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Geographical Accessibility and Dental Service Cost in Client-Centered Perspective under Universal Health Coverage Between Community Medical Units and the Dental Clinic at Hatyai Hospital

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Abstract:

Objective: This study aimed to examine the geographical accessibility and cost in client-centered perspective associated with dental services at community medical units (CMUs) and dental clinics at Hatyai Hospital, Thailand.

Material and Methods: A total of 380 dental patients from three CMUs under Hatyai Hospital were included, with proportional sampling based on patient volume at each unit. Data on service-related costs, travel distance, and transportation modes were collected using a structured questionnaire. Client costs were assessed for non-medical out-of-pocket expenses (transportation, food, lost wages), as all patients were covered under the Universal Coverage Scheme and did not incur medical treatment costs. Descriptive statistics and analysis of variance (ANOVA) were applied for data analysis.

Results: The findings revealed statistically significant differences in both travel distance and travel time among the three CMUs. Patients from CMU3 had the longest median [Interquartile Range (IQR)] distance of 15.0 (5.8) kilometers (KM). Motorcycles were the predominant mode of transportation, although automobile use increased from 20.3% to 39.2% during hospital visits. While median (IQR) total costs of CMUs were not significantly different from those at the hospital, visits to the hospital incurred significantly higher out-of-pocket costs (p-value<0.001). The median (IQR) of total client costs was 46.2 (117.4), 39.5 (117.6), and 37.5 (101.5) THB for CMU1-3.

Conclusion: The main cost components were transportation, food/snacks, and lost income due to the time spent receiving care. These findings underscore the impact of geographical access on service utilization and the economic burden on dental patients in semi-urban settings.

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Introduction

The Global Oral Health Status Report[1] from the World Health Organization (WHO) highlights the critical importance of preventive measures and the integration of oral health services into Universal Health Coverage (UHC) as a means to reduce disparities in access to care and treatment. This report emphasizes that oral diseases are a global public health issue that affects billions of people, particularly those in low-income countries and disadvantaged groups. In Thailand, the UHC strategy is implemented through a primary care approach, aligning with the Ministry of Public Health's policy on health system development as outlined in the Service Plan. The Service Plan includes the expansion of public access to dental care and the provision of dental services as key strategies to enhance equity and improve the population's oral health. However, a significant proportion of the population still faces unmet dental care needs. The study on factors related to the accessibility of dental care among the elderly in Thailand found that service costs, along with geographical barriers such as distance, travel time, and transportation methods, remain major obstacles to service utilization[2,3]. Hatyai Hospital, one of the largest tertiary care centers in Southern Thailand, serves as a key referral hub in the region. To alleviate overcrowding of basic oral health services at the hospital and to enhance access for the broader population, the Community Medical Unit (CMU) model has been introduced as a decentralized service delivery approach[4].

Despite ongoing efforts to expand access to oral health services under Thailand's UHC, there remains limited evidence regarding how geographical accessibility and out-of-pocket dental service costs affect patient experiences and service utilization[5]. In particular, it remains uncertain whether decentralized Community Medical Units (CMUs) can lower patients' non-medical expenses and travel burden compared with tertiary dental clinics, once socio-economic and geographic factors are taken into account.

This gap in knowledge limits the ability of policymakers and service planners to design equitable and efficient oral health delivery systems.

This study aimed to evaluate the geographical accessibility and client costs of dental care at CMUs and the Dental Clinic at Hatyai Hospital within the context of UHC. By generating evidence on barriers to access and financial burden, the study sought to inform strategies for enhancing the efficiency and equity of dental services. The findings are expected to contribute to policy recommendations on resource allocation, infrastructure development, and the reduction of oral health disparities issues that are of global relevance, particularly in low- and middle-income countries. Based on these objectives, study hypotheses were developed to facilitate comparisons between CMUs and the Dental Clinic at Hatyai Hospital. The hypotheses and expected differences are outlined in Table 1, and a geographical map of the CMUs is also provided in Figure 1.

Material and Methods

This study employed a cross-sectional analytical design to compare dental-service costs and geographical accessibility between CMUs and the Dental Clinic at Hatyai Hospital, from the perspective of service users under Thailand's UHC System. The study population included individuals who received dental services at CMUs affiliated with Hatyai Hospital. To assess geographical accessibility, CMU1 was in the municipal area, located adjacent to Hatyai Hospital, and served as the reference site, representing the most centrally located community-based dental unit. CMU2 and CMU3 provide primary dental care services

across three urban subdistricts each. Both units operate within semi-urban settings and play a key role in expanding access to care under Thailand's Universal Health Coverage System. The Dental Clinic at Hatyai Hospital was used as a comparator because it functions as the main tertiary referral center, providing both basic and specialized services under the UHC system. Patients may attend not only through referral from CMUs but also when already seeking other medical care at the hospital. This comparison allows the additional non-medical burden of travelling to a central hospital, rather than using decentralized CMUs, to be quantified.

The study population comprised individuals who utilized dental services at CMUs that operated on working

Table 1 Study hypotheses and expected differences

Hypothesis	Comparison variables	Expected difference	Rationale
Hypothesis 1 Across CMUs	- Distance from home to CMUs - Total client cost from home to CMUs	No significant differences	All CMUs were intended to serve nearby residents in their respective catchment zones.
Hypothesis 2 CMUs vs. Dental Clinic at Hatyai Hospital	- Distance from home to dental clinic at Hatyai Hospital - Total client cost from home to dental clinic at Hatyai Hospital	Significant differences	CMU1 is located adjacent to the Dental Clinic at Hatyai Hospital and was created primarily to relieve congestion in the municipal area. Other areas with no CMUs nearby have access to dental clinic at Hatyai Hospital.

CMUs=Community Medical Units

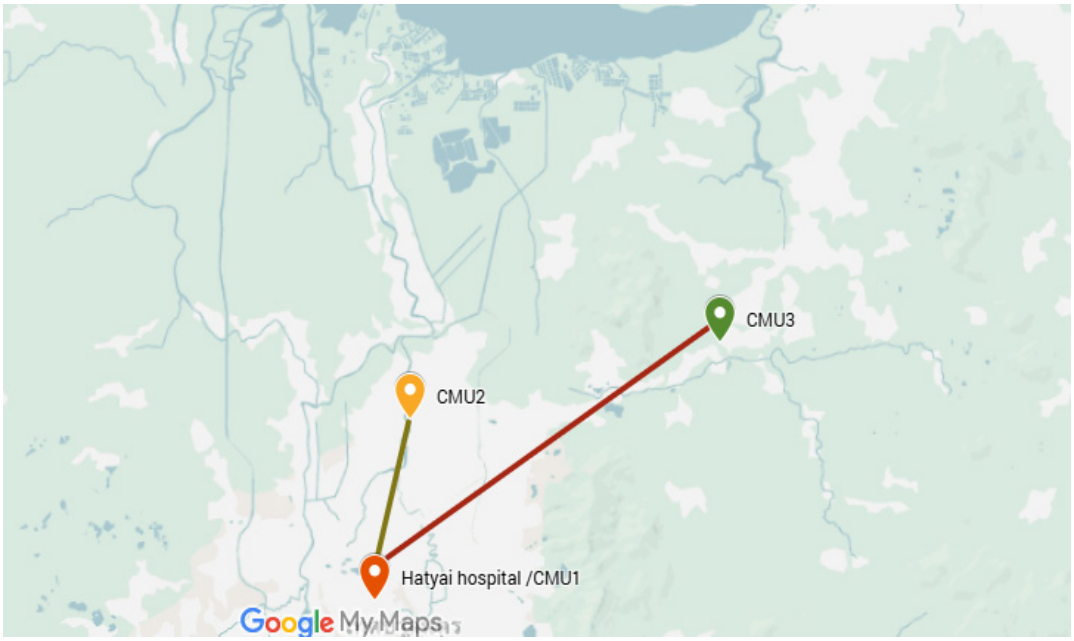

Figure 1 Location of Community Medical Unit (CMU)1/Dental clinic at Hatyai Hospital, CMU2 and CMU3

days during the 2024 fiscal year (FY). FY2024 data were used as the sampling frame since FY2025 data were not yet available at the time of study implementation. A total of 7,220 clients were recorded: 2,770 at CMU1, 2,943 at CMU2, and 1,507 at CMU3. The sample size was calculated using Yamane's formula[6] with a total population of 7,220 and a margin of error of 5%, resulting in a required sample size of 379 participants. A total of 380 participants were enrolled, and a proportional-to-size sampling approach was applied based on the service volume at each CMU, yielding 146 participants from CMU1, 155 from CMU2, and 79 from CMU3. Data collection was conducted from April to June 2025.

Data were collected using a structured questionnaire developed based on an extensive review of relevant literature and previous studies involving populations similar to the target group. The questionnaire was designed to align closely with the study objectives and consisted of closed-ended questions divided into three sections: general demographic information, access to dental services, and client costs. The questionnaire assessed access to dental services by asking respondents about their travel distance from home to the dental facility, the mode of transportation used (e.g., private car, public transportation, or walking), and the total travel time. Travel time was defined to include the journey to the facility, parking for private car users or waiting time for public transportation, waiting for treatment, the treatment duration itself, and the return journey home. Client costs for dental care utilization were also assessed. Transportation expenses were tracked individually and included fuel, parking fees, and public transportation costs. Lost income was calculated by dividing reported daily earnings by an 8-hour working day (480 minutes), resulting in income per minute, which was then multiplied by total time away from work. Additional out-of-pocket expenses, such as food and snacks during service use, were also considered. Client costs were calculated as out-of-pocket expenses and included both medical and non-medical costs. However, patients did not pay medical care costs as these were covered by the Universal Coverage (UC) Scheme. Therefore, the client costs in this study referred mainly to non-medical expenses, including transportation, food and beverages, and lost wages. These costs were assessed based on the most recent dental visit.

Content validity was evaluated by three experts using item–objective congruence (IOC). Items were considered acceptable when endorsed by at least two of the three experts, and further revisions were made according to their recommendations until all items met the standard. Test–retest reliability was assessed with a two-week interval, yielding an overall Cohen's kappa coefficient of 0.93, indicating excellent agreement. The questionnaires were administered to patients across all three CMUs. Inclusion criteria included: individuals under 18 years of age (with a parent or guardian completing the questionnaire on their behalf), enrollment in the UHC Program at Hatyai Hospital, and prior utilization of dental services at both the CMUs and the hospital-based dental clinic.

Data were analyzed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize sociodemographic characteristics, access variables, and client costs. Total client costs and distances, which were not normally distributed, were compared among groups using the Kruskal–Wallis test. Post-hoc pairwise comparisons were performed with Dunn's test, applying the Bonferroni adjustment for multiple testing. Differences in mode of transportation across community medical units were analyzed using the Chi-square test.

The Human Ethics Committee for Research in Humans at Hatyai Hospital has approved this research investigation, with the project code HYH EC 025-68-01. The approval date is April 2, 2025. For individuals under the age of 18, their parents completed the questionnaire.

All parents and children under 18 were notified. Data confidentiality measures included recording all information using ID codes rather than as personal data.

Results

The questionnaire was completed by 380 individuals, with 71.6% of the respondents being service users and the remaining individuals being parents/guardians. Seventy percent of the sample population consisted of females. The sample group's age distribution was relatively uniform across various age groups, with the 45–59 age group being the largest at 24.7%; 43.2% of respondents had an education level below lower secondary, while 22.1% had a bachelor's degree or higher. The majority of respondents were Buddhist (68.2%). In terms of employment status, students comprised the plurality (34.7%), followed by general laborers (31.1%). The majority of respondents (39.2%) reported an aggregate family income of 5,000–10,000 THB/month. And 55.8% of the sample group had an adequate income to cover their expenses (Table 2).

Table 3, Mode of transportation: CMU and the hospital were accessed by each group of service users using distinct modes of conveyance, with statistically significant differences (p–value=0.037) and p–value<0.001. Motorcycles were identified as the most frequently employed primary mode of transportation. However, there was a rise in the use of vehicles, particularly in the CMU3 group, where 39.2% of individuals used cars to travel to the hospital, compared to only 20.3% who used cars to travel to the CMU. The CMU3 group's walking/cycling rate, which was 7.6% when traveling to the CMU, decreased to 2.5% when traveling to the hospital.

Table 4 reveals the median (IQR) total client cost: home to CMU1 was 46.2 (117.4) THB, home to the Dental Clinic at Hatyai Hospital was 61.0 (148.3) THB, home to CMU2 was 39.5 (117.6) THB, home to the Dental Clinic at Hatyai Hospital was 75.9 (179.9) THB, home to CMU3 was 37.5 (101.5) THB, and home to the Dental Clinic at Hatyai Hospital was 135.2 (227.2) THB.

Table 2 Participant characteristics (n=380)

Variables	n (%)
Respondent	
Clients	272 (71.6)
Parents/care givers	108 (28.4)
Sex	
Male	114 (30)
Female	266 (70)
Age (years)	
<18	84 (22.1)
18–29	87 (22.9)
30–44	52 (13.7)
45–59	94 (24.7)
≥60	63 (16.6)
Religion	
Buddhist	259 (68.2)
Christian	4 (1.1)
Muslim	117 (30.8)
Education	
Lower than grade 9 or equivalent	164 (43.2)
Grade 10–12 or equivalent	98 (25.8)
Diploma or equivalent	34 (8.9)
Higher than bachelor degree or equivalent	84 (22.1)
Occupation	
Student	132 (34.7)
Company employee	13 (3.4)
Business owner	59 (15.5)
Farmers	24 (6.3)
General labor for hire	118 (31.1)
Not employed	34 (8.9)
Family income	
Less than 5,000 baht	68 (17.9)
5,000–10,000 baht	149 (39.2)
10,001–15,000 baht	95 (25.0)
More than 15,000 baht	68 (17.9)
Income satisfaction	
Enough	212 (55.8)
Enough, with some left over	42 (11.1)
Not enough	126 (33.2)

For the median (IQR), client cost components consisted of transortation costs, lost income, and food/beverage costs. Median (IQR) transportation costs: home to CMU1 was 2.1 (4.3) THB, home to the Dental Clinic at Hatyai Hospital was 2.3 (4.4) THB, home to CMU2 was 3 (3.6) THB, home to the Dental Clinic at Hatyai Hospital was 5.5 (6.2) THB, home to CMU3 was 3.8 (3.1) THB,

Table 3 Geographical accessibility represented by mode of transportation between CMUs and Dental clinic at Hatyai Hospital

Geographical accessibility	Group	Walking/bicycle n (%)	Motorcycle n (%)	Car n (%)	χ^2 df	p-value
Home to CMU	CMU1	13 (8.9)	123 (84.3)	10 (6.8)	χ^2=10.187 df=4	0.037
	CMU2	12 (7.7)	124 (80.0)	19 (12.3)		
	CMU3	6 (7.6)	57 (72.2)	16 (20.3)		
Home to Dental Clinic at Hatyai Hospital	CMU1	9 (6.2)	128 (87.7)	9 (6.2)	χ^2=42.195 df=4	<0.001*
	CMU2	8 (5.2)	123 (79.4)	24 (15.5)		
	CMU3	2 (2.5)	46 (58.2)	31 (39.2)		

*=chi-square test, significance at p-value<0.05 CMU1 and Dental clinic at Hatyai Hospital are situated in the same location
IQR=interquartile range, CMUs=Community Medical Units

Table 4 Total Client cost at CMU and the Dental clinic at Hatyai Hospital classified by cost details

Group	Cost details	total client cost: Home to CMU		Total Client Cost: Home to Dental Clinic at Hatyai Hospital	
		Median (IQR)	Min - Max	Median (IQR)	Min - Max
CMU1	Total cost	46.2 (117.4)	0 - 635.1	61.0 (148.3)	0 - 635.1
	Transportation	2.1 (4.3)	0 - 144.4	2.3 (4.4)	0 - 144.4
	Income lost	0.0 (76.6)	0 - 333.3	0.0 (89.1)	0 - 375.0
	Food/beverage	0.0 (72.5)	0 - 300.0	0.0 (100)	0 - 300.0
CMU2	Total cost	39.5 (117.6)	0 - 404.8	75.9 (179.9)	0 - 728.6
	Transportation	3.0 (3.6)	0 - 45.4	5.5 (6.2)	0 - 75.9
	Income lost	0.0 (68.8)	0 - 400.0	0.0 (93.8)	0 - 600.0
	Food/beverage	0.0 (0.0)	0 - 200.0	0.0 (100.0)	0 - 300.0
CMU3	Total cost	37.5 (101.5)	0 - 306.1	135.2 (227.2)	0 - 571.9
	Transportation	3.8 (3.1)	0 - 53.6	12.5 (50.8)	0 - 250.0
	Income lost	0.0 (37.5)	0 - 187.5	0.0 (112.5)	0 - 375.0
	Food/beverage	0.0 (0.0)	0 - 200.0	0.0 (120.0)	0 - 300.0

IQR=interquartile range, CMUs=Community Medical Units

and home to the Dental Clinic at Hatyai Hospital was 12.5 (50.8) THB. Median (IQR) income lost components: home to CMU3 was 0.0(37.5) THB, while home to the Dental Clinic at Hatyai Hospital was 0.0 (112.5) THB. Median food/beverage costs: home to CMU3 was 0.0 (0.0) THB, while home to the Dental Clinic at Hatyai Hospital was 0.0 (120.0) THB.

According to Table 5, the median total client cost from home to the CMUs did not differ significantly among CMU1, CMU2, and CMU3 (Kruskal–Wallis test, p-value=0.580). In contrast, the total client cost from home to the Dental Clinic at Hatyai Hospital differed significantly across CMUs (Kruskal–Wallis test, p-value<0.001), with post-hoc comparisons showing significant differences between CMU1 and CMU3 (p-value<0.001) and between CMU2 and CMU3 (p-value=0.004). This difference was largely attributable to the longer distance from CMU3 to the hospital, whereas medical care costs and income loss did not differ between facilities. The median distance from home to CMUs 2 and 3 did not differ significantly (p-value=0.207), indicating that both units serve populations in nearby locations. The distance to CMU1 differed significantly from both CMU2 and CMU3 (p-value<0.001). This could be explained by the fact

Table 5 Compares the differences in total client cost and distance from home to CMU and home to Dental clinic at Hatyai Hospital

CMU	Home to CMU: total client cost			Home to Dental Clinic at Hatyai Hospital: total client cost		
	Median (IQR) Min–max	Kruskal–Wallis# χ^2, df, p–value	p–value of post–hoc test	Median (IQR) Min–max	Kruskal–Wallis# χ^2, df, p–value	p–value of post–hoc test
CMU1	46.2 (117.4) 0 – 635.1	χ^2=1.091 df=2		61.0 (148.3) 0–635.1	χ^2=24.989 df=2	CMU1 vs CMU2=0.083 CMU1 vs CMU3=<0.001*
CMU2	39.5 (117.6) 0 – 404.8	p–value 0.580	NA	75.9 (179.9) 0–728.6	p–value<0.001*	CMU2 vs CMU3=0.004*
CMU3	37.5 (101.5) 0 – 306.1			135.2 (227.2) 0–571.9		
CMU	**Home to CMU: distance**			**Home to Dental Clinic at Hatyai Hospital: distance**		
	Median (IQR) Min–max	**Kruskal–Wallis# χ^2, df, p–value**	**p–value of post–hoc test**	**Median (IQR) Min–max**	**Kruskal–Wallis# χ^2, df, p–value**	**p–value of post–hoc test**
CMU1	3.3 (4.6) 0.2–35.0	χ^2=28.656 df=2	CMU1 vs CMU2=<0.001* CMU1 vs CMU3=<0.001*	3.3 (4.6) 0.3–35.0	χ^2=153.055 df=2	CMU1 vs CMU2=<0.001* CMU1 vs CMU3=<0.001*
CMU2	4.5 (4.6) 0.2–21.0	p–value<0.001*	CMU2 vs CMU3=0.207	7.1 (8.4) 0.3– 19.0	p–value<0.001*	CMU2 vs CMU3=<0.001*
CMU3	5.7 (3.9) 0.1–13.0			15.0 (5.8) 5.3–25.0		

#Kruskal–Wallis test was used and Dunn's post–hoc test with Bonferroni correction was applied for pairwise comparisons.
*Significance at p–value<0.05, IQR=Interquartile range, CMUs=Community Medical Units

that CMU1 also serves residents from locations without a local CMU. All CMUs have dramatically different distances from home to the hospital clinic.

Discussion

This study explores the distance, mode of transportation, and costs from a client's perspective of the fundamental determinants of geographical accessibility to healthcare services. This will assist in the mitigation of concerns regarding costs, socioeconomic status, and the awareness of health issues[2,3,7], all of which have an impact on quality of life and the provision of equity in a population.

In our context, CMUs mainly provide basic dental services, including oral examinations, preventive interventions, simple restorations, and uncomplicated extractions. By contrast, the Dental Clinic at Hatyai Hospital offers a broader scope of care that covers both basic and specialized dental services, such as advanced restorative treatment, prosthodontics, endodontics, oral surgery, and other specialty procedures. Patients commonly seek care at the hospital clinic when they are already utilizing other medical services at the hospital, when they are referred from CMUs for specialized treatment, or when their residence is geographically closer to the hospital than to a CMU.

The variation in travel distance across the CMUs compared with the hospital underscores the importance of service decentralization in improving access to dental care. CMUs located nearer to residential areas can substantially reduce the travel burden, while facilities with a wider catchment area, such as CMU3, may still pose challenges for some populations. By contrast, the hospital dental clinic generally requires longer travel, reinforcing its role as a referral or specialized care center rather than a first point of access. These patterns suggest that well–distributed

CMUs can enhance equity by making preventive and routine services more accessible, particularly for individuals with limited mobility or without private vehicles. Travel time was not included as a comparison variable because its value is considerably affected by external factors such as mode of transportation and availability. Instead, travel distance and total client cost, which are typically viewed as more consistent measurements, were considered more accurate markers of geographic accessibility in assessing a CMU site. From a policy perspective, optimizing the geographic placement of CMUs could contribute to reducing disparities, lowering travel-related costs, and encouraging greater utilization of primary dental care services, while the hospital can remain focused on more complex treatments[7-9]. This is consistent with the concept of Penchansky and Thomas[10], who asserted that access to the service system is a critical element of healthcare quality. They also observed that distance and time are significant indicators of the "closeness" between patients and the service system, as evidenced by "service-seeking behavior."

Although this study did not directly analyze participants' income levels, the fact that all respondents accessed services through the UC Scheme indicates that they predominantly represent the lower-income populations who rely on public healthcare. For such groups, community medical centers are particularly important in reducing the barriers to care. Vulnerable populations in urban settings often experience difficulties accessing services due to a lack of private vehicles and limited public transport options, while elderly individuals in rural or remote areas may face additional challenges when required to travel independently. Locating dental services within CMUs, therefore, helps to alleviate these constraints by minimizing travel demands, improving equity in service access, and ensuring that those most dependent on the UC system can obtain timely and affordable care[7,8,11].

The total cost of services for patients at all three community medical centers was not significantly different. Nevertheless, patients from CMU3, the most remote unit, incurred substantially higher total service costs than those from CMU1 and CMU2 when they sought services at the hospital. This is indicative of the heightened financial burden that patients experience as a result of the cost of travel, the opportunity costs associated with lost income during travel and while waiting for services, and the cost of food and beverages during travel or while waiting for services. This can potentially affect their long-term health maintenance and quality of life, as well as their decision to seek assistance. This is consistent with the notion of non-medical costs; these concealed expenses have a long-term impact on patients' quality of life and their service-seeking behavior[12]. The nature of out-of-pocket expenses, which can be a significant barrier to access for vulnerable groups, is reflected in the fact that the majority of the cost of dental services falls on the patients themselves. This is particularly true in the context of Thailand, where there is spatial inequality between urban and rural areas. It is proposed that poverty is not only an economic constraint but also a barrier to direct access to services, particularly in developing countries[13]. Consequently, the findings of this investigation underscore the significance of disseminating service units in a manner that is both comprehensive and accessible, particularly for populations residing in remote areas, in order to mitigate the necessity of traveling to large hospitals. In terms of health economics and fairness in access to services, the presence of service units in the community that are readily accessible and adequately equipped will result in a substantial reduction in costs for service users.

Even though the study included clients who had used both CMUs and the hospital clinic, which may have introduced selection bias, the impact is likely to be minimal, as less than 5% of the local population had never used the hospital clinic, indicating its long-standing presence in comparison to the relatively recent establishment of CMUs. Furthermore, using recent customer cost data

reduced reliance on the long-term recall of expenses and trip time, minimizing recall bias. Nonetheless, some limits exist. First, multivariable adjustment was not used to account for potential residual confounding. Variables such as age, gender, income, occupation, and car access may have influenced service selection and pricing. Second, no sensitivity studies were conducted to determine the robustness of the findings. Finally, the study was conducted in an urban/semi-urban setting, which limits its applicability to rural Thailand, where accessibility issues may differ. Future research should therefore expand on these benefits while addressing the remaining shortcomings of using longitudinal or mixed-method designs, multivariable and sensitivity analyses, and the inclusion of rural populations. Such efforts would yield more complete and rigorous evidence to inform policy for the equitable and efficient delivery of oral health care.

Conclusion

Local services are the solution to equality. Research results suggest that a primary care-oriented healthcare system is instrumental in enhancing access to services and reducing costs for both the general population and vulnerable groups, particularly in the context of Thailand, where income and service structure disparities exist. Supporting the widespread establishment of primary dental care units at the community level, ensuring that community health centers are adequately equipped with personnel, equipment, and appointment systems, providing mobile dental services in remote areas or offering transportation subsidies in rural areas, and developing a system for compensating non-medical costs such as travel expenses and lost income for low-income individuals, the elderly, vulnerable groups, and both formal and informal workers are among the key policy recommendations.

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Conflict of interest

The authors declare no conflict of interest.

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