labor cost and depreciation from capital cost).

Findings in this study indicated that the cost per outpatient visit for individuals with T2DM at the community hospital level ranged from THB 519 to THB 939. Additionally, cost per person ranged from THB 4,436 to THB 9,176. Due to a few studies on cost per visit of wound care using cold plasma, there is only one study from Thailand. The costs estimated by the previous study in university hospitals in Thailand were higher than in the current study (Supasit Pannarunothai et al., 2022). This is due to the fact that there is variation in a number of public health professional, material used, service intensity, hospital level and utilization rate. For example, Hospital C exhibited the highest cost per visit compared to other hospitals due to a lower number of visits, which affects costs, particularly the depreciation of cold plasma. Previous study on cold

plasma suggested that cold plasma therapy may reduce overall healthcare costs by accelerating wound healing and decreasing the need for antibiotics and additional medical resources (Abu Rached et al., 2023; *Cold Plasma against Chronic Wounds* - www.Max-Planck-Innovation.Com, 2023; Supasit Pannarunothai et al., 2022). However, information on costing or economic evaluation remains limited. Therefore, further studies are warranted.

To the authors' knowledge, this study was the first to estimate hospital costs of wound care using cold plasma among patients with a primary diagnosis of T2DM at community hospitals in Thailand. Our findings provide important policy and practice implications for the cost analysis of cold plasma in diabetic wound care within Thai community hospitals. Shorter healing durations and decreased frequency of hospital visits reduce the total cost of treatment. In the context of Thailand, where more than 700 community hospitals serve as the primary point of care, particularly in resource-limited settings, such characteristics make cold plasma a highly practical and patient-friendly option. Reduced travel and fewer follow-up visits enhance convenience for patients while alleviating service burden on healthcare facilities. Cold plasma seems to be a viable supplementary technology that can improve the efficacy of wound treatment together with a low cost. In addition, these results support the integration of cold plasma into the continuum of diabetes care to reduce the burden of chronic wounds. In case of wound care services using cold plasma, policymakers should consider implementing a reimbursement system, such as bundled payments or fees for services, to support hospitals that adopt this technology. This is because this approach showed less visiting and it also has a potential to lower healthcare cost in long term. Significantly, the use of real-world cost data can inform reimbursement policies across Thailand's three main health insurance schemes

Limitation and future research

This study has several limitations. First, the cost analysis was conducted in only four community-level hospitals, which may limit the generalizability of the findings to other levels of healthcare facilities. Nevertheless, the use of a relatively large dataset from these hospitals strengthens the relevance of the results within similar community hospital settings in Thailand. In addition,

the cost data were obtained through direct reviewing of services and accounting records, which enhances the accuracy and validity of the findings. Second, this study focused on direct medical cost from hospital perspective and did not include non-direct medical cost in which the total cost from this study underestimate about 20% of total cost. Further research incorporating total cost from provider perspective, society perspective, cost-effectiveness analysis and long-term outcomes is commended to confirm its economic value compared with standard care. Additionally, a sensitivity analysis should be included in addition to the economic evaluation. Future studies should also explore scalability and implementation feasibility across different healthcare settings such as health promotion center.

Conclusion

Among patients with diabetes mellitus in Thai community institutions, this investigation offers critical evidence regarding the unit cost of wound care using cold bio plasma. The results indicate that the integration of cold plasma into routine wound care services has the potential to enhance clinical outcomes and optimize resource utilization. The total cost of treatment is reduced by the shorter healing durations and decreased

frequency of hospital visits, despite the fact that the initial investment in apparatus and training may be higher than standard care. In resource-constrained settings such as community hospitals in Thailand, cost-efficient interventions are essential for ensuring sustainable healthcare delivery. Cold plasma therapy represents a viable, cost-effective adjunctive technology capable of enhancing wound management outcomes in resource-constrained settings. By reducing healing durations and hospital visit frequency, it offers a sustainable solution for managing complex diabetic wounds at the community level.

Acknowledgment

Authors would like to express their sincere gratitude to the Health Systems Research Institute (HSRI) for financial support. The authors also extend appreciation to steering committee members, Hospital directors, and staff from the five participating hospitals for their valuable contributions and support in providing data essential for the cost estimation.

Funding

This research project is funded by Health Systems Research Institute (HSRI), Thailand.

References

- Abu Rached, N., Kley, S., Storck, M., Meyer, T., & Stücker, M. (2023). Cold Plasma Therapy in Chronic Wounds—A Multicenter, Randomized Controlled Clinical Trial (Plasma on Chronic Wounds for Epidermal Regeneration Study): Preliminary Results. *Journal of Clinical Medicine*, 12(15), 5121. <https://doi.org/10.3390/jcm12155121>
- Armstrong, D. G., Boulton, A. J. M., & Bus, S. A. (2017). Diabetic Foot Ulcers and Their Recurrence. *New England Journal of Medicine*, 376(24), 2367–2375. <https://doi.org/10.1056/NEJMr1615439>
- Arruzzoli, S., Leoni, O., Buffoli, M., & Capolongo, S. (2025). Comparative cross national analysis of healthcare service provision in community health centers based on policies and regulations from 13 international models. *Discover Health Systems*, 4(1), 119. <https://doi.org/10.1007/s44250-025-00292-w>
- Aujirapongpan, S., Meesuk, K., Theinsathid, P., & Maneechot, C. (2020). Performance Evaluation of Community Hospitals in Thailand: An Analysis Based on the Balanced Scorecard Concept. *Iranian Journal of Public Health*, 49(5), 906–913.
- Bhatt, P., Reema, & Sankaranarayanan, K. (2025). Cold Atmospheric Plasma as a Promising Medical Device for Wound Healing: Implications from Protein Perspective. *Regenerative Engineering and Translational Medicine*. <https://doi.org/10.1007/s40883-025-00410-3>
- Braný, D., Dvorská, D., Halašová, E., & Škovierová, H. (2020). Cold Atmospheric Plasma: A Powerful Tool for Modern Medicine. *International Journal of Molecular Sciences*, 21(8), Article 8. <https://doi.org/10.3390/ijms21082932>
- Cold plasma against chronic wounds—Www.max-planck-innovation.com*. (2023). <https://www.max-planck-innovation.com/max-planck-innovation/news/press-releases/press-release/cold-plasma-against-chronic-wounds.html>
- Cooper, R., & Kaplan, R. S. (1992). *Activity-Based Systems: Measuring the Costs of Resource Usage*. 15.

- Diabetes Association of Thailand under The Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn. (2026). *Clinical Practice Guideline for Diabetes 2023*.
<https://www.dmtai.org/new/index.php/sara-khwam-ru/sahrab-bukhkhhl-thawpi/diabetes-book/naewthang-wech-ptibati-sahrab-rokh-bea-hwan-2566>
- Díaz-Herrera, M. Á., González-Durán, M., Rodríguez-Martínez, F. J., Tujillo-Flores, G., Tuset-Mateu, N., Verdú-Soriano, J., Gea-Caballero, V., Sanllorente-Melenchón, A., Almeda-Ortega, J., Cunillera-Puértolas, O., Acedo-Anta, M., & Martínez-Riera, J. R. (2025). The financial burden of chronic wounds in primary care: A real-world data analysis on cost and prevalence. *International Journal of Nursing Studies Advances*, 8, 100313. <https://doi.org/10.1016/j.ijnsa.2025.100313>
- Dubey, S. K., Parab, S., Alexander, A., Agrawal, M., Achalla, V. P. K., Pal, U. N., Pandey, M. M., & Kesharwani, P. (2022). Cold atmospheric plasma therapy in wound healing. *Process Biochemistry*, 112, 112–123. <https://doi.org/10.1016/j.procbio.2021.11.017>
- Edmonds, M., Manu, C., & Vas, P. (2021). The current burden of diabetic foot disease. *Journal of Clinical Orthopaedics and Trauma*, 17, 88–93. <https://doi.org/10.1016/j.jcot.2021.01.017>
- Eriksson, E., Liu, P. Y., Schultz, G. S., Martins-Green, M. M., Tanaka, R., Weir, D., Gould, L. J., Armstrong, D. G., Gibbons, G. W., Wolcott, R., Olutoye, O. O., Kirsner, R. S., & Gurtner, G. C. (2022). Chronic wounds: Treatment consensus. *Wound Repair and Regeneration*, 30(2), 156–171. <https://doi.org/10.1111/wrr.12994>
- Frykberg, R. G., & Banks, J. (2015). Challenges in the Treatment of Chronic Wounds. *Advances in Wound Care*, 4(9), 560–582. <https://doi.org/10.1089/wound.2015.0635>
- International Diabetes Federation. (2025). IDF Diabetes Atlas 2025. *Diabetes Atlas*.
<https://diabetesatlas.org/resources/idf-diabetes-atlas-2025/>
- Kitreerawutiwong, N., Jordan, S., & Hughes, D. (2017). Facility type and primary care performance in sub-district health promotion hospitals in Northern Thailand. *PLOS ONE*, 12(3), e0174055. <https://doi.org/10.1371/journal.pone.0174055>
- Kunsathian, J., Pimolkatekul, S., & Wongchan, N. (2025). Diabetes Patients Follow-up Tracking System in Urban Community: A Case Study of the Diabetes Center, Charoenkrung Pracharak Hospital. *Journal of The Royal Thai Army Nurses*, 26(3), 19–26.
- Ministry of Finance, Thailand. (2021). *Depreciation and Amortization information*.
https://www.cgd.go.th/cs/internet/internet/edas.html?page_locale=en_US
- Puangpet, T., Pongkunakorn, T., Chulkarat, N., Bunlangjit, C., Surawit, A., Pinsawas, B., Mongkolsucharitkul, P., & Mayurasakorn, K. (2022). Control and complications of diabetes in urban primary care units in Thailand: A cross-sectional study. *BMC Primary Care*, 23(1), 212. <https://doi.org/10.1186/s12875-022-01823-7>
- Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., Stein, C., Basit, A., Chan, J. C. N., Mbanya, J. C., Pavkov, M. E., Ramachandaran, A., Wild, S. H., James, S., Herman, W. H., Zhang, P., Bommer, C., Kuo, S., Boyko, E. J., & Magliano, D. J. (2022). IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*, 183, 109119. <https://doi.org/10.1016/j.diabres.2021.109119>
- Supasit Pannarunothai, Nilawan Yoopukdee, Piyameth Dilokthornsakul, Nattanun Wetsasuntorn, Nattasit Chuchote, Pantip Khamta, & Parunee Yimsabai. (2022). *Cost-effectiveness study of chronic wound treatment with Low Temperature Atmospheric Pressure Plasma versus Standard Care in public hospitals*. (pp. 1–62). Center for Health Equity Monitoring Foundation.
- Tonaree, W., Taweepraditpol, S., Kongkunnawat, N., Pongjantaradej, N., Kotistienkul, B., Yongsuvimol, M., Chinaronchai, K., Rachata, P., Ongkasuwan, P., Chansanti, O., Mongkornwong, A., Chaichote, C., & Chuangsuwanich, A. (2025). The Efficacy of Low-Temperature Atmospheric-Pressure Plasma (LTAPP) in the Multicenter Treatment of Pressure Ulcers: A Randomized Controlled Trial. *The International Journal of Lower Extremity Wounds*, 15347346251323940. <https://doi.org/10.1177/15347346251323940>
- Utoomporn Wongsin, Passakorn Suanrueang, & Tuo-Yu Chen. (2023). Cost Analysis of Outpatient Services for Hypertension, Heart Attack, and Stroke among Older Adults in Community Hospitals in Thailand. *Journal of Health Systems Research*, 17(2), 317–328.

Witvorapong, N., Ngamkiatphaisan, S., & Sriratanaban, J. (2022). Cost analysis of a teaching hospital in Thailand: Impacts of the first wave of COVID-19. *PLOS ONE*, 17(9), e0273771.

<https://doi.org/10.1371/journal.pone.0273771>

World Health Organization. (2019). *ICD-10 Version:2019*. <https://icd.who.int/browse10/2019/en>

Yousefian, F., Hesari, R., Jensen, T., Obagi, S., Rgeai, A., Damiani, G., Bunick, C. G., & Grada, A. (2023). Antimicrobial Wound Dressings: A Concise Review for Clinicians. *Antibiotics*, 12(9), 1434.

<https://doi.org/10.3390/antibiotics12091434>