BORNEO EPIDEMIOLOGY JOURNAL | BEJ

ORIGINAL ARTICLE Open Access

COST ANALYSIS OF SMOKING CESSATION PROGRAMME IN PUSAT RAWATAN WARGA, UNIVERSITI MALAYSIA SABAH

Ahmad Syuaib A Sazali[1], Darryl Daring[1], Farida Nazahiya Mohd Salleh[1], Idzhar Azwan Mohd Idrus[1], Nur Atiqah Ihsan[1], Nik Dewi Delina Nik Mohd Kamil[1], S. Muhammad Izzudin Rabbani Mohd Zali[1], Norsyahida Md Taib[1], Abdul Rahman Ramdzan[1,2*], Kamal Kasra[3]

Abstract

Despite ongoing tobacco control measures, data on the direct costs of local smoking cessation programmes in Malaysian tertiary educational settings remain scarce. This study evaluates the cost implications of nicotine replacement therapy (NRT) at Universiti Malaysia Sabah (UMS) Quit Smoking Clinic, focusing on 2 mg and 4 mg Nicorette gum dosages. A retrospective cost analysis using a bottom-up micro-costing approach was conducted at Pusat Rawatan Warga, UMS, in 2023. Twenty patients were enrolled in the programme: those receiving 2 mg gum (follow-up every two months) and those receiving 4 mg gum (follow-up monthly). Direct programme costs, including counselling sessions, annual blood tests, and daily Nicorette gum consumption, were calculated. The annual cost per patient was RM 3,249.67 for the 2 mg gum group and RM 4,860.33 for the 4 mg gum group, with a mean annual cost of RM 4,055.00. Cost variations were influenced by gum dosage strength, frequency of follow-ups, and associated clinical procedures. The study highlights the substantial financial requirements of operating a structured smoking cessation programme in a tertiary educational setting. Policymakers and healthcare planners may use this evidence to inform budgeting, optimize resource allocation, and evaluate the sustainability of smoking cessation services. Future research should assess the cost-effectiveness of different NRT dosages to guide policy on scaling up cessation programmes.

Keywords: Cost Analysis, Nicotine Replacement Therapy, Smoking Cessation, Tobacco Control, Universiti Malaysia Sabah

*Correspondence Email: abdul.rahman@ums.edu.my

[1]*Department of Public Health Medicine, Faculty of Medicine & Health Sciences, Universiti of Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Malaysia.*

[2]*Health Economic Evaluation Research (HEER) Group, Universiti of Malaysia Sabah, Jalan UMS, Kota Kinabalu 88400, Malaysia.*

[3]*Faculty of Public Health, Universitas Andalas, West Sumatera 25175, Indonesia*

Received: 17/03/2025
Accepted: 22/08/2025
Published: 04/11/2025

INTRODUCTION

Smoking-related morbidity and mortality remain a major global public health concern. An estimated 3 million deaths occur annually due to smoking-related diseases, with projections indicating a rise to 10 million by 2030. The main contributors to smoking-related mortality include cancer, respiratory diseases, and cardiovascular conditions (K. H. Lim et al., 2022). Approximately 70% of these deaths are expected to occur in developing countries, where smoking prevalence remains high (K. Lim et al., 2018). Within the Western Pacific Region, smoking prevalence varies considerably from 14.1% in Australia to as high as 52% in some areas contributing to nearly one million tobacco-related cardiovascular deaths annually (MacKay et al., 2022). Despite global tobacco control measures, both smoked and smokeless tobacco use continue to pose persistent public health challenges.

In Malaysia, smoking prevalence has shown a modest decline, from 23.1% in 2011 to 21.3% in 2019 (Yusoff et al., 2022). Nevertheless, smoking is still responsible for about 20,000 deaths annually and remains a major contributor to disability-adjusted life years (DALYs) and years of life lost (YLL) (K. Lim et al., 2018). To address this, Malaysia has committed to the World Health Organization's Framework Convention on Tobacco Control (FCTC) and has implemented multiple initiatives, including the establishment of Quit Smoking Clinics under the Ministry of Health (MOH). These clinics provide free access to pharmacological interventions such as nicotine patches and Nicorette gum, as well as psychological support like motivational interviewing (Lee et al., 2014).

At Universiti Malaysia Sabah (UMS), a Quit Smoking Clinic was established in August 2022 at Pusat Rawatan Warga (PRW) to support staff and students in smoking cessation. The clinic combines physician-led counselling with pharmacological interventions, primarily Nicorette gum available in 2mg and 4mg dosages. Evidence on the comparative effectiveness of these dosages is mixed: while some studies report higher abstinence rates with 4mg gum (Kornitzer et al., 1987), others show no significant difference (Garvey et al., 2000).
Despite the existence of such clinics, there is a lack of localized cost analyses of smoking cessation interventions in Malaysia, particularly within tertiary educational settings. This represents a critical knowledge gap, as understanding the costs associated with manpower, clinical services, and medications is essential for resource allocation, programme sustainability, and policy planning.

Therefore, this study aims to determine the costs involved in delivering nicotine replacement therapy through the Quit Smoking Clinic at PRW, UMS. Specifically, it compares the annual costs of providing 2mg and 4mg Nicorette gum regimens, offering insights into the financial implications of smoking cessation services in a university healthcare setting.

METHODS

This study employed a retrospective cost analysis using a bottom-up micro-costing approach to estimate the direct costs of a smoking cessation programme at Pusat Rawatan Warga (PRW), Universiti Malaysia Sabah (UMS). PRW is the primary healthcare centre for UMS staff and students, although members of the public may also seek services without subsidy. The clinic

provides comprehensive primary care services delivered by medical officers, nurses, assistant medical officers, and medical specialists. The analysis focused on patients enrolled in the Quit Smoking Clinic at PRW during January to December 2023, the first full year since the programme's launch in August 2022. A total of 20 patients (UMS staff and students) actively participated in the programme and were included in the study.

Two nicotine replacement therapy (NRT) regimens were provided to patients in the Quit Smoking Clinic. The first regimen, referred to as the usual dosage group, involved the use of 2mg Nicorette gum with an average of six pieces consumed daily, accompanied by follow-up appointments every two months. The second regimen, or maximum dosage group, consisted of 4mg Nicorette gum with the same daily consumption of six pieces, but with follow-up appointments scheduled monthly to allow closer monitoring. Direct programme costs included staff time, counselling sessions, laboratory investigations, consumables, and medication. Capital costs (e.g., equipment) were annualised using a 5% discount rate. All costs were expressed in Malaysian Ringgit (RM) for the year 2023. The information for price for all capital and recurrent costs was also obtained from Pusat Warga UMS as in Table 1.

Table 1: Capital and Recurrent Costs Involved in the Smoking Cessation Programme in Pusat Rawatan Warga, UMS

Category	Number	Cost
Capital Cost		
Instrument cost		
Peak Flow meter	1	RM286.60
Blood Pressure Monitor	1	RM132.00
Height Weight BMI Scale	1	RM2798.70
Recurrent Cost		
Healthcare staff (monthly emolument)		
Healthcare Assistant (U11)	1	RM1204.00
Registered Nurse (U29)	1	RM1797.00
Medical Officer (UD44)	1	RM3611.00
Assistant Medical Officer (U29)	1	RM1797.00
Pharmacy Officer (UF41)	1	RM2740.00
Assistant Pharmacy Officer (U29)	1	RM1797.00
Medications		
Nicorette gum (2mg)	1	RM1.22 / gum
Nicorette gum (4mg)	1	RM1.75 / gum
Blood screening		

Full blood count (FBC)	1	RM25.30
Lover function test (LFT)	1	RM29.00
Renal profile and serum electrolytes (RP + SE)	1	RM31.50
Fasting blood sugar (FBS)	1	RM4.70
Fasting lipid profile (FLP)	1	RM23.00
Uric acid (UA)	1	RM7.50
Consumables		
Disposable face mask	1	RM0.16 / pcs
Hand glove	1	RM0.186 / pcs
Syringe (10ml)	1	RM0.2780 / pcs
Blue needle	1	RM0.0842 / pcs
Mouthpiece for peak expiratory flow rate (PEFR)	1	RM0.5500 / pcs

RESULTS AND DISCUSSION

The cost analysis was conducted using a bottom-up (micro-costing) and activity-based approach. As the programme operated on an outpatient basis, costs were calculated based on appointment visits and daily medication consumption only, without including any inpatient or hospitalisation costs. To ensure a comprehensive assessment, all consumables, procedures, and staff salaries were included in the calculations. Three main activities contributed to the overall programme cost: smoking cessation counselling, annual blood profile assessments, and daily Nicorette gum consumption. These activities represented the core components of the smoking cessation service provided at Pusat Rawatan Warga, UMS.

Given the variation in follow-up schedules and gum dosages, patients were categorised into two groups. The usual dosage group consisted of individuals who received 2mg Nicorette gum, taken as six pieces daily, with follow-up appointments scheduled every two months. In contrast, the maximum dosage group comprised patients prescribed 4mg Nicorette gum at the same daily frequency, but with monthly follow-up appointments for closer monitoring. As there were varied data in terms of appointments and Nicorette gum intake, the calculation was divided into two main categories and different frequency of activities which were shown below in Table 2.

Table 2: Comparison and Differences in Activities Between Usual and Maximum Dosage Groups

Activity	Usual dosage group	Maximum dosage group
Smoking cessation counselling	Every two months	Every month
Annual blood profile	Once per year	Once per year
Daily Nicorette gum consumption	2mg 6 pieces daily	4mg 6 pieces daily

The annual cost per patient in the usual dosage group was RM 3,249.67, while the maximum dosage group incurred an annual cost of RM 4,860.33. The overall mean annual cost across both groups was RM 4,055.00. Capital costs were annualised using a 5% discount rate. In total, 20 patients were treated under this programme at Pusat Rawatan Warga, UMS, during 2023.

Table 3: Costs for Annual Blood Profile

Activity		Frequency		
Annual Blood profile		1 / year		
Recurrent cost				
Assistant Medical Officer (U29)	1	RM1797.00	30 minutes	RM6.24
FBC	1	RM25.30	Once per year	RM25.30
LFT	1	RM29.00	Once per year	RM29.00
RP + SE	1	RM31.50	Once per year	RM31.50
FBS	1	RM4.70	Once per year	RM4.70
FLP	1	RM23.00	Once per year	RM23.00
UA	1	RM7.50	Once per year	RM7.50
Disposable face mask	1	RM0.16 / pcs	Once per year	RM0.16
Hand glove	1	RM0.186 / pcs	Once per year	RM0.19
Syringe (10ml)	1	RM0.2780 / pcs	Once per year	RM0.28
Blue needle	1	RM0.0842 / pcs	Once per year	RM0.08
			Total cost	RM127.95
			Total cost per year	RM127.95

Table 4: Costs for Smoking Cessation Counselling Session in the Usual Dose Group

Activity		**Frequency**		
Smoking cessation counselling		Once every 2 months		
Capital cost				
Category	**Number**	**Cost**	**Frequency / Age**	**Total Cost**
Peak Flow meter	1	RM286.60	2 years	RM7.70
Blood Pressure Monitor	1	RM132.00	4 years	RM1.86
Height Weight BMI Scale	1	RM2798.70	3 years	RM52.35
Recurrent cost				
Medical Officer (UD44)	1	RM3611.00	30 minutes	RM12.53
Mouthpiece (PEFR)	1	RM0.5500 / pcs	Once per patient	RM0.55
			Total cost	RM74.99
			Total cost per year	RM449.94

Table 5: Costs for Smoking Counselling Session in the Maximum Dose Group

Activity		**Frequency**		
Smoking cessation counselling		Once every month		
Capital cost				
Category	**Number**	**Cost**	**Frequency / Age**	**Total Cost**
Peak Flow meter	1	RM286.60	2 years	RM7.70
Blood Pressure Monitor	1	RM132.00	4 years	RM1.86
Height Weight BMI Scale	1	RM2798.70	3 years	RM52.35
Recurrent cost				
Medical Officer (UD44)	1	RM3611.00	30 minutes	RM12.53

Mouthpiece (PEFR)	1	RM0.5500 / pcs	Once per patient	RM0.55
			Total cost	RM74.99
			Total cost per year	RM899.88

Table 6: Cost for Daily Nicorette Gum Usage in the Usual Dose Group

Activity		**Frequency**		
Daily Nicorette gum usage		Average 6 pieces per day		
Recurring cost				
Category	**Number**	**Cost**	**Time**	**Total Cost**
Nicorette gum (2mg)	30 days	RM1.22 / gum / day	Average 6 pieces per day	RM219.60
			Total cost	RM219.60
			Total cost per year	RM2671.78

Table 7: Cost for Daily Nicorette Gum Usage in the Maximum Dose Group

Activity		**Frequency**		
Daily Nicorette gum usage		Average 6 pieces per day		
Recurring cost				
Category	**Number**	**Cost**	**Time**	**Total Cost**
Nicorette gum (2mg)	30 days	RM1.75 / gum / day	Average 6 pieces per day	RM219.60
			Total cost	RM219.60
			Total cost per year	RM3832.50

Table 8: Comparison of Annual Costs for Smoking Cessation Programme Between the Usual and Maximum Dosage Groups

Activities	Usual dosage group	Maximum dosage group
Smoking counselling	RM449.94	RM899.88
Annual blood profile	RM127.95	RM127.95
Daily Nicorette gum	RM2671.78	RM3832.50
Total yearly cost	**RM 3249.67**	**RM 4860.33**

This study demonstrated that the maximum dosage of Nicorette gum (4mg) was more costly than the usual dosage (2mg), with annual per-patient costs of RM 4,860.33 and RM 3,249.67, respectively. These costs are considerably higher than those reported in Universiti Sains Malaysia (USM), where the annual cost per client was approximately RM 414.75 (Ibrahim et al., 2016). The discrepancy is largely attributable to differences in costing methods: the USM study excluded annual blood tests and other clinical investigations, while our analysis incorporated staff time, consumables, and laboratory procedures. Thus, the present study provides a more comprehensive estimation of the financial requirements for operating a structured smoking cessation programme in a tertiary educational setting.

The difference in costs between the two regimens reflects both the higher unit price of 4mg gum and the more frequent follow-up visits required for patients on higher doses. International evidence suggests that higher doses may lead to better abstinence outcomes, particularly among smokers with higher nicotine dependence. Kornitzer et al. (1987) reported abstinence rates of 32.2% with 4mg gum compared to 22.3% with 2mg at one year, while Garvey et al. (2000) found no significant difference overall, though higher-dependence subgroups benefitted more from 4mg gum. These mixed findings highlight the need for future cost-effectiveness analyses to determine whether the additional costs of higher dosages translate into meaningful long-term health and economic benefits.

Our results also align with international studies showing variation in programme costs. For example, annual smoking cessation costs were estimated at RM 889 in China (Qin et al., 2022) and RM 1,506 in Japan (Nakamura et al., 2013), both lower than the UMS programme. Exchange rate fluctuations and differences in healthcare delivery models partly explain these discrepancies. Notably, Sweden has demonstrated that high-intensity interventions may be more cost-effective in the long run than low-intensity approaches (Feldman et al., 2019). Similarly, USM reported counselling as the most cost-effective component of cessation programmes, with a success rate of 29.1% (Ibrahim et al., 2016), underscoring the importance of integrating behavioural support with pharmacotherapy.

The UMS programme incorporates evidence-based practices recommended in international guidelines, including provider-led counselling and pharmacological therapy (Fiore et al., 2008; Adsit et al., 2020). Research consistently supports combining NRT with structured behavioural support to improve quit rates, particularly in institutional settings (Tsoh et al., 1997; Reid et al., 2016). Our study adds to this body of evidence by quantifying the financial inputs required to sustain such interventions in a Malaysian university healthcare setting.

Limitations of this study include the small sample size (20 patients), single-site analysis, and one-year observation period, which may limit generalizability. Additionally, regional variations in drug pricing and service delivery may affect cost estimates elsewhere. Despite these limitations, the findings provide a valuable baseline for planning and budgeting smoking cessation services in similar tertiary institutions.

The findings highlight the need for sustainable funding models to support university-based smoking cessation services. Policymakers and institutional decision-makers must balance affordability with effectiveness, considering whether to expand coverage using lower-cost regimens or to prioritize higher-cost, higher-dose regimens for patients with greater nicotine dependence. Incorporating routine cost analyses into programme planning can guide more efficient resource allocation and contribute to the long-term sustainability of smoking cessation initiatives.

CONCLUSION

This study demonstrates that operating a structured smoking cessation programme requires substantial financial resources, with the maximum Nicorette dosage (4mg) incurring higher costs than the usual dosage (2mg). By detailing the cost components, the findings provide important evidence for healthcare planners and policymakers in allocating budgets and justifying investments in university-based cessation services. Sustainable funding models are essential to balance affordability with treatment effectiveness, ensuring that programmes remain viable and accessible to those in need. Future research should extend this work through comprehensive cost-effectiveness analyses that compare different nicotine replacement regimens, incorporate long-term health outcomes, and evaluate scalability across diverse healthcare and educational settings. Such evidence will be critical for guiding policy and sustaining the impact of smoking cessation initiatives in Malaysia and beyond.

Ethical Considerations

All data collected were handled with strict confidentiality. No identifiable patient information, including names or any details that could potentially reveal the identity of the participants, was recorded or disclosed. All data were used solely for academic and research purposes. The study adhered to ethical research principles, including respect for privacy, protection of sensitive information, and compliance with relevant research ethics standards and institutional guidelines.

Acknowledgement

The authors would like to express sincere appreciation to the staff and administration of Pusat Rawatan Warga UMS and Hospital UMS for their cooperation and support which enabled the researchers to successfully complete the assessment.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the analysis and reporting of this study.

Funding

This work was fully self-funded by the researchers. No external grants or institutional financial support were received.

REFERENCES

Adsit, R. T., Alberg, A. J., Augustson, E., Babb, S., Baker, T. B., Checkley, W., Colditz, G. A., Creamer, M., Dorans, K. S., & England, L. (2020). Smoking Cessation. In R. A. Grana, A. Malarcher, J. M. Samet, G. L. Scahauer, J. Unger, B. A. King, L. A. Norman, & P. L. Taylor (Eds.), *US Department of Health and Human Services* (Vol. 204, Issue 2). https://doi.org/10.1097/JU.0000000000001114

Baker, C. L., Flores, N. M., Zou, K. H., Bruno, M., & Harrison, V. J. (2017). Benefits of quitting smoking on work productivity and activity impairment in the United States, the European Union and China. *International Journal of Clinical Practice*, *71*(1), e12900. https://doi.org/10.1111/IJCP.12900

Chang, L.-C., & Loh, K.-Y. (2022). Personalized Approach in Smoking Cessation of a Rural Community Health Clinic in Malaysia. *Asian Journal of Education and Social Studies*, *30*(1), 19–23. https://doi.org/10.9734/AJESS/2022/V30I130711

Dai, X., Gakidou, E., & Lopez, A. D. (2022). Evolution of the global smoking epidemic over the past half century: strengthening the evidence base for policy action. *Tobacco Control*, *31*(2), 129–137. https://doi.org/10.1136/TOBACCOCONTROL-2021-056535

Feldman, I., Helgason, A. R., Johansson, P., Tegelberg, Å., & Nohlert, E. (2019). Cost-effectiveness of a high-intensity versus a low-intensity smoking cessation intervention in a dental setting: long-term follow-up. *BMJ Open*, *9*(8), e030934. https://doi.org/10.1136/BMJOPEN-2019-030934

Fiore MC, CR, J., TB, B., WC, B., NL, B., SJ, C., SF, D., ES, F., MG, G., & CG, H. (2008). A Clinical Practice Guideline for Treating Tobacco Use and Dependence: 2008 Update: A U.S. Public Health Service Report The Clinical Practice Guideline Treating Tobacco Use and Dependence 2008 Update Panel, Liaisons, and Staff. *Am J Prev Med*, *35*(2), 158–176. https://doi.org/10.1016/j.amepre.2008.04.009.A

Garvey, A. J., Kinnunen, T., Nordstrom, B. L., Utman, C. H., Doherty, K., Rosner, B., & Vokonas, P. S. (2000). Effects of nicotine gum dose by level of nicotine dependence. Nicotine & tobacco research: official journal of the Society for Research on Nicotine and Tobacco, 2(1), 53–63. https://doi.org/10.1080/14622200050011303

Ibrahim, M.I., Magzoub, N.A., Maarup,N (2016). University-Based Smoking Cessation Program Through Pharmacist-Physician Initiative: An Economic Evaluation, J Clin of Diagn Res. 10(2), LC11-LC15. https://doi.org/10.7860/JCDR/2016/17641.7325

Kornitzer, M., Kittel, F., Dramaix, M., & Bourdoux, P. (1987). A double-blind study of 2 mg versus 4 mg nicotine-gum in an industrial setting. Journal of psychosomatic research, 31(2), 171–176. https://doi.org/10.1016/0022-3999(87)90073-0

Nakamura, K., Sakurai, M., Miura, K., Morikawa, Y., Nagasawa, S. Y., Ishizaki, M., Kido, T., Naruse, Y., Suwazono, Y., & Nakagawa, H. (2013). Nicotine Dependence and Cost-Effectiveness of Individualized Support for Smoking Cessation: Evidence from Practice at a Worksite in Japan. PLOS ONE, 8(1), e55836. https://doi.org/10.1371/JOURNAL.PONE.0055836

Reid, R. D., Pritchard, G., Walker, K., Aitken, D., Mullen, K. A., & Pipe, A. L. (2016). Managing smoking cessation. *Canadian Medical Association Journal*, *188*(17–18), E484–E492. https://doi.org/10.1503/cmaj.151510

Reitsma, M. B., Kendrick, P. J., Ababneh, E., Abbafati, C., Abbasi-Kangevari, M., Abdoli, A., Abedi, A., Abhilash, E. S., Abila, D. B., Aboyans, V., Abu-Rmeileh, N. M., Adebayo, O. M., Advani, S. M., Aghaali, M., Ahinkorah, B. O., Ahmad, S., Ahmadi, K., Ahmed, H., Aji, B., … Zuniga, Y. H. (2021). Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990â€“2019: a systematic analysis from the Global Burden of Disease Study 2019. *The Lancet*, *397*(10292), 2337–2360. https://doi.org/10.1016/S0140-6736(21)01169-7

Tsoh, J. Y., McClure, J. B., Skaar, K. L., Wetter, D. W., Cinciripini, P. M., Prokhorov, A. V., Friedman, K., & Gritz, E. (1997). Smoking Cessation 2: Components of Effective Intervention. *Behavioral Medicine*, *23*(1), 15–27. https://doi.org/10.1080/08964289709596363

Qin, T., Jin, Q., Li, X., Bai, X., Qiao, K., Gu, M., & Wang, Y. (2022). A Cost-Effectiveness Analysis of Comprehensive Smoking-Cessation Interventions Based on the Community and Hospital Collaboration. Frontiers in Public Health, 10, 853438. https://doi.org/10.3389/FPUBH.2022.853438/BIBTEX

Zamzuri, M. A. I. A., Kamarudin, S. A. A., Ariffin, A. H., Ibrahim, A. A., Othman, M. H., Johari, A., Ali, N. K. M., Abd Rashid, M. F., Hassan, M. R., Ming, S. S., & Pang, N. T. P. (2021). Rate of smoking cessation and factors associated with successful quit smoking in Seremban District of Malaysia. *Clinical Epidemiology and Global Health*, *12*, 100862. https://doi.org/10.1016/j.cegh.2021.100862