



Cost Analysis of Personalized Intensive Lifestyle Modification for NCD Risk Populations in Thailand

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Abstract

Background: Non-communicable diseases (NCDs) remain the leading cause of morbidity, mortality, and healthcare expenditure in Thailand, yet real-world cost evidence for personalized intensive lifestyle interventions is limited. **Objective:** To estimate the cost of implementing the Personalized Intensive Lifestyle Modification Program (PILM) for populations at risk of NCDs in Thailand. **Methods:** A cross-sectional retrospective cost analysis was conducted using an activity-based costing approach from the provider perspective. Fiscal year 2023 cost data were collected from 12 service settings (hospitals, municipal health facilities, and public institutions). Core PILM components delivered across settings included baseline risk assessment, individualized lifestyle counseling/coaching, structured diet and physical activity planning, and continuous follow-up via face-to-face visits and digital communication. Costs were classified as labor, material, and capital. Unit cost per participant was calculated for a six-month program cycle and reported in U.S. dollars. **Results:** A total of 477 participants received PILM services across 12 settings. Labor accounted for 63% of total cost, followed by capital (29%) and material (8%). The mean unit cost was USD 83 per participant (range:

USD 24.97–156.71). **Conclusion:** PILM implementation costs varied across settings, with labor as the primary cost driver. These findings support budgeting and service design for integrating personalized NCD prevention into Thailand's universal health coverage.

Keywords: Cost analysis, Health promotion, Lifestyle coaching, Non-communicable diseases, Personalized intensive lifestyle modification

What was Known

- Lifestyle change supports health promotion, but cost evidence in Thailand is limited.
- Most health promotion programs use population-wide rather than personalized services.

What's New and Next

- Costs of personalized health promotion vary by service model and workforce design.
- Cost evidence can guide integrating personalized prevention into routine health services.

Introduction

Non-communicable diseases (NCDs) represent one of the most significant public health challenges globally and in Thailand. Cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases account for more than 70% of global deaths, with a disproportionate burden borne by low- and middle-income countries. In Thailand, NCDs contribute to approximately three-quarters of all deaths and consume a substantial share of national healthcare expenditure. Despite the country's long-standing achievement of universal health coverage, the growing prevalence of NCDs continues to exert pressure on healthcare financing and service capacity^(1–5).

The majority of NCDs are driven by modifiable behavioral risk factors, including unhealthy diets, physical inactivity, tobacco use, and harmful alcohol consumption. Consequently, preventive strategies focusing on lifestyle modification have been widely promoted as cost-effective approaches to reducing disease incidence and long-term healthcare costs. Compared with treatment-oriented care, investment in health promotion and disease prevention offers the potential for improved population health outcomes while containing future expenditure^(6–8).

Thailand has demonstrated strong policy commitment to NCD prevention through national strategies, integration of NCD services into primary care, and community-based initiatives supported by village health volunteers and local governments. The Thai Health Promotion Foundation has further strengthened prevention efforts through sustained financing mechanisms. However, many

existing interventions emphasize population-wide or group-based approaches, which may be insufficient to address individual risk profiles, behavioral readiness, and contextual factors influencing lifestyle change⁽⁹⁻¹³⁾.

Personalized lifestyle modification approaches, including individualized risk assessment, tailored behavioral coaching, and continuous follow-up, have shown effectiveness in reducing cardiometabolic risk in international and Thai studies. Programs such as the Diabetes Prevention Program and community-based lifestyle interventions in Thailand have demonstrated favorable health outcomes and cost-effectiveness. Nevertheless, evidence on the actual cost of implementing personalized and intensive lifestyle modification programs within routine service settings remains limited, particularly in the Thai context⁽¹⁴⁻¹⁸⁾.

The Personalized Intensive Lifestyle Modification/Coaching Program (PILM) was developed to address this gap by providing individualized health promotion services for populations at risk of NCDs across diverse service settings, including hospitals, municipal health centers, workplaces, and public institutions. To support policy decision-making and potential scale-up, robust cost information is required to assess the feasibility and sustainability of such programs under Thailand's health system.

This study aimed to estimate the cost of implementing PILM across multiple service settings in Thailand and to examine variation in cost structure (labor, material, and capital) across settings. The study further explored potential contextual contributors to cost variation, including service model and workforce configuration.

Materials and Methods

Study Design and Setting

This study employed a cross-sectional retrospective cost analysis design. Cost data were collected from 12 service settings participating in the PILM during the fiscal year 2023. The settings included eight hospitals, three healthcare facilities under municipal administration, and one public institution located in different regions of Thailand.

Sampling Strategy

The 12 service settings were purposively selected from institutions actively implementing PILM during fiscal year 2023. Inclusion criteria included completion of a six-month program cycle and availability of complete financial and service activity records for cost verification. The selected

settings represented heterogeneous service models (hospital, municipal, and public institution), enabling comparative interpretation.

Perspective and Time Horizon

The analysis was conducted from the provider's perspective, focusing on costs incurred by service providers in delivering PILM services. The time horizon covered one complete six-month program cycle for each participant.

Costing Method

An activity-based costing (ABC) approach was applied to estimate the cost of PILM services. This method identifies key service activities and allocates costs based on actual resource use associated with each activity. Under the ABC framework, activities were categorized as: (1) baseline assessment, (2) individualized counseling/coaching, (3) structured lifestyle sessions and planning, and (4) follow-up monitoring and tracking. Costs were allocated based on time and resource utilization.

Core PILM intervention components across settings

To ensure comparability across service settings, the PILM program included a set of core intervention components implemented at all participating sites. These core components comprised: (1) baseline risk screening and assessment of cardiometabolic risk and lifestyle behaviors; (2) individualized lifestyle counseling and behavioral coaching delivered by trained health personnel; (3) structured lifestyle modification planning focused on dietary and physical activity changes; and (4) continuous follow-up monitoring throughout the six-month program period using face-to-face visits and/or digital communication (e.g., telephone or messaging applications).

In addition to the core components, some settings offered optional or enhanced services (e.g., facility-based exercise support, hydrotherapy, or acupuncture). These context-specific additions were not considered part of the required core intervention package and contributed to variation in resource use and unit costs across settings. Costs related to development and maintenance of centralized digital monitoring systems and wearable devices were not included in this analysis.

Cost Components

Costs were categorized into three main components:

1. Labor Costs: Included salaries, compensation, overtime payments, and employment-related benefits of all personnel involved in service delivery. Labor costs were allocated based on the proportion of working time dedicated to PILM activities.

2. Material Costs: Included consumable supplies, office materials, utilities, communication expenses, meeting-related costs, and contracted services. When direct expenditure data were unavailable, market prices were used for estimation.

3. Capital Costs: Included depreciation of equipment and facilities used in the program, such as body composition monitoring devices and exercise equipment. Depreciation was calculated using the straight-line method, assuming a residual value of one Thai Baht.

Data Collection

Cost data were extracted from financial reports, expenditure records, payroll documents, and administrative service records. Service activity and utilization data (participant volume, frequency, time allocation, and equipment use) were verified with service providers using structured verification.

Cost Analysis

Total costs were calculated by summing labor, material, and capital costs for each service setting. Labor costs were allocated based on documented time spent on PILM activities, derived from service schedules, time-use records, and verification with providers. Material costs were assigned using direct expenditure records; when these were unavailable, market prices were used as proxies. Capital costs were estimated using straight-line depreciation based on asset purchase price (or market price if donated), useful life, and the proportion of utilization attributable to PILM activities. Unit cost per participant was derived by dividing total cost by the number of participants completing the six-month program. Costs were converted to U.S. dollars using an exchange rate of 34 Thai Baht per USD, based on the Bank of Thailand reference rate for 2023. Descriptive statistics were used to summarize cost components and unit costs across settings⁽¹⁹⁾.

Result

Service Settings and Participants

The PILM was implemented across 12 service settings, comprising eight hospitals, three healthcare facilities under municipal administration, and one public institution. These settings

represented diverse service delivery contexts, including hospital-based NCD clinics, wellness centers, municipal health facilities, workplaces, and public organizations.

A total of 477 participants at risk of non-communicable diseases were enrolled in the program. Participants were primarily identified through health screening activities and routine service contacts and voluntarily participated in a six-month PILM. Across all settings, services included individualized counseling, dietary and physical activity guidance, behavioral coaching, and follow-up monitoring, delivered through a combination of face-to-face sessions and digital communication platforms.

Cost Structure of the PILM Program

The overall cost structure of the PILM program is presented by cost component in Figure 1. Labor cost constituted the largest proportion of total program cost, accounting for 63%, followed by capital cost (29%) and material cost (8%).

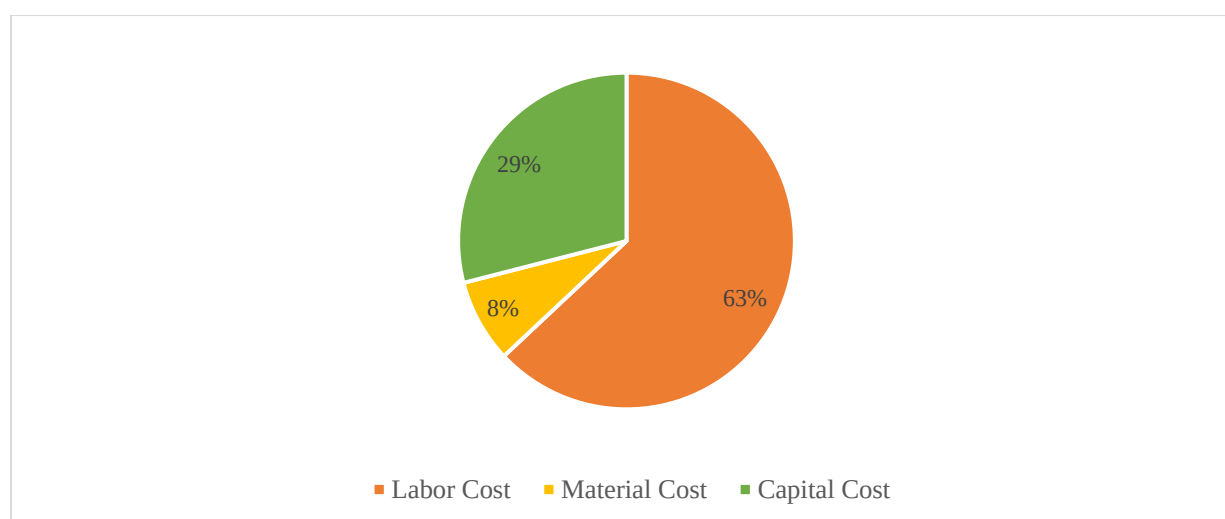


Figure 1 Distribution of average total cost of the PILM Program by cost component (labor, material, and capital) across 12 service settings.

Labor costs reflected the intensive, person-centered nature of the program, which relied on multidisciplinary teams including physicians, nurses, nutritionists, physical therapists, public health technical officers, and other trained wellness coaches. Capital costs were mainly associated with the use of body composition monitoring devices, fitness equipment, and service space, while material costs were relatively modest across all settings.

Unit Cost per Participant

The unit cost of providing PILM services per participant over a six-month period varied substantially across service settings (Table 1). The mean unit cost was USD 83 per participant (SD = 37.05), with a minimum of USD 24.97 and a maximum of USD 156.71.

Table 1 Total cost of the PILM Program per participant over a six-month period by labor, material, and capital cost across 12 service settings (USD).

Service facilities	Number of participants (persons)	Labor Cost	Capital Cost	Material Cost	Total Cost
Hospital A	53	35.71	11.85	6.76	54.32
Hospital B	50	27.06	47.59	8.50	83.15
Hospital C	28	20.85	0.47	7.35	28.68
Hospital D	65	96.44	59.71	0.56	156.71
Hospital E (includes acupuncture)	20	83.29	-	2.79	86.09
Hospital E (excludes acupuncture)	20	22.18	-	2.79	24.97
Hospital F	59	23.38	10.79	29.06	63.26
Hospital G	12	89.03	62.50	-	151.53
Health Center	31	25.29	52.15	10.29	87.74
Municipality A	56	78.68	0.41	0.62	79.74
Municipality B	34	41.53	43.56	0.85	85.94
Medical University	10	74.12	0.56	7.74	82.41
Public Institution	39	65.91	23.91	4.68	94.50
Average	477*	52.56	24.12	6.32	83.00

Note. 1. Values are expressed in United States dollars (USD) per participant for a six-month program period. Capital costs were calculated using the straight-line depreciation method. A dash (–) indicates no capital cost incurred. Total number of participants across all service settings was 477.

2. Hospital E is presented as two scenarios (including and excluding acupuncture) to illustrate the cost impact of optional services; it represents one service setting.

Comparative Cost by Facility Type

When stratified by facility type, unit costs differed across hospital, municipal, and public-institution settings, reflecting differences in workforce configuration, service intensity, and capital equipment use.

Labor costs per participant ranged from USD 20.85 to USD 96.44. Higher labor costs were observed in settings where physicians served as primary wellness coaches or where services were delivered by large multidisciplinary teams, such as provincial hospitals and municipal programs with multiple professional groups. In contrast, lower labor costs were found in settings where services were delivered primarily by non-physician health professionals, such as public health technical officers and nurses.

Material cost per participant ranged from USD 0 to USD 29.06, with an average of USD 6.32. These costs were higher in settings that incorporated additional service components, such as structured fitness activities or specialized equipment.

Capital cost per participant ranged from USD 0 to USD 62.50, with an average of USD 24.12. Higher capital costs were associated with settings that utilized advanced body composition monitoring devices and fitness facilities, particularly when the number of participants was relatively small, resulting in higher per-person depreciation costs

Discussion

This study provides empirical cost evidence for the implementation of the PILM across diverse service settings in Thailand. The findings demonstrate that personalized lifestyle modification can be delivered at a relatively modest cost, with an average expenditure of USD 83 per participant over a six-month program period. However, substantial variation in unit costs was observed across settings, reflecting differences in service design, workforce composition, and resource utilization.

Labor cost emerged as the dominant cost component, accounting for nearly two-thirds of total program cost. This finding is consistent with the nature of personalized and intensive behavioral interventions, which require sustained interaction between service providers and participants. Programs relying heavily on physician-led services or large multidisciplinary teams incurred higher labor costs, whereas those utilizing trained non-physician health professionals demonstrated lower costs (Table1). This suggests that workforce configuration plays a critical role in determining program

efficiency and highlights the potential for task-shifting strategies to improve cost containment without compromising service quality.

The lowest unit cost was observed in settings delivering the core program with limited add-on services and greater reliance on non-physician health personnel, whereas the highest unit cost occurred in settings with larger multidisciplinary teams and higher capital equipment depreciation per participant, suggesting effects of workforce configuration and economies of scale.

The average unit cost observed in this study is comparable to previous Thai studies on lifestyle modification and health promotion programs targeting populations at risk of NCDs. Prior research has reported costs ranging from approximately USD 100 per participant for six-month preventive interventions^(18,20). International studies on lifestyle modification and behavior change programs have also demonstrated favorable cost-effectiveness profiles, particularly when compared with long-term treatment costs for chronic diseases^(21,22). Although direct comparison is limited by differences in context, target populations, and outcome measures, the findings of this study reinforce the economic plausibility of investing in preventive, behavior-based interventions.

From a health system perspective, the results have important implications for Thailand's universal health coverage system. The observed cost range suggests that personalized lifestyle modification services can be flexibly integrated into existing service platforms, including hospitals, municipal health services, and workplace health programs. The variability in cost highlights opportunities for local adaptation, allowing decision-makers to design service models that align with available resources, workforce capacity, and population needs.

Importantly, this study contributes to the evidence base by documenting real-world implementation costs rather than relying on modeled estimates. Such information is critical for budgeting, planning, and scaling up personalized prevention programs. By identifying labor and capital costs as key drivers, the findings provide actionable insights for policymakers and administrators seeking to optimize service delivery and ensure long-term sustainability.

Limitations and Future Research

This study has several limitations. First, certain cost components, such as the development and maintenance of digital monitoring systems and wearable devices, were not fully captured, potentially leading to an underestimation of total program cost. Second, the analysis focused solely on cost estimation and did not assess health outcomes or cost-effectiveness. As a result, the

relationship between program cost and health impact could not be evaluated. Future evaluations should incorporate standardized prospective cost tracking templates across settings and include the development and maintenance costs of digital monitoring systems and wearable devices where applicable. In addition, linking costs to health outcomes will enable cost-effectiveness analysis.

Future research should incorporate outcome measures, such as changes in body weight, metabolic indicators, and quality of life, to enable cost-effectiveness analysis. Longitudinal studies examining the sustainability of behavior change and potential healthcare cost savings are also warranted. Additionally, expanding the analysis to community-based and broader population groups would further inform national policy decisions regarding the scale-up of personalized NCD prevention programs.

Conclusion

This study provides comprehensive cost evidence for the implementation of the PILM across multiple service settings in Thailand. The findings demonstrate that personalized lifestyle modification can be delivered at a reasonable cost, with labor as the primary cost driver and substantial variation across service models. The results support the feasibility of integrating personalized preventive services into Thailand's health system and offer valuable insights for budget planning, workforce design, and policy development. Incorporating such evidence into national and local decision-making may contribute to more effective and sustainable strategies for preventing non-communicable diseases and reducing future healthcare expenditure.

Ethical Approval Statement

The study was approved by the Ethics Committee of the Faculty of Medicine, Chiang Mai University (Approval No. 187/2023). All participants provided informed consent prior to participation. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Author Contributions

OQ conceived and designed the study, led the overall conceptual framework of the PILM, coordinated data collection across service settings, contributed to data interpretation and drafted the original manuscript. KC provided academic supervision, methodological guidance, and critical input on study design, health system relevance, and interpretation of findings. SS and PT contributed to field implementation, service process documentation, and verification of program and cost data from participating institutions. CA provided expert input on public health and epidemiological perspectives.

and contributed to critical interpretation of findings. KP contributed to methodological consultation and critical review of the manuscript for important intellectual content. All authors contributed to critical revision of the manuscript, approved the final version for publication, and agreed to be accountable for all aspects of the work, ensuring its accuracy, integrity, and compliance with ethical and scientific standards.

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Conflicts of Interest

The authors declare that they have no conflicts of interest related to this study.

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