SERVICE AREA AND SPATIAL DISTRIBUTION PATTERN OF DRUGSTORES IN NONTHABURI PROVINCE

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ABSTRACT: The Medicine Pickup at Neighborhood Drugstores Project is an initiative policy to reduce hospital overcrowding by providing patients with an alternative to receiving medication after meeting a doctor. This program enables patients to receive their medicines at participating pharmacies, avoiding waiting in line at hospitals. Nonthaburi has 17 pharmacies in its network to serve the public. However, the distribution of these pharmacies is not evenly spread throughout the area, mainly concentrated in Mueang Nonthaburi and Pak Kret districts. This research aims to analyze the spatial distribution and serviceable area of pharmacies participating in the program in Nonthaburi. The research used various methods to increase coverage, including Nearest Neighbor Index, proximity index, network analysis, location-allocation analysis techniques, and scenario analysis. Based on the findings, the study identifies a clustered distribution of participating pharmacies, with some areas lacking coverage. The research proposes adding five more pharmacies to cover 82.74% of the study area and up to 22 more pharmacies to expand coverage to 95% of the area, covering 417 study villages. The study also identifies 27 participating pharmacies that do not cover all services, suggesting a need to expand the scope of service to more study areas in Nonthaburi.

1. INTRODUCTION

1.1 Introduction /Rational

The project of receiving medication at local pharmacies is a part of the policy to alleviate congestion in hospitals by offering the opportunity for the public to receive medications at participating pharmacies voluntarily or obtain medication from nearby or community pharmacies as an alternative after consulting with healthcare professionals. This approach aims to avoid waiting in hospital queues for medication. Among the participants in the project, the age group that participates the most willingly is the 61-75 years old, comprising 11,765 individuals (40.16%). Following this group are patients aged 46-60 years, totaling 9,326 individuals (31.83%), patients aged 75 years and above, numbering 3,825 individuals (13.06%), and those aged 31-45 years, accounting for 2,517 individuals (8.60%).

The top five most prevalent medical conditions for which medication is obtained from pharmacies are as follows: other chronic conditions that can be managed (12,896 cases, 44.01%), hypertension and other chronic conditions (4,663 cases, 15.91%), hypertension and diabetes (4,085 cases, 13.94%), hypertension alone (3,183 cases, 10.86%), and notably, patients with psychiatric disorders receive medication from pharmacies more than diabetic patients, with 1,329 cases (4.54%) versus 1,096 cases (3.74%) respectively (National Health Security Office, 2021).

To enhance convenience for the public, hospitals from various provinces, including Bangkok, have officially registered in the system, amounting to 500 hospitals, and 800 pharmacies have undergone training. Participating pharmacies must display the "Warm Community Pharmacy" sign on their storefronts. Participating pharmacies meet the following criteria: they are Type 1 pharmacies under the current classification and have passed the Good Pharmacy Practice (GPP) standards set by the Pharmaceutical Council. These pharmacies are open for at least 8 hours and have a pharmacist available during business hours. Pharmacists are willing to collaborate with healthcare units spread across different provinces, especially in densely populated urban areas. One such example is Nonthaburi province, which ranks

74th in terms of land area but has the second highest population density in Thailand after Bangkok. As of December 30, 2015, the total population was 1,193,711, with 559,119 males (46.83%) and 634,592 females (53.17%). The population within the municipal area is 55.79%, while 44.21% reside outside the municipal area. The population density is approximately 1,886 people per square kilometer, with an average of 4 individuals per household and 3,525 individuals per village (Nonthaburi Provincial Cultural Office, 2017).

In this context, Nonthaburi province has Phra Nangklao Hospital, which experiences the highest patient congestion among hospitals in the metropolitan area. Approximately 2,500 to 3,000 patients from outside the area receive services daily. The policy to reduce congestion has led to the distribution of medications through pharmacies in Health Zone 4, where Phra Nangklao Hospital is considered the second-largest hospital in the zone after Saraburi Hospital and the first in Nonthaburi province to participate in the local pharmacy medication distribution program. Furthermore, the Department of Mental Health's psychiatric hospitals have joined the project, such as Srinakharinwirot Hospital, becoming another participant in the medication distribution program in Nonthaburi province. This project involves a network of 27 pharmacies, mostly located in the Mueang Nonthaburi District and Pak Kret District. However, this coverage does not extend to the entire area (Health Promotion Support Fund Office, 2019).

Due to these circumstances, the research team aims to analyze pharmacies' spatial distribution patterns and service boundaries under the local pharmacy medication distribution program in Nonthaburi province. This preliminary analysis intends to provide guidance or a foundational model for relevant agencies to use as a preliminary database to support decision-making for future planning and expansion of the local pharmacy medication distribution program and other related projects. The goal is to improve the efficiency and coverage of service delivery

1.2 Objectives

The research endeavors to assess the service coverage of drugstores within Nonthaburi province, encompassing their distribution. This evaluation centers on three primary objectives. Firstly, it seeks to scrutinize the spatial distribution patterns of drugstores throughout Nonthaburi province. Secondly, it aims to analyze the service areas of drugstores participating in the Medicine Pickup at Neighbourhood Drugstores Project in Nonthaburi province. Lastly, it delves into the analysis of service areas concerning drugstores that meet the criteria for participation in the aforementioned project within Nonthaburi province.

1.3 Scope and Study Area

This research investigates spatial patterns within Nonthaburi province, which includes six districts: Tha Sai Noi, Bang Yai, Bang Kruai, Bang Bua Thong, Mueang Nonthaburi, and Pak Kret. Secondly, it aligns with three primary objectives 1) Spatial Distribution Analysis examines pharmacy spatial patterns in Nonthaburi, encompassing Type 1 pharmacies and contextual factors; 2) Service Area Analysis (Project Participants) assesses service boundaries of project-participating pharmacies, considering location, environment, and population; 3) Service Area Analysis (Participation Criteria) evaluates service boundaries of pharmacies meeting participation criteria. The study adopts a cross-sectional approach, analyzing data collected online from August to September 2022 and through a field survey conducted in November and December 2022. The target population comprises Type 1 pharmacies and project participants in Nonthaburi province.

2. MATERIALS AND METHODOLOGY

2.1 Data used and collections

Data collection methods encompass a multi-faceted approach, involving on-site field surveys to gather geographical coordinates of Type 1 pharmacies in Nonthaburi Province, data analysis collaboration with the National Health Security Office (NHSO) for project-participating pharmacy data, and retrieval of geographic and demographic data from various sources. These sources include the Geo-Informatics and Space Technology Development Agency (GISTDA) for road network data, the Ministry of Interior for village coordinates, the NHSO for pharmacy-related information, and the Ministry of Public Health's Food and Drug Administration for data on Type1 pharmacies.

2.2 Data Analysis

In the data analysis phase, we employ various techniques to gain insights into the research. Firstly, researchers utilize the Nearest Neighbor Index (NNI) to assess the spatial distribution of Type1 pharmacies, providing a measure of their

spatial clustering. Secondly, researchers apply Network Analysis in conjunction with Location-Allocation techniques. This involves an assessment of service coverage areas, factoring in road networks, geographic coordinates of Type1 pharmacies, and village coordinates. These analyses aid in identifying service areas and formulating hypothetical scenarios aimed at optimizing service coverage area.

3. RESULTS AND DISCUSSIONS

3.1 Spatial Distribution Pattern of Drugstores in Nonthaburi Province

The spatial distribution pattern of drug stores was analyzed in a total of 6 districts, namely Sai Noi, Bang Yai, Bang Bua Thong, Mueang Nonthaburi, and Pak Kret districts. This analysis was conducted using the current coordinates of drug stores of Type1 that participating in the project, and the drug stores that have not yet participated in the project including unqualified pharmacies. The Nearest Neighbor Index (NNI) method was used to calculate the nearest neighbor index value for 433 drugstores within the study area. The Spatial Distribution Pattern of Drugstores results are clustered as it indicated a Significance Level (P-Value) of 0 and a Z-Score of -19.708566. These values suggest the spatial distribution pattern of drug stores.

Drugstores Participating in the Program were observed they are predominantly located along main roads, easy to access, and convenient transportation for the local population. The majority of participating pharmacies are clustered around the Mueang Nonthaburi and Pak Kret districts, mainly because they are part of the network affiliated with Phra Nangklao Hospital and Sri Than Ya Hospital.

The drugstores that meet the criteria for participation in the project (qualified) are mostly clustered in Bang Bua Thong District. It was found that pharmacies in this District fulfill the required criteria. These criteria include equipment readiness, opening hours of more than 8 hours per day, and the availability of consultation areas, among others.

Pharmacies lacking the criteria for project participation (unqualified) are primarily clustered in Mueang Nonthaburi District. It was observed that this district has limitations, such as a lack of consultation space, insufficient lighting conditions, and a lack of medical equipment readiness, such as blood pressure monitors.

3.2 Service Area of Drugstores with the Medicine Pickup at Neighbourhood Drugstores Project Participation in Nonthaburi Province.

The project in the study area utilized coordinates data of pharmacies participating in the project obtained from the National Health Security Office (16 pharmacies) and additional direct field surveys which identified an additional 11 participating pharmacies, bringing the total to 27. The analysis included the coordinates of 511 villages and road networks, using network analysis techniques, Location-Allocation Analysis, and constraints based on the Maximize Coverage problem model. Population weights within the age range of 41-80 years were used, with a service radius of 5 kilometers as stipulated by the National Health Security Office.

The results showed that the 27 participating pharmacies covered services to only 199 out of the total 511 villages among the districts, Mueang Nonthaburi had the highest coverage with 72 villages while Sai Noi District had the lowest coverage with only 8 villages. This indicates that the 27 participating pharmacies have not been able to cover all services within the area.

Furthermore, on average, each pharmacist served 13,451 people. This is beyond the National Health Security Office's recommendation that one pharmacist should care for no more than 10,000 people.

3.3 Service Area of the Qualified Drugstores of the Medicine Pickup at Neighbourhood Drugstores Project in Nonthaburi Province.

Locations of 27 participating pharmacies and coordinates data of pharmacies that have the required characteristics but have not yet participated in the program. Additionally, coordinates data of 511 villages and road networks were included. Network analysis techniques, Location-Allocation Analysis, and constraints based on the Maximize Coverage problem model were applied. Population weights within the age range of 41-80 years were used, with a service radius of 5 kilometers as stipulated by the National Health Security Office.

Furthermore, the Maximize Market Share method was used to calculate the coverage percentage of the area, and the Target Market Share method was employed to determine the coverage percentage of the area at 80%. This resulted in the addition of 5 drugstores and 22 drugstores, producing a total of 3 outcomes:

1. ***Current Service Coverage:*** Drugstores Participating in the Project from 2019 - present, totaling 27 locations. (Figure 1), These are located in five districts: Mueang Nonthaburi 15 stores, Pak Kret 9 stores, one each in Bang Bua Thong, Bang Kwai, and Pak Kret District. covering 199 villages, accounting for 59.09% of the total data.

2. ***Scenario Analysis (Increase 5 additional pharmacies):*** By adding 5 more drugstores in three districts, including 2 in Bang Yai, 2 in Bang Bua Thong, and 1 in Bang Kwai District, the coverage area expands to 325 villages, representing 82.74% of the total data. (Figure 2)

3. ***Scenario Analysis (Increase 22 additional pharmacies):*** By adding 22 more drugstores in six districts by further expanding the alternative areas to cover more than 95% of the total data, 22 drugstores are added, including 4 in Sai Noi, 3 in Bang Yai, 4 in Bang Bua Thong, 5 in Bang Kwai, 3 in Pak Kret, and 3 drugstores in Mueang Nonthaburi. This brings the coverage to a maximum extent, covering 417 villages out of 511 villages in total. (Figure 3)

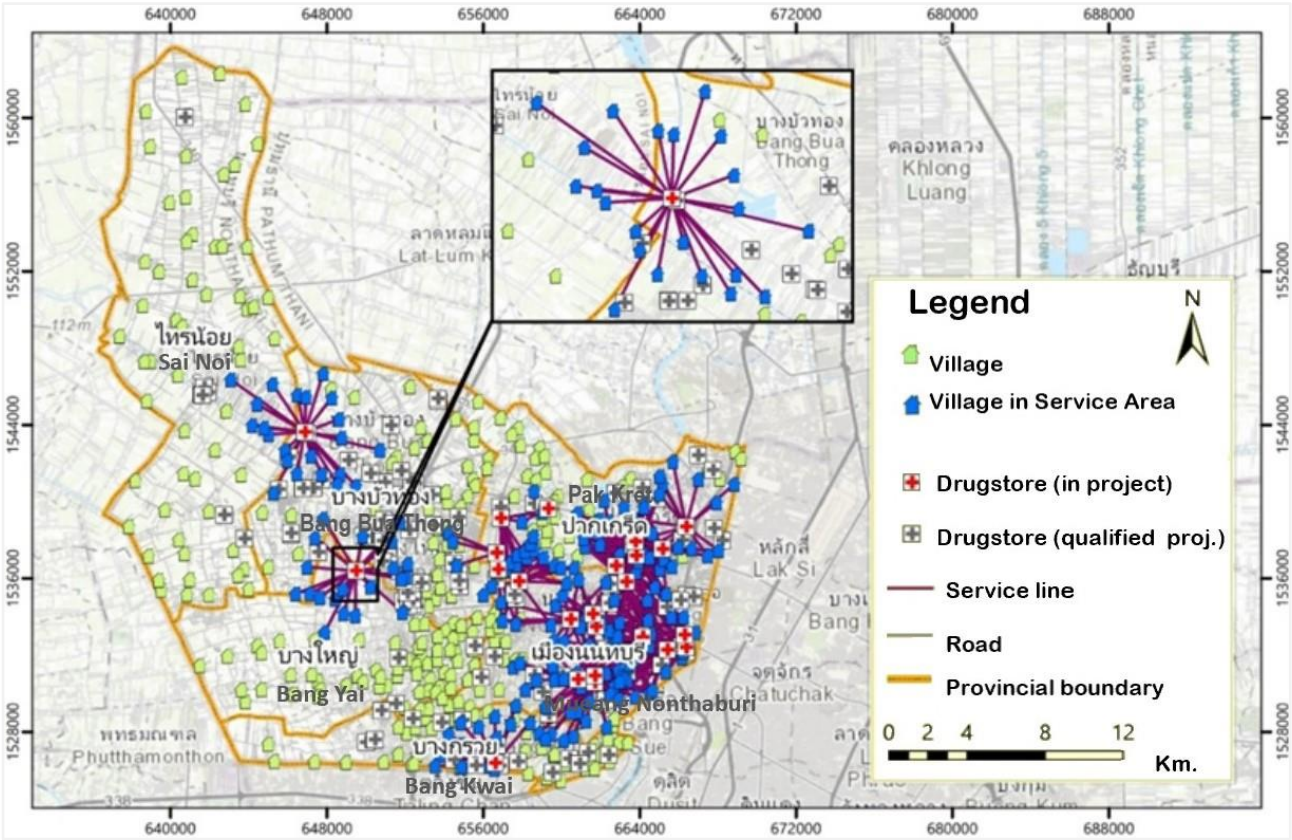

Figure 1. Service Area of Drugstores with the Medicine Pickup at Neighbourhood Drugstores Project Participation in Nonthaburi Province.

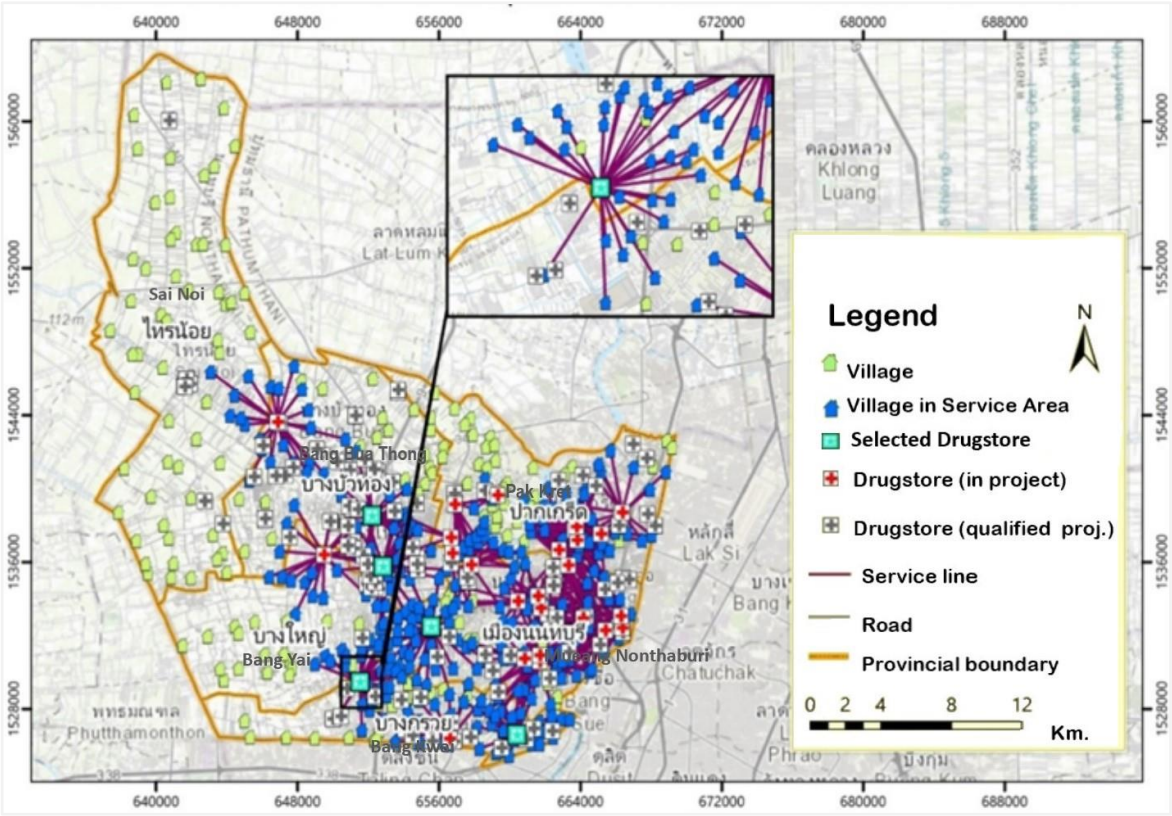

Figure 2 Service Area of the Qualified Drugstore (additional 5 drugstores)

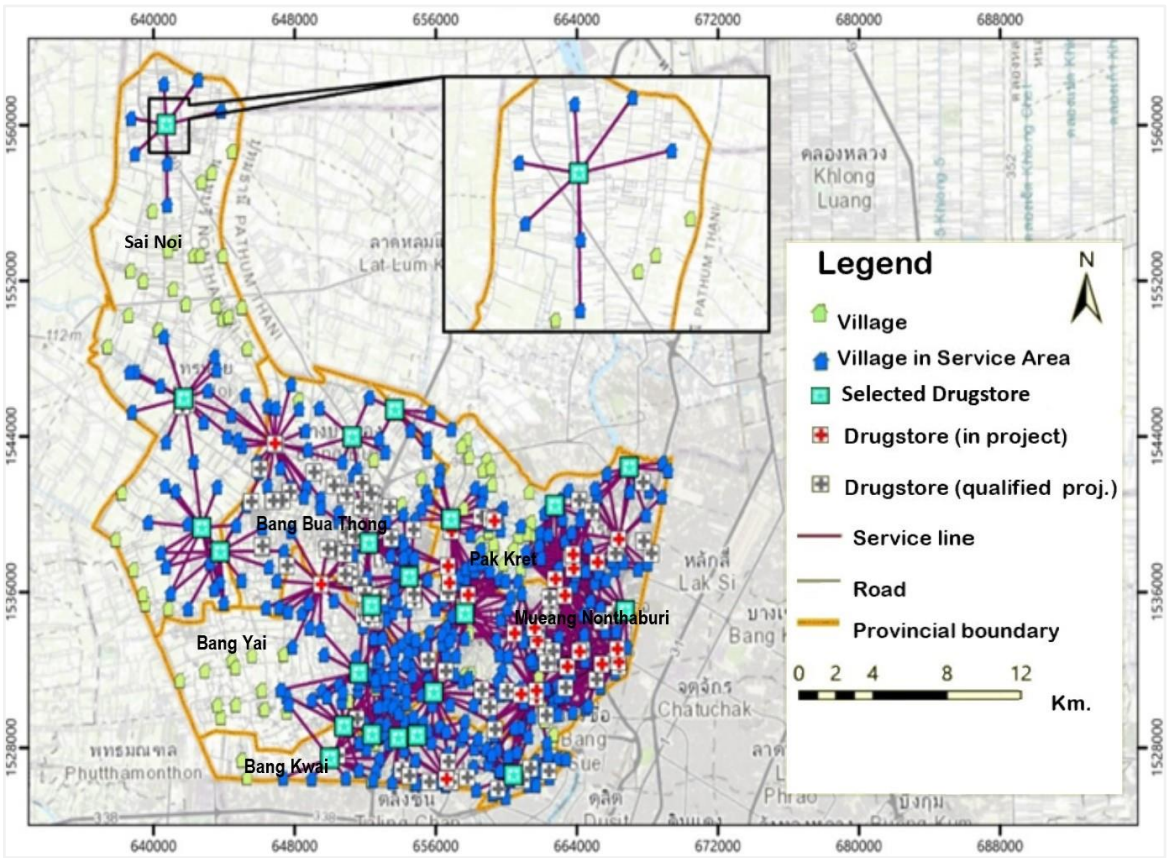

Figure 3 Service Area of the Qualified Drugstore (additional 22 drugstores)

4. CONCLUSION

4.1 Spatial Distribution of the Drugstores

The study analyzed the spatial distribution of pharmacies in Nonthaburi province. The current distribution shows a clustered pattern, with pharmacies primarily located along main roads for easy accessibility and transportation. Most pharmacies participating in the project are concentrated in Mueang Nonthaburi and Pak Kret districts, often affiliated with Phra Nang Klao Hospital and Sri Than Ya Hospital.

Pharmacies meeting the project criteria are mainly clustered in Bang Bua Thong district. These pharmacies meet the specified requirements such as equipment readiness, opening hours exceeding 8 hours a day, and having consultation areas. Pharmacies lacking project criteria are predominantly located in Mueang Nonthaburi district. These pharmacies lack facilities such as consultation spaces and essential medical equipment like blood pressure monitors.

4.2 Service Area of Drugstores with the Medicine Pickup at Neighbourhood Drugstores Project Participation

The study results regarding the service area of the drug stores participating in the project to receive medicine at nearby drug stores in Nonthaburi Province, using Location-Allocation Analysis techniques under the constraints of the Maximize Coverage problem-solving model, found that the 27 participating drug stores cover an area that includes only 199 villages out of the total 511 villages within the study area. It was determined that full coverage of services in the area has not yet been achieved. The highest coverage is found in Mueang Nonthaburi District, which is also where the participating hospitals are located and has a higher number of public transportation routes passing through the communities. On the other hand, the lowest coverage area is in Sai Noi District, as there are no participating drug stores there, although there are communities that access services from participating drug stores located in Bang Bua Thong District only.

Furthermore, when averaging the number of target population using services in a single drug store, it was found to be approximately 13,451 people per pharmacist. The National Health Security Office has set the standard for each pharmacist to care for no more than 10,000 patients, indicating an increased workload for pharmacists.

4.3 Service Area of the Qualified Drugstores of the Medicine Pickup at Neighbourhood Drugstores Project

The study results regarding the service area of the qualified drug stores with participation criteria in the project for receiving medicines at nearby drug stores in Nonthaburi Province, utilizing Location-Allocation Analysis techniques under the constraints of the Maximize Coverage problem-solving model and the Target Market Share technique to calculate the coverage percentage of the area, found that since the year 2019 until the present (2023), there have been 27 drug stores with the participation criteria. These stores cover an area that includes 199 villages, accounting for 59.09% of the total data.

Five additional drug stores were introduced to create a hypothetical scenario to increase the coverage of the study area. This scenario achieved coverage of 325 villages, accounting for 82.74% of the total data. Further expansion by adding 22 drugstores resulted in coverage of 417 villages, which is 95% of the total data. This represents an expansion of the coverage area within Nonthaburi Province.

4.4 Recommendation

For Relevant Organization: The findings of this research can be utilized as a guideline for developing databases for relevant agencies, including the National Health Security Office, the Pharmacy Council, and the Community Pharmacy Association. The results can be presented to relevant authorities to motivate and encourage pharmacies, both those meeting the criteria and those that do not, to prepare and participate in similar projects in the future.

For Future research: It should be noted that real-world travel may be affected by factors like transportation methods and traffic issues. Future research should consider these factors to improve accuracy. The target population specified for ages 41-80 includes individuals who do not all possess the senior citizen card. Adjusting the target population to include only those eligible for the Universal Coverage Scheme (UCS) card would improve the accuracy of population data for service utilization.

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