

Evaluation of ACF for TB among older adults in a suburban district of Vietnam: a combination of project results and literature review

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Evaluation of ACF for TB among older adults in a suburban district of Vietnam: a combination of project results and literature review

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Science in Public Health

by

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Declaration:

Where other people's work has been used (from either a printed source, internet or any other source), this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis EVALUATION OF ACF FOR TB AMONG OLDER ADULTS IN A SUBURBAN DISTRICT OF VIETNAM: A COMBINATION OF PROJECT RESULTS AND LITERATURE REVIEW is my own work.



Signature:

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Abbreviation

TB	Tuberculosis
MDR/RR	multi-drug or rifampicin-resistant
NTP	Vietnam National TB Control Program
ACF	Active Case Finding
WHO	World Health Organization
DALYs	Disability Adjusted Life Years
NNS	Number needed to screen
FIT	Friends for International TB Relief
CXR	chest X-ray/radiography
NTP	Vietnam National Tuberculosis Programme
Xpert	Xpert MTB RIF assay
HRGs	High-risk groups of TB

Key terms

- Presumptive TB: patient who had suggestive symptoms or signs of TB infection (as known as TB suspect) (1)
- Multi-drug or rifampicin-resistant: “Mycobacterium tuberculosis infection that is resistant to isoniazid (H) and rifampicin (R) with or without resistance to other drugs. Rifampicin-resistant TB (RR-TB) defined as resistance to rifampicin detected using genotypic or phenotypic methods with or without resistance to other first-line anti-TB drugs” (2).
- The older adults: people aged from 55 years old and above
- TB hotspot: an area which contains elevated of TB “transmission efficiency” or emerging TB-acquired risk (2)
- Positive screening results: Abnormal chest radiography results
- Presumptive/suspected TB cases: people who had abnormal chest radiography results or/and suspected TB symptoms
- Positive microscopy test: all results confirmed the presence of AFB in the smear samples are defined as positive TB results in microscopy test
- Bacteriologically confirmed TB case: a person whose smear is detected as positive with TB by at least one of the following tests: smear microscopy, culture or such as Xpert MTB/RIF (1)
- All forms of TB case: TB case who had bacteriologically confirmed result(s) or/and clinical diagnosis with TB.

Abstract

Introduction: Tuberculosis remains one of the deadliest infectious diseases in Vietnam. Despite significant efforts to reduce the tuberculosis burden in Vietnam, the current reduction rates are insufficient to eliminate tuberculosis by 2035. Active case findings might be a practical solution to improve tuberculosis detection, thus increasing Vietnam's reduction rates. It is necessary to assess active case finding activities to find an optimal plan that balances coverage, case detection, and resource allocations. This study involved the results of an active case finding activity in Binh Chanh – a suburban district in Vietnam, to answer these questions: 1) What are the needs, gaps and weaknesses of active case finding for older adults in suburban areas of Vietnam; and 2) What should be prioritized in these active case finding activities?

Methodology: This is a mix-method study, consists of secondary quantitative data analysis and literature review. Secondary data was extracted from a 2-year tuberculosis screening program in Binh Chanh, in which participants were screened for TB by a questionnaire and chest X-ray. Individuals with a positive screening result were requested to provide sputum samples to test for *Mycobacterium tuberculosis* by light microscopy using direct Ziehl-Neelsen-stained smear and Xpert MTB/Rif assays.

Results: Among 6,389 eligible, screened participants, 956 (15.0%) had abnormal chest X-ray and required sputum tests. In total, 124 TB cases were identified, in which 97 were males and 27 were females. Potential factors that affect the risk of acquiring tuberculosis including sex, age, residential status, diabetes and previous TB treatment history. The number needed to screen to detect one tuberculosis case in Binh Chanh is 51.5 older adults. Active case finding increased tuberculosis notification rate of the district by an average of 6.8%. The number needed to screen in other active case finding projects in Vietnam were remarkably higher than this study.

Discussion: The result from this study suggests that tuberculosis health policy should focus on males who only have temporary residency, having co-morbidities or previous tuberculosis treatment history to increase detection rate in suburban areas. Also, active case finding to detect tuberculosis among older adults might be more cost-effective than other high-risk groups, with chest X-ray as the primary screening method and Xpert MTB/Rif assays should be used along with other bacteriological tests to diagnose tuberculosis. Active case finding strategies should consider tuberculosis services coverage and quality, socioeconomic status of the target community, and the distance of such community to the nearest tuberculosis health facility.

Keywords: Tuberculosis, active case finding, ACF, community-based

Introduction

Later, from 2016 to 2018, I worked in the Global Fund office – Vietnam National Tuberculosis Programme as a public health officer. This position granted me valuable opportunities to work with multiple tasks related to various aspects of health projects. I have developed my skills in establishing strategy, budget planning, and supporting tuberculosis research implementation. Along the way, I realized that I need to consolidate my knowledge at a higher level of academic education. Thus, I enlisted in The Royal Tropical Institution, where I was extensively trained in health policy management in general, and research implementation and data analysis in particular. Studying at the KIT not only broadened my knowledge in many aspects of public health but also inspired me to orient my career to health research. Thus I was eager to challenge myself to conduct my graduation thesis on a new topic in tuberculosis in Vietnam - active case finding for the older adults with the support of statistical and spatial analysis. By working with the thesis, I realized I am truthfully into this pathway.

1. Chapter 1: Background information

1.1. Geography and demography

The Socialist Republic of Vietnam is a tropical country which is located in Southeast Asia, occupying in the Eastern bank of the Indochina Peninsula. Vietnam is among the most populous countries in Asia (1), with a population of more than 95.5 million (2) and a general population density of 308 people per squared-kilometers in 2018 (3). The proportion of the rural population showed a sharp decline in the past 20 years; however, it still constituted more than half the general population (63.37% - 2019 estimation) (4). The country has 63 provinces, 673 districts, and 10,925 communes, with fifty-four different ethnic groups.

1.2. Socioeconomic status

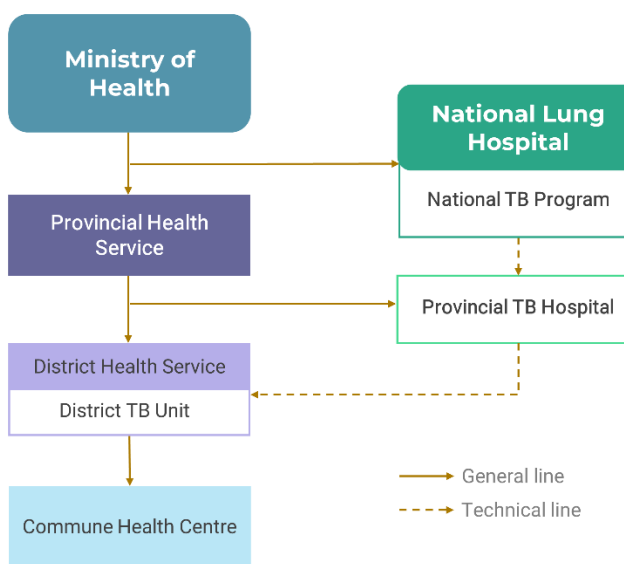
Vietnam is a lower-middle-income country with a GDP per capita at over USD 2,700 in 2019. Since 2000, the GDP growth rate became stable, fluctuating around 5.2% to 7.5% annually, which showed the essential capacity and elasticity in the country's economy (5). The year 2019 witnessed GDP growth in Vietnam reached 7.02%, bringing the country into the first rank for this indicator in the region (5).

1.3. The National Tuberculosis Program (NTP)

The NTP network follows the hierarchy of the health system. There is, in principle, full population access to TB services. There are 63 provinces with provincial TB hospitals or TB units as part of the provincial preventive medicine department and 696 districts that each have a TB coordinator, a total of 1080 microscopy laboratories, 63 provincial laboratories, and 2 (sub) national reference laboratories (6). The 11,000 communes have a commune health worker that manage village health workers on TB duties. Village health workers play critically important roles in identifying suspected TB patients, conducting counseling for examination and tests, paying home visits to patients undergoing treatment, and reporting problems in the monthly meeting with the commune health center (6). Also, there are three sub-national TB referral hospitals: Pham Ngoc Thach Hospital in Ho Chi Minh City, K71 in Thanh Hoa Province, and K74 in Vinh Phuc province, and one national referral hospital: the National Lung Hospital in Hanoi (6).

Figure 1

Flow chart of health system and TB network in Vietnam



1.4. Case detection and diagnosis: passive case finding versus active case finding

TB case detection in Vietnam is based mainly on passive case finding (PCF). Symptomatic patients of TB services reporting cough for at least two weeks are requested to submit two sputum samples (spot and morning) to test for TB using direct light microscopy on Ziehl-Neelsen stained sputum

smears as the primary method (6). For specific high-risk groups (such as presumptive MDR-TB cases, HIV patients, and children with presumptive TB), Xpert MTB/RIF (Xpert) is used as the primary diagnostic tool if available (6). Since 2012, an increasing number of Xpert units offer access to diagnosis of TB and MDR-TB to people from high-risk groups, improving diagnosis quality, reducing delays in result reporting, and paving the way for earlier initiation of treatment (7).

A pilot active case finding (ACF) using CXR and Xpert was conducted in eight provinces with low case detection rates in 2011-2014. The results showed a notification rate increase of 22%, while a high level of treatment success rate for new smear-positive pulmonary TB patients was maintained (90.9%) (8). In 2017-2018, active case finding was implemented in Hai Phong, Hoi An, Ca Mau, and Ho Chi Minh City, with a promising impact on case finding (9,10). In a total-population TB screening event on Cu Lao Cham Island, 17 new TB cases were identified, in addition to 2 active cases on the island before the screening event start (11).

1.5. Public-Public and Public-Private Mix

The NTP has maintained and expanded the Public-Private Mix in TB Control Model (PPM) in 27 provinces, 15 national general hospitals, and 10 provincial general hospitals (6). This model has been achieved through a strong collaboration with the provincial PPM committees, health facilities, private pharmaceutical associations, and civil society organizations, such as the Women's Union and the Farmers' Union. The PPM model centers on a referral system that encourages private pharmacies, clinics, and public non-TB facilities to refer presumptive TB individuals to TB facilities for diagnosis and treatment. TB facilities also provide capacity building for private and public non-TB providers to detect the disease through training, review meetings, and supportive supervision. In the provinces where the PPM model is implemented, the private sector contributed, on average of 9.7% to the total number of notified TB cases (6). In the 14 provinces where the practical approach to lung health (PAL) is implemented, the level and quality of referrals for TB within the health system improved (6).

2. Chapter 2: Problem statement, justification

2.1. Problem statement

Tuberculosis (TB) remains one of the fatal causes of morbidity and mortality worldwide, especially in low-middle income countries like Vietnam. According to the Global TB Report 2019, Vietnam is among 20 countries with the highest TB incidence in the world, with an estimation of 174,000 new TB cases each year (11). Among them, 3.6% are multi-drug or rifampicin-resistant (MDR/RR) (11), which yield a double-burden on Vietnam due to the prolonged and costly treatment (12). Annually, the country witnessed 17,000 deaths caused by TB, which is double the mortality number of traffic accidents (13).

Despite the heavy burden of TB in Vietnam, the country is making major efforts in achieving a steady reduction in TB incidence, with an average rate of 3% annually (11). As a result, the TB incidence declined by one-third of cases between 2000 and 2018 (from 296 to 182 per 100,000 people, respectively) (14). Also, the annual reduction of TB prevalence in Vietnam throughout 1990-2010 was 4.6%, by the WHO estimation (15). Furthermore, national surveillance data from the Vietnam National TB Control Program (NTP) showed a downward trend in the notification rate of smear-positive TB in the period of 2007 – 2012, from 65 to 57 per 100,000 population, respectively (16). In contrast, TB treatment coverage, which refers to “notifications as a percentage of estimated incidence,” increased by 10% from 2007 to 2017 (47% and 57%, respectively). These achievements showed the country’s improvement in TB control with the national reporting system’s advancement and the cohesive inter-sectoral collaboration (17). However, the country data was aggregated on the national scale, which geography variation and risk heterogeneities between different populations demand spatial approach and specific strategies for each ACF activities. Also, these reduction rates may not be enough to fulfill the ambitious national target of eliminating TB by the year 2030, in consonance with the global End TB Strategy, which was committed by the Vietnamese Deputy Prime Minister (18). One of the WHO requirements for this strategy is that the reduction rate of national TB incidence should reach 4-5% annually (19). Thus, more measures and efforts should be taken to meet such targets before the declared time.

One of the main reasons behind the slow reduction is that nearly half of TB infection in the country have not enrolled for diagnosis and treatment. According to WHO estimation, 43% of estimated new TB cases were still not notified in Vietnam national surveillance data in 2017 (11). Meanwhile, a cross-sectional study in Vietnam pointed out that most TB patients didn’t go to the health care center shortly after their first symptom appeared, with an average of the delay time is 4.7 weeks (20). Delaying TB diagnosis not only exacerbates the morbidity of the diseases toward the patients but also stagnate the progress of TB elimination due to the scale-up new infections transmitted from untreated cases in the communities (21). Therefore, early TB detection and diagnosis for prompt treatment would be a practical remedy to improve the TB reduction rate in Vietnam.

Considerable evidence indicated that community-based active case finding (ACF) could detect more and earlier TB cases in the community than passive case finding (PCF) alone, especially in low or middle-income countries (19)(21)(22)(23). However, although mass TB screening produces extensive coverage, it requires a large amount of financial and human resources and only provides a low-yield of TB cases detected. Therefore, it was strongly objected to according to WHO’s guidelines, and active TB detection should be conducted by systematic screening among high-risk groups (24)(25).

The prevalence survey in 2017 in Vietnam indicated that around 53.8% of TB cases were above 54 years old (26), while this age group only contributed for 16% (10) of the national population. Besides, TB detection and treatment for the elderly are more complicated compared to the young. Typical symptoms of active TB, such as hemoptysis, fever, or dyspnea infrequently occur in the old. Besides, low immune responses and pathological background of chronic diseases heighten the risk of TB among the people above 54. The likelihood of co-morbidity among these age groups also lowers the efficiency of TB treatment (27). In Vietnam, more than half of TB Disability Adjusted Life Years (DALYs) were witnessed in patients above 54 years (2017) (28). With the rapid aging transition of the population (29), early TB detection among old adults also needs to put on prioritization to reduce the burden of TB co-morbidity and mortality in Vietnam.

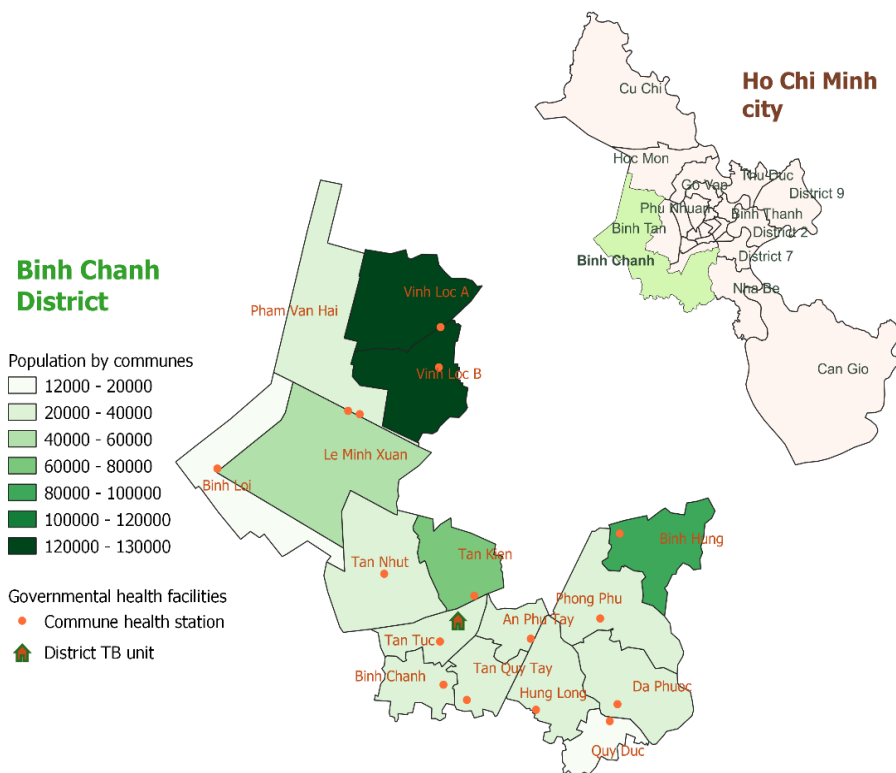
2.2. Justification

To implement cost-effective ACF in Vietnam on a large scale, supporting evidence is required to identify the optimal ACF plans that can balance between coverage, case detection, and resource allocations. This evidence, while essential for the success of an ACF campaign, is still limited in Vietnam, especially regarding target TB screening for people above 54 years old – the group takes an excessively high proportion among TB cases.

In Vietnam, several community-based ACF were conducted and proved their promising efficiency in TB detection (16)(17). However, under the WHO’s guideline, this type of intervention is not a favorable option for sustainable TB detection strategies(24)(25). On the other hand, TB detection for high-risk groups, so far, was tailored to focus on coal mines, HIV patients, injection drug use,

Figure 2

Map of Binh Chanh district and the population size of each commune



TB contact (household and neighbors) (19)(30)(31)(32). Thus, the older adult population has not been attached importance to TB ACF in Vietnam.

The second TB prevalence survey in Vietnam revealed that TB prevalence was highest in the Southern regions of Vietnam, and people in urban settings were more at risk of being infected with the disease (26). Evidence showed that poor urban residents are the most affected because of their unfavorable living conditions and lack access to health services (33). Therefore, to accelerate TB detection in urban areas, ACF intervention should also focus on suburban areas where most of the poor urban reside.

One of these suburban areas is Binh Chanh districts. In this district, active case finding was conducted in two years, 2017-2019. The ACF is a complementary TB service provided by the People's Committee in Binh Chanh District and other involved stakeholders (Annex 1). My targeted subjects will be all older adults age above 54 years. The results from this analysis can contribute to the TB intervention and health policies in the area, as well as fortify the evidence for TB ACF among this group nationwide when compared to other initiatives.

Binh Chanh is a suburban district, located to the West of Ho Chi Minh City (HCMC) (Figure 2). With a population of 652,900 in 252.56 square kilometers, the area had the highest population among five suburban districts of the city, but its population density only ranked second among the city outskirts (2017 estimation) (34). Following the national proportion by age groups, the estimated number of older adults in Binh Chanh was around 104,464. Binh Chanh is subject to booming urbanization in general, but still in a moderate economic transition (35). This setting might represent the majority of areas in Vietnam, a low-middle income country still in the middle stage of urbanization.

The study aims to contribute to the acceleration of TB control and increase access to high-quality TB services via more tailored approaches, thus, answering for the questions:

- What are the needs, gaps, and weaknesses of TB ACF interventions for older adults in Vietnamese suburban areas from the results of the Binh Chanh active detection program?
- What should be prioritized in the ACF strategies for older adults in suburban areas in Vietnam?

Objectives:

Overall objective:

To discover the prioritizing strategy and evaluate the effectiveness of ACF among people above 54 years old in Vietnam.

Specific objective:

1. To identify TB epidemiology among older adults in suburban areas in Vietnam from TB screening activities in Binh Chanh districts.
2. To identify the notification impacts from ACF for older adults into notification rate in Binh Chanh
3. To compare results from ACF in Binh Chanh with other ACF in Vietnam and active detection for older adults in other countries.

4. To discuss the needs, gaps, and weaknesses of TB ACF for older adults in Vietnam.
5. To formulate recommendations for the prioritizing strategy of ACF interventions among older adults on the national scale.

3. Chapter 3: Methodology

3.1. Study type:

The study methodology consists of two sections, which are secondary quantitative data analysis and literature review. The quantitative data analysis, through the use of statistical and spatial tools, will provide the results of TB ACF among people above 54-year-old in Binh Chanh District, Ho Chi Minh city, in 2017, covering objectives one and two. The literature review will contribute to the discussion that embraces objective three to five.

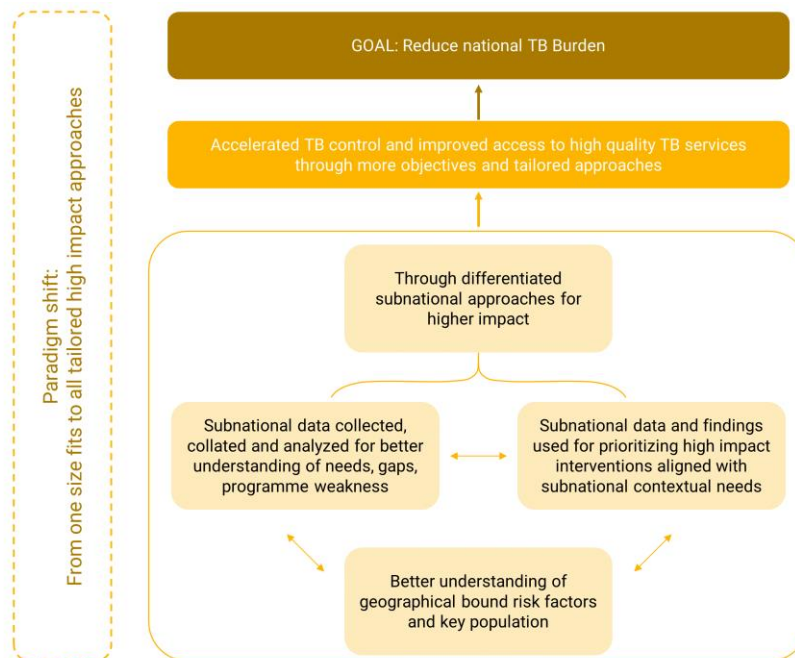
3.2. Conceptual framework:

The research was based on “The theory of change” developed from the MATCH project (29) (Annex 2). Since the dataset from the original project purely concentrates on active TB detection, section “TB data system strengthening” in the original framework was discarded. Also, additional assessment on the TB data system might broaden the purpose of this study approach, whereas this thesis aims to concentrate in-depth analysis of ACF results among the older adults. Moreover, TB information management in Vietnam has been continuously improving for the past ten years, according to WHO’s TB Global Report (11). Besides, due to the unavailability of commune data in demography, socioeconomic status, and health service coverage in Binh Chanh, geographical risk-factors in the framework were not discussed in this study.

My analysis followed the modified framework (Figure 3), attempting to identify the characteristics of TB among older adults at the subnational level, which is data collected from TB screening activity in a suburban district – Binh Chanh. The TB notification was temporally performed and visualized in cartography to gain assess the TB detection among older adults in this activity, as well as evaluate impacts of the interventions for TB program in Binh Chanh. These findings were

Figure 3

Modified conceptual framework to analyze and access TB ACF



juxtaposed and discussed to develop strategic prioritizations for ACF for older adults in Binh Chanh. Besides, results from ACF for older adults in Binh Chanh were compared and discussed with preceding ACF activities in Vietnam and ACF for older adults in other countries to identify the needs, gaps, and weaknesses of this type of intervention. Finally, through differentiated subnational approaches, the study will formulate recommendations to strengthen ACF interventions among this study's subjects on the national scale.

3.3. Source of quantitative data for subnational ACF analysis

The data was extracted from the 2-year TB screening program, authorized by The People's Committee of Binh Chanh Districts, Ho Chi Minh city. The program activities were operated by a non-governmental organization - Friends for International TB Relief (FIT). The primary beneficiaries of this service were people above 54-years-old living in all 16 communes and other high-risk groups of the districts. However, due to financial hindrance and other logistic issues, the other high-risk groups was not clearly classified during recruitment. To focus on the primary study purposes and avoid potential selection bias for the study, I only include older adults above 54.

The ACF utilized mobile chest X-ray camps, which were located in accessible and convenient places around the districts. In the two years from 2017 to 2019, 44 chest X-ray camps were arranged around 16 communes in Binh Chanh. Each chest X-ray camp was in charge of screening for the sub-communes in the proximity of its opted location in one day, followed by the assigned schedule. Prior to screening events, communication campaigns were deployed around residential areas and the local markets to ensure the announcement reaching the maximal attendance population, especially the marginalized groups. These campaigns which included radio spots, banners, billboards, and short speeches also aimed to remind the participants the screening date and location involved

In total, 7,869 individuals above 54 consented to participate in the activity. On the day of the screening, participants were interviewed for TB symptoms by trained healthcare workers (HCWs). Regardless of their symptoms, all of them were offered chest radiography. Chest X-Ray (CXR) images were read on the spot by a radiologist to make rapid decisions about who needs a follow-on diagnostic testing. Progressively, people with abnormal CXR results were asked to provide sputum to run on two tests: microscopy and Xpert. Samples collected on the spot were transported to laboratories for testing. For those who were not able to provide sputum on the camps, local health workers followed up to collect the sputum samples at their homes the next morning. All diagnosed TB patients were initiated on treatment at the District TB Units or Commune Health Stations in the wards where they lived with support from the project team to minimize loss to follow up. (Annex 1)

3.4. Secondary data analysis

3.4.1. Characteristics of TB among older adults in suburban areas in Vietnam in ACF in Binh Chanh.

Statistical summary reported the number of bacteriologically confirmed and clinically confirmed TB cases among older adults in the data from ACF intervention in Binh Chanh district. Statistical differences of TB positive between stratified groups following available variables (Table 1) were tested using the Chi-square proportion test, depending on the types of the variables. The multivariate logistic analysis was involved in assessing the risk factors of TB based on available variables. TB statuses of the participants, which were coded as a binary variable (TB and non-TB),

are the dependent variable throughout all regression models. I analyzed the data using Stata14 (Stata Corporation, College Station, TX, USA).

Table 1

List of used variables

No	Name	Values	Type
Potential factors			
1	Sex	- Female - Male	Binary
2	Age group	- 55-64 - 65-74 - >=75	Nominal
3	Commune	1 - An Phu Tay 2 - Binh Chanh 3 - Binh Hung 4 - Binh Loi 5 - Da Phuoc 6 - Hung Long 7 - Le Minh Xuan 8 - Pham Van Hai 9 - Phong Phu 10 - Quy Duc 11 - Tan Kien 12 - Tan Nhut 13 - Tan Quy Tay 14 - Tan Tuc 15 - Vinh Loc A 16 - Vinh Loc B	Nominal
4	Residential status	- Permanent resident (RP1) - Intra-province temporary resident (RP2) - Long-term extra-province temporary resident (RP3) - Short-term extra-province temporary resident (RP4)	Nominal
5	Health insurance	- No - Yes	Binary
6	Diabetes	- No - Yes	Binary
7	Previous TB treatment	- No - Yes	Binary
Symptoms screening results			
1	Cough	- No - Yes	Binary

2	Cough duration	- <2 weeks - ≥2 weeks	Binary
3	Haemoptysis	- No - Yes	Binary
4	Chest pain	- No - Yes	Binary
5	Fever	- No - Yes	Binary
6	Night sweat	- No - Yes	Binary
7	Fatigue	- No - Yes	Binary
8	Weight loss	- No - Yes	Binary
Test result			
1	Chest X-ray result	- Normal - Abnormal	Binary
2	Microscopy result	- Negative - Positive	Binary
3	Xpert test result	- Negative - Positive	Binary
4	TB of all forms (bacteriologically and clinical confirmed)	- Negative - Positive	Binary

3.4.2. Efficiency and effectiveness of the ACF for older adults in Binh Chanh

For the efficiency of the ACF among older adults in Binh Chanh, the study calculated the yield proportion, the number needed to screen from the TB detection. This data was later used to compare with other ACF interventions in Vietnam and ACF for older adults in other countries. The effectiveness appraised based on the patterns change of notification rate before and after the intervention. The TB yield and notification impacts were also temporally performed and visualized in cartography to bring in better angles for the assessment. The cartography highlighted the patterns of detected TB, as well as the transition of notification rate by interventions. Thus, the areas with high TB burden among older adults were identified. This evidence was used to develop probable hypotheses and formulate recommendations for local TB policies. Microsoft Excel and QGIS 3.12 (Quantum Geographic Information Systems) were employed for these analyses.

3.5. Literature review - Predecessor TB ACF interventions in Vietnam and TB screening program among older adults in other countries

The literature review was built to contribute to two parts. The first is to appraise the efficiency of ACF for older adults in Vietnam. The study initially searched for ACF intervention, which was systematically designed for TB screening in the community. According to the national TB briefing 2018, the previous ACF interventions in Vietnam was initially conducted as mass screening for all opted communities or focused on coal miners, people living with HIV, drug users, TB contact

(household and neighbors) (36). Among PLHIV and drug users, TB screening is offered for individuals who were registered in the HIV Programme system (37,38). As this method did not compatibly reflect my aforementioned purpose, TB ACF for PLHIV and drug users were excluded. Secondly, the study reviewed the TB screening program for older adults residing in the community in other countries. In both parts, the comparisons were established in study settings, applied algorithms, TB yield, and NNS. These two components aimed to identify the needs, gaps, and weaknesses of TB ACF for older adults, then, suggesting the prioritizing strategy of ACF interventions among these subjects for the Vietnam TB program.

The sources for literature review comprised Google, Google Scholar, Pubmed, Trip Medical databases, online library of VU, and Hanoi University of Public Health. The snowballing method was applied to avoid omissions. For inclusion criteria, both published and unpublished studies conducted in Vietnam and other countries were reviewed. For TB ACF in other countries, studies whose results for older adults are unavailable were be excluded. Literature reviews, systematic reviews, quantitative and qualitative surveys in both English and Vietnamese were included. Grey literature was also included, which originated from the Ministry of Health and other relevant sources, such as WHO, Reliefweb, World Bank. Studies conducted before 2000 were excluded. Search terms are manifested in Table 4 – Annex 3.

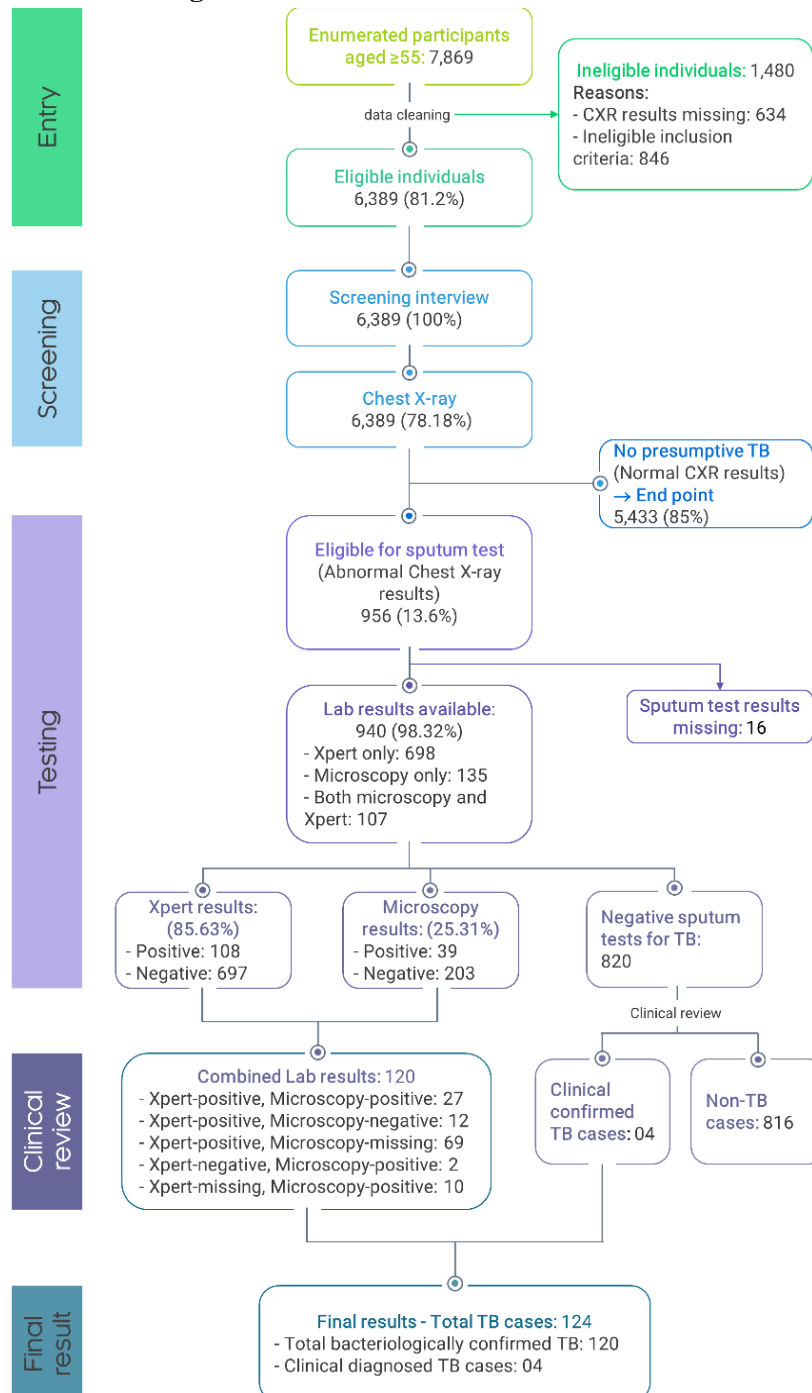
4. Chapter 4: Study Results

4.1. Characteristics of TB among older adults in suburban areas in Vietnam from TB screening activities in Binh Chanh districts.

4.1.1. Demographic description of the study population

Figure 4

Flow diagram of the ACF among older adults in Binh Chanh district



In total, 7,869 participants aged above 54 are enumerated in the dataset, of which 1,480 individuals are ruled out due to missing screening data and disqualification of inclusion criteria followed by project protocol. Thus, 6,389 participants were eligible for the analysis, equivalent to 6.12% of the estimated older adult population in Binh Chanh district (n= 104,464) (Figure 4). Among 6,389 eligible individuals for data analysis, more than half of the eligible participants were females, with the percentage at 56%, the other 44% was males (Figure 5). Age group 55-64 predominates in the number of eligible participants, with the contributing proportion at 47.91% (3,061), followed by age group 65-75 (33.03%) and age group above 74 years old (19.06%) (Figure 7). In terms of residential status, only 93.16% eligible participants had this information logged, and the rest were missing (6.84%). The proportion of permanent residents (RP1)* based in Binh Chanh was the greatest, at 87.29%. People categorized as RP2 and RP3 were approximately equal in numbers, accounted for 2.52% and 2.57%, respectively. The participation proportion in the RP4 category was the smallest, at 0.78%. Health insurance (HI) covered 88.89% of all participants. Among all eligible participants, 12.02% of them reported being diagnosed with diabetes, 61.56% were non-diabetes, the other 26.42 % were missing this value. The majority of the study sample (91.99%) had not enrolled in TB treatment in their medical history; the other 7.92% were previously involved in TB treatment (Annex 4 – Table 9).

4.1.2. General TB results of ACF for older adults in Binh Chanh districts (Table 4-Annex 9)

Among 6,389 eligible participants, all of them were screened by symptomatic questionnaires and CXR. Through radiography, 85 % (5,433) participants were classified as normal CXR results. The other 956 participants who had abnormal CXR images would be labeled as positive screening and became eligible for sputum tests. Laboratory results that involved microscopy or Xpert tests were only available among 98.32% (940) of the screened positive individuals. Subsequently, 698 individual sputa were analyzed by Xpert only, 135 were checked by microscopy only, and 107 individual samples went through both Xpert and microscopy. Results from Xpert tests for 805 participants identified 108 (13.42%) individuals whose sputum specimens were positive with MTB. Microscopy results were available in 242 participants, of which 39 (16.12%) samples showed positive with Acid - Fast Bacilli (AFB). In total, laboratory results witnessed 27 participants who were positive with TB in both Xpert and microscopy. Smear specimens of 14 participants were spotted as discordant positive results, which were performed as positive Xpert and negative microscopy or vice versa. An additional 69 participants were identified as TB positive by Xpert only because of missing microscopy results, and 10 participants whose Xpert results were missing had positive AFB results through microscopy, which brought in total 120 bacteriologically confirmed TB cases. Of 820 presumptive TB cases whose sputum tests were negative, four of them were confirmed TB positive through clinical panel review. At the end, a total of 124 TB cases aged from 55 and above were detected from the ACF in Binh Chanh districts (Figure 4).

* Definition:

- RP1 – Permanent resident: Participants who are residing in Binh Chanh and their permanent residence permit are also in Binh Chanh district.
- RP2 – Intra-province temporary: Participants who have a temporary residence permit in Binh Chanh and their permanent residence permit are in another district in Ho Chi Minh city.
- RP3 – Long-term extra province: Participants who possess a temporary residence permit in Binh Chanh and are residing in Binh Chanh for more than six months. Their permanent residence permit is in another province.
- RP4 – Short-term extra province: Participants who possess a temporary residence permit in Binh Chanh and are residing in Binh Chanh for less than six months. Their permanent residence permit is in another province.

Sex distribution

Figure 5

The proportion of participants by sex

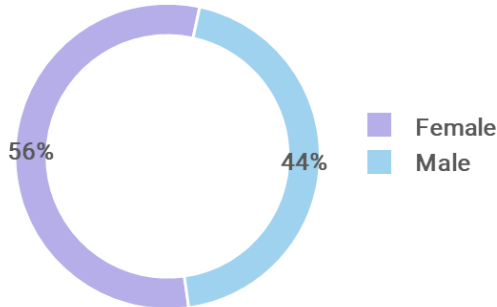
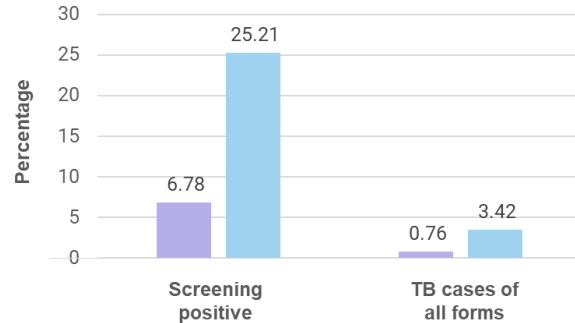


Figure 6

Proportion of screening positive and confirmed TB cases in each sex group



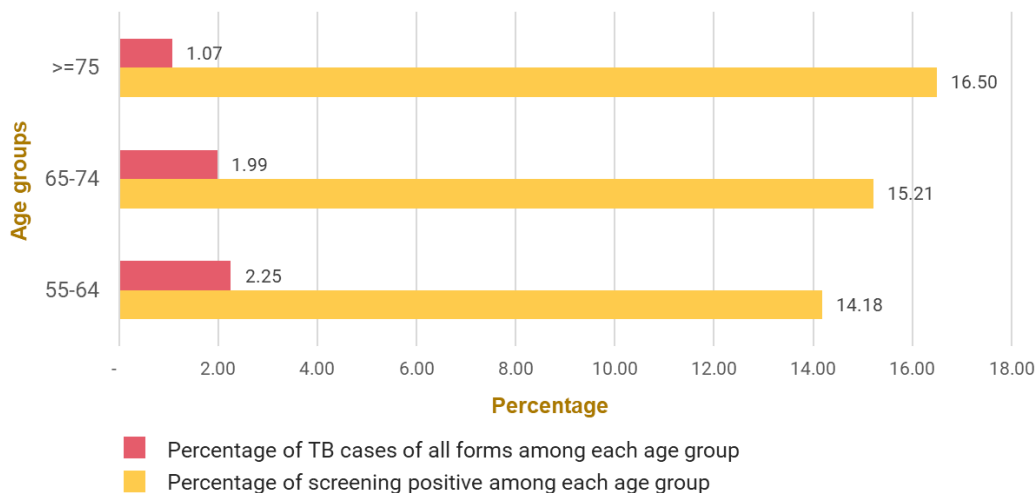
The proportion of screening positive among females was 6.78%, statistically lower than this figure among males (25.21%). The percentage of TB detected among females was also much smaller than among males, at 0.76% and 3.42%, respectively, with 5% level of significance (Table 5 – Annex 4 and Figure 6).

Age distribution

During the screening stage, the percentage of screening positive increased progressively by from the youngest to the oldest age group (from 14.18 to 16.5%), and this trend was statistically significant (p-value=0.05). In contrast, the proportion of bacteriologically confirmed TB increased in reverse order. The smallest percentage of TB detected was in the oldest age group - 75 and above (1.07%), followed by age group 65-74, and the highest percentage was in the age group 55-64 (2.25%). This trend was witnessed in 95% of confidence interval (Table 5 – Annex 4 and Figure 7).

Figure 7

The proportion of screening positive and TB cases of all forms by age groups

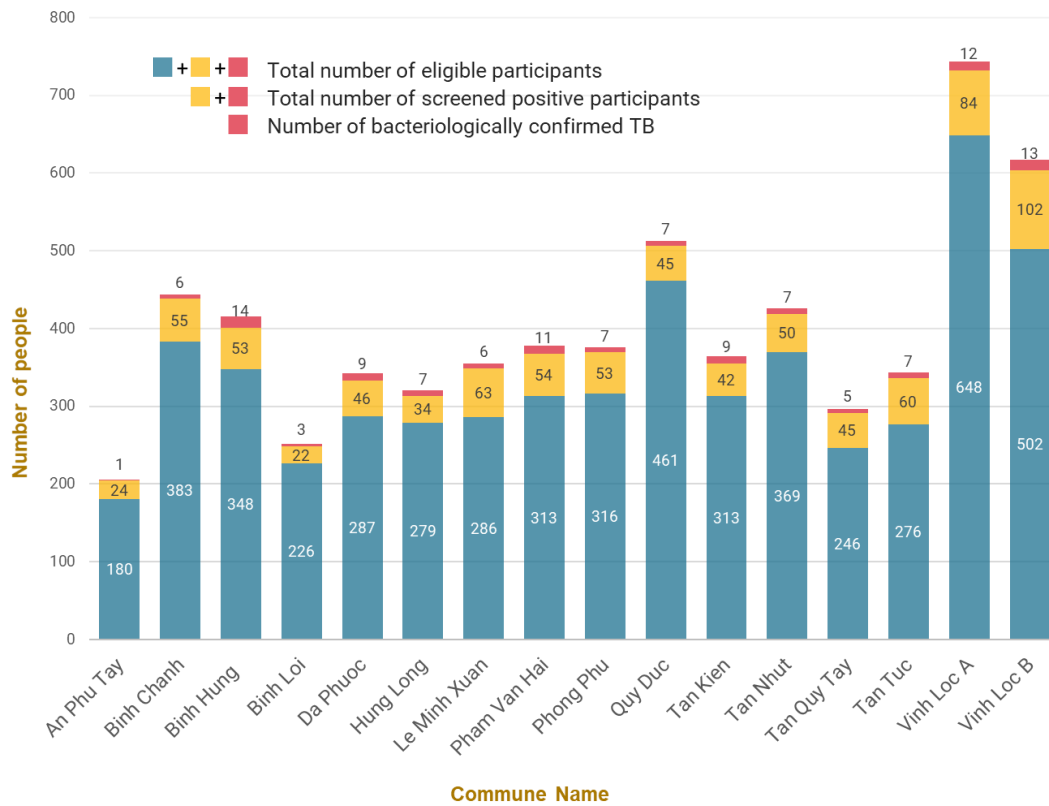


TB screening results by communes

Of all 16 communes, Vinh Loc A had the highest number of residents participating in the ACF (744 participants), and An Phu Tay was in the last rank of this classification (205 participants). Through TB screen by CXR, Commune Binh Loi had the smallest proportion of residents with abnormal CXR results (positive screening) (9.96%) - the highest percentage was in Tan Tuc (19.53%). The proportions of screening positive results were statistically different between each commune ($p < 0.001$). The highest proportion of TB detected was in Pham Van Hai, at 2.91%, and the lowest was in An Phu Tay, at 0.49%. In this testing stage, the proportion of all-form TB between each commune didn't show any statistical difference ($p = 0.513$) (Table 5 – Annex 4 and Figure 8).

Figure 8

Summary ACF results by communes



Residential status

In terms of residential status, screened positive proportions in each group gradually ascended from RP1 to RP4, from 13.79% to 38%. During testing, 1.72 % of RP1 participants were detected TB positive, the lowest in four groups of all residential status groups, followed by group RP2, at 4.97%. The proportion of TB detected in group RP3 was approximately equal to this percentage in groups RP4, at 6.1%, and 6.0%, respectively. TB detected proportion in each group showed a 95 % confidence interval of difference.

Financial access to services

The proportion of individuals suspected of having TB based on screening was 21.19 among individuals without HI coverage, whereas it was 14.23% among people with HI, a statistically

significant difference. In the testing and diagnosis stage, the percentage of TB cases among HI owners was also statistically smaller than in groups non-HI, at 1.8% and 3.11%, respectively (p=0.01).

Co-morbidities

The proportion of presumptive TB among diabetes patients was 10.4%, smaller than this proportion among non-diabetes participants (14.65%), with a 95% confidence interval (p=0.001). The percentage of all-forms TB, however, was higher among diabetes-diagnosed participants (1.56%) than those without diabetes (1.47%). Yet the difference between these two proportions was not statistically significant (p=0.38).

History of TB treatment

In CXR results, 63.83% of participants who were used to TB patients were presumptive TB, six times higher than this proportion among those without TB treatment. Through sputum tests, 6.72% of participants having previous TB treatment were identified as TB positive, while this proportion was only 1.53% among participants without previous TB treatment. In both the screening and diagnosis phases, the difference of positive results among these two groups showed statistical significance.

Symptoms of cases

Table 2

Suspected TB symptoms reported by all-form TB cases

TB symptoms	TB cases reported with the following symptoms	Proportion (%)	95% confidence interval (CI)
Cough (any duration)	93	75	66.5-81.9
Cough < 2 week	15	12.1	7.37-19.2
Cough >=2 weeks	78	62.9	54-71
Cough with sputum	83	66.9	58.1-74.7
Hemoptysis	0	-	-
Chest pain	23	20.2	13.9-28.3
Fever	10	8.1	4.4-14.5
Night sweats	7	5.83	2.7-11.5
Fatigued	33	26.6	19.5-35.2
Weight loss	13	10.5	6.1-17.3
Any symptom	113	91.1	84.6-95.1
Asymptomatic	11	8.9	4.9-15.4
Total TB cases	124		

Symptomatic interviews were performed in all eligible participants. Among 120 TB cases detected, coughing of any duration were reported by 93 participants (75%, CI: 66.5-81.9), of which 15 TB cases (12.1%, CI: 7.37-19.2) reported coughing for less than two weeks, 78 TB cases (62.9%, CI: 54-71) reported coughing for two weeks or more, 83 cases (66.9%, CI: 58.1-74.7) reported cough with sputum. No TB case reported developing hemoptysis. Other TB suspicious symptoms also appeared among TB infected participants, namely chest pain (23 cases), fever (10

cases), night sweats (7 cases), fatigued (33 cases), weight loss (13 cases). Overall, 113 TB cases reported having at least one suggestive symptoms of TB, and 11 TB cases showed asymptomatic regarding TB (Table 2).

4.1.3. Potential factors analysis

In this section, potential risk factors were established based on sub-group analysis from the dataset's available information. Overall, the chance of TB infection showed a statistical association with the difference between sex, residential statuses, and historical TB treatment. Multivariate logistics regression showed that men had more 3.5 times of odds of TB infection compared to women (95% CI: 2.2-5.5) (Table 4). The odds of finding positive TB among those who were categorized as RP2 and RP3 were 2.2 (CI: 1.0-4.9) and 2.7 (CI: 1.34-5.6) times higher than than the figure among permanent residents (RP1) ($p < 0.05$). The difference between TB positive among stratum RP4 and RP1 didn't show a statistical significance ($p = 0.062$). Previous TB patients had three times more likely to be diagnosed with TB than those without historical TB treatment (CI: 1.97-4.83). This result is statistically significant.

The odd of TB positive results between each age group didn't show a statistically significant effect ($p > 0.05$). There is no statistical difference in the odds of TB infection between each commune ($p > 0.05$). Health insurance possession was not associated with TB positive (OR=0.86, $p = 0.593$). Diabetes status was not associated with the likelihood of a positive TB (OR~1, $p < 0.001$) (Table 3).

Table 3

Odd ratios of potential factors of TB in Binh Chanh District (n= 5,944)

Potential factors		Odds Ratio	95% CI	p-value
Sex	Female	1		
	Male	3.5	2.2-5.5	<0.0001
Age	55-64	1		
	65-74	1.03	0.69-1.60	0.896
	>=75	0.56	0.32-1.08	0.06
Commune	An Phu Tay	1		p>0.05
	Binh Chanh	3.3	0.4-28.3	
	Binh Hung	6.5	0.8-51.2	
	Binh Loi	3.4	0.4-33.9	
	Da Phuoc	5.5	0.7-44.9	
	Hung Long	4.8	0.6-40.1	
	Le Minh Xuan	2.7	0.3-23.7	
	Pham Van Hai	4.5	0.6-35.8	
	Phong Phu	3.7	0.4-31.0	
	Quy Duc	3.4	0.4-27.9	
	Tan Kien	6.0	0.7-49.0	
	Tan Nhut	3.6	0.43-29.6	
Tan Quy Tay	3.9	0.4-34.3		

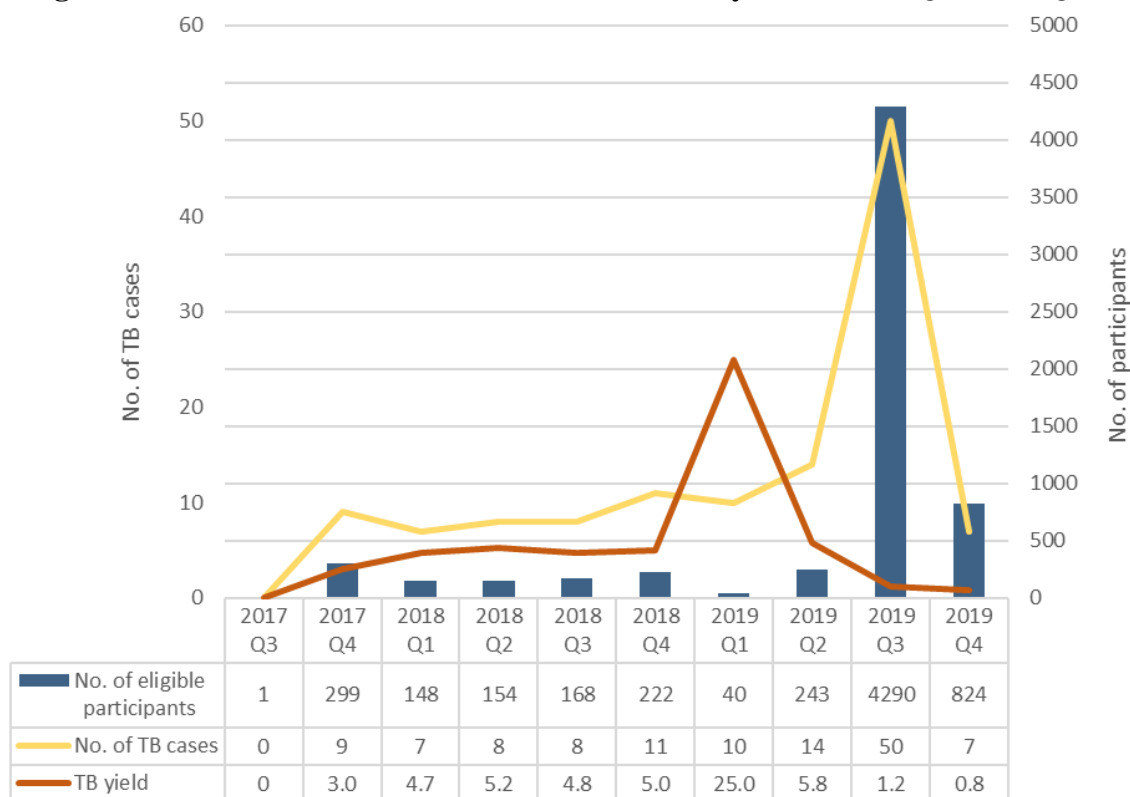
	Tan Tuc	5.0	0.6-41.3	
	Vinh Loc A	3.6	0.5-28.1	
	Vinh Loc B	4.2	0.5-32.7	
Residential status	Permanent (RP1)	1		
	Intra-province temporary (RP2)	2.2	1.0-4.9	0.05
	Long-term extra-province (RP3)	2.7	1.34-5.6	0.006
	Short-term extra-province (RP4)	3.3	0.94-11.3	0.062
Health insurance	No	1		
	Yes	0.86	0.51-1.5	0.593
Diabetes	No	1		
	Yes	1.008	1.004-1.012	p<0.001
Previous TB treatment	No	1		
	Yes	3.0	1.95-4.7	p<0.001

4.2. Efficiency and effectiveness of ACF intervention for older adults in Binh Chanh

4.2.1. The efficiency of the intervention in terms of time and geography

Figure 9

Screening results in ACF for older adults in Binh Chanh by times from Q3.2017- Q4.2019



This section described the case detection from the ACF for older adults in Binh Chanh based on the number of TB detected, NNS, or TB yield by time. Also, I looked into the patterns of case detection in each commune during implementation time.

ACF in Binh Chanh district started from the last month of quarter three of 2017 (June 2017) to the fourth quarter of 2019 (December 2019). However, enumerated data of screening for older adults were only available from Quarter 3, 2017. In the third quarter of 2017, only one participant aged above 54 was screened. On average, the ACF screened 355 people per quarter during 1.5 years of intervention. The intervention was most active in quarter three of 2019, with a significantly high number of people participating in the ACF, at 4290 people. The number of TB detected in this quarter was also highest in this period (50 cases) compared to other quarters. TB yield in this quarter, however, was at a moderate level (1.2%).

Interestingly, TB yield reached a peak of 25% (n=10 cases) in the first quarter of 2019 when participation hit the lowest point (except for the 1st of 2017). In the whole implementation time, the ACF for older adults in Binh Chanh obtained TB yield at 1.94%. To detect one TB case (all forms), it needed to screen in a total of 51.5 older adults (Figure 9).

TB yields in the whole implementation time were witnessed noticeably high in Binh Hung and Pham Van Hai (3.3% and 2.9%, respectively). The lowest TB yield was in An Phu Tay district (0.5%), where only one TB positive was detected in the ACF. TB yields in the remaining communes slightly varied in a small range around the overall yield of the intervention, from 1.2% to 2.1% (overall TB yield was 1.94%). The number of CXR in each commune was arranged following the size of the population in each commune. This explained Vinh Loc A and Vinh Loc B had more CXR camps (Figure 10).

In terms of the distribution of new TB cases that were detected from the ACF, the highest notification rate in the intervention was seen in Quy Duc, at 49/100,000 population, followed by Pham Van Hai and DaPhuoc. An Phu Tay Vinh Loc A and Vinh Loc B showed the lowest notification rate in this intervention (Figure 11).

Figure 10

Average TB yield in ACF for older adults in Binh Chanh in whole period of ACF | Q3.2017-Q4.2019 (%)

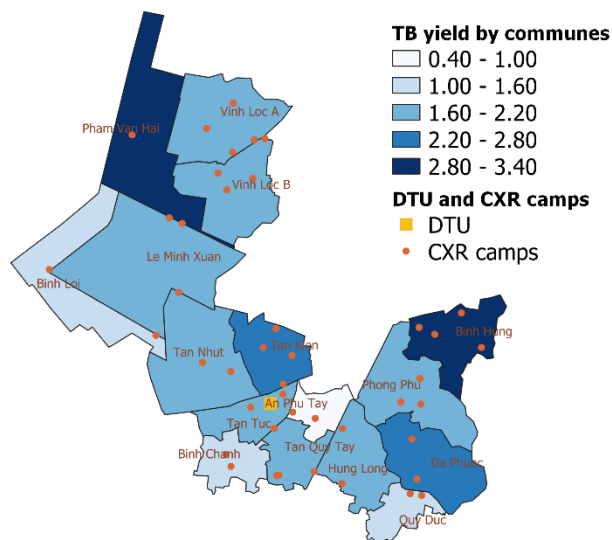
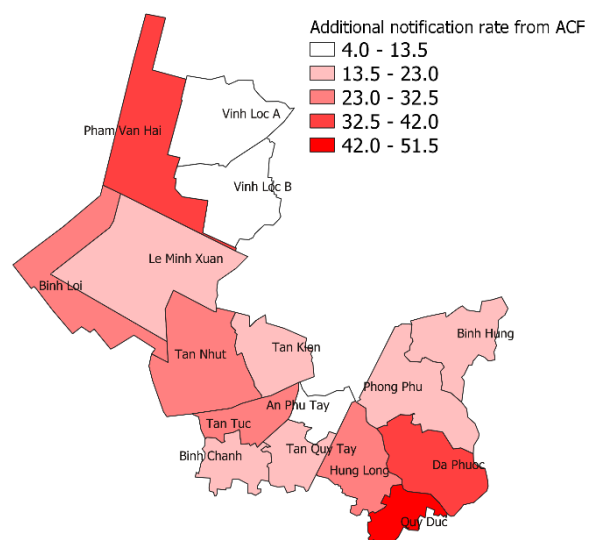


Figure 11

Additional notification rate from cases detected in ACF for older adults in Binh Chanh Unit: per 100,000 | (Q3.2017-Q4.2019)



4.2.2. Effectiveness of the ACF

This section described the notification impact of the ACF through the change of notification rate before and after the ACF for older adults. The changing trends were performed by temporal and geographical analysis. In this study, notification data of Binh Chanh were only available until the third quarter of 2019. Thus, to access notification impacts of the ACF for older adults in Binh Chanh, the temporal comparison referenced from the last quarter of 2017 until the third quarter of 2019. The third quarter of 2017 was excluded because only one participant was screened during this time.

Notification impacts by time from

Figure 12 showed the contribution of ACF in TB detection in the district during the aforementioned period. On average, the ACF for older adults increased by 6.8% into the TB notification rate of the district. The difference of increasing trend shaped at a steady level from Quarter 4-2017 until Quarter 2-2019. In the third quarter of 2019, the intervention brought in the greatest contribution, elevating 23.9% for the local TB detection (Table 6 – Annex 4).

Figure 12

TB notification rate in Binh Chanh with and without ACF for older adults from Q4-2017 to Q3-2019 (Unt: per 100,000 population)

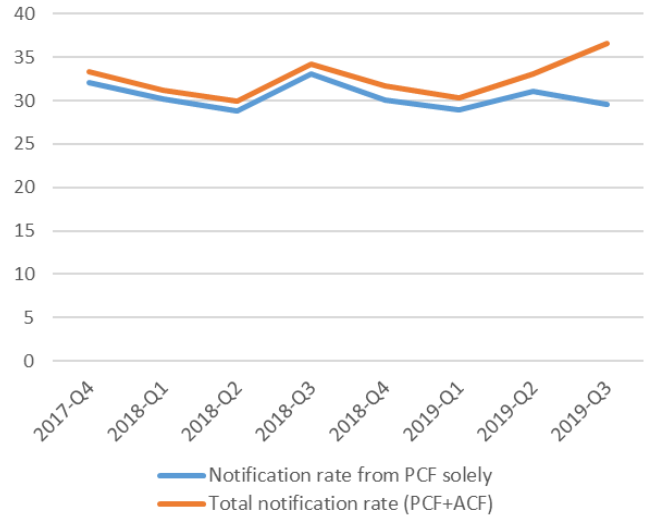
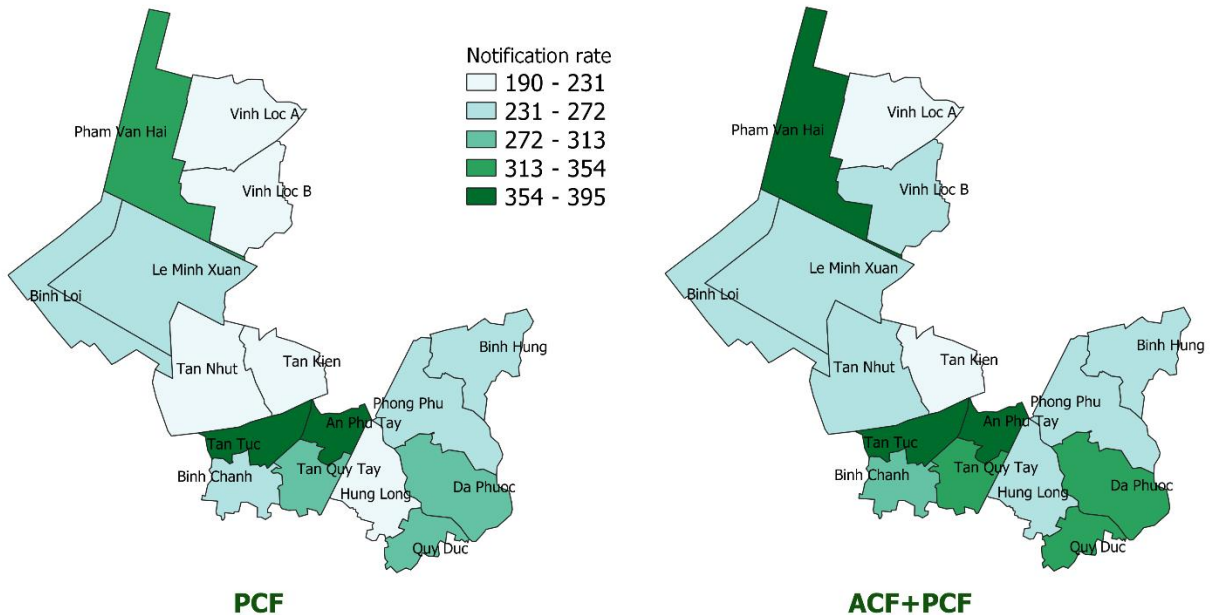


Figure 13

TB notification rate in Binh Chanh with and without ACF intervention for older adults from Q4.2017-Q3.2019 | Unit: per 100,000 people



The patterns of notification change among communes in the whole period – Q4.2017-Q3.2019

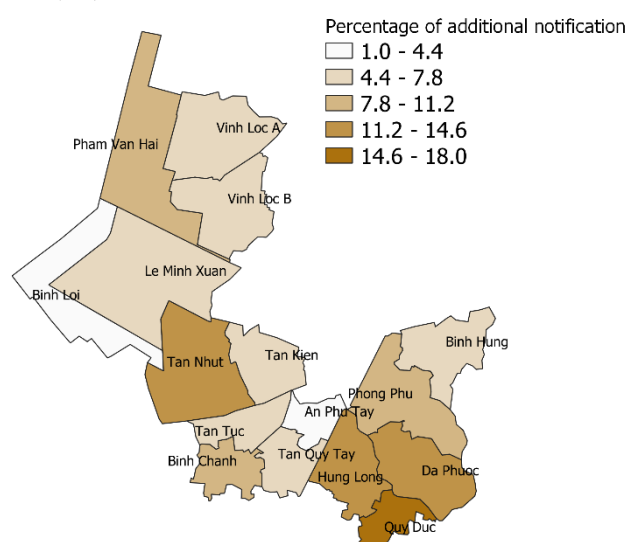
In this section, TB screening results in each commune were statistically performed. The efficiency of the ACF on each commune will be identified based on observation in the patterns of TB yields, additional notification rate from ACF among older adults in whole implementation time. Besides, I also used spatial analysis to appraise the impact of the intervention on the total notification rate stratified by each commune from Quarter 4 of 2017 to Quarter 3 of 2019 (based on available information provided by local surveillance data).

Overall, in the total period from the last quarter of 2017 to the third quarter of 2019, TB notification rate in the districts showed the highest in Pham Van Haim Tan Tuc and An Phu and the lowest in Tan Kien and Vinh Loc A. With the contribution from ACF, the significant increase in notification rate was observed in Vinh Loc B, Tan Nhut, Tay Hung Long, Quy Duc, and Da Phuoc. The interventions also shifted the concentration of TB cases in Binh Chanh from the central areas to around southeastern regions (Figure 13).

In Figure 14, the highest density of undetected TB positive concentrated in the Southern part of the district. Quy Duc had the highest density of undetected TB cases age above 54, followed by the neighbor communes – Tay Hung Long and Da Phuoc. Tan Nhut, and the center commune – Tan Nhut.

Figure 14

Percentage of additional notification rate from the ACF for older adults in Binh Chanh from Q4.2017-Q3.2019 (%)



4.3. Literature review – Predecessor TB ACF interventions in Vietnam and TB screening program among older adults in other countries (Summary in Table 7 – Annex 6)

4.3.1. Active TB detection in Vietnam

Despite the skew TB distribution toward the older age groups in Vietnam, early TB detection have not targeted to older populations. Up to now, the ACF intervention designs based on a residential approach in Vietnam were initially focused on coal miners, TB contact (household and neighbors) (36), or conducted as community-based screening (16)(17). In total, five eligible studies were

included, of which, one study was community-wide screening (39) and the other four targeted in TB contacts (31)(32) (40)(41). All five TB detection programs utilized District TB Units (DTUs) services for screening implementation.

The community wide-screening by Guy Marks et al. (39) was conducted in suburban areas in three years from 2014 to 2018. The study implemented door-to-door visits to every household. After symptomatic checking, the project staff requested sputum expectoration based on the responses and transferred collected sputum to the local DTU laboratory for the Xpert examination. The study, a cluster-randomized controlled trial, demonstrated the effectiveness of community-wide screening; however, the NNS was remarkably high, at 1002 per TB case (39).

Among two studies – both written by one by Gregory Fox et al. (40)(41) – focusing on household contacts, which recruited household members of registered TB patients for TB examination at the local DTUs in 6, 12, and 24 months during the implementation time. Participants were contacted through phone calls for inviting and reminding for examinations and follow-ups. During the visits, presumptive TB cases, which were defined as presenting TB symptoms or/and abnormality in chest radiography, were referred to sputum tests by Xpert or microscopy. The two studies chose both rural and urban locations but different sample sizes and periods. The study conducted from 2009-2011 screened the sample size of 545 participants and had NNS at 136 (41). The other study screened for about 10,000 people in 2.5 years (2010-2013), but produced smaller NNS, at 74.6 (40).

Two other studies, written by the same author Luan Vo et al. (31)(32), conducted TB investigation of household and neighboring contacts toward TB index cases. Both studies applied the same screening algorithm, which is symptomatic screened at the contacts' houses by outreach workers (door-to-door), referring to DTUs for CXR for suspected cases defined by symptoms, and Xpert MTB, smear tests and clinical review for TB diagnosis. All household members were invited to DTUs regardless of their responses for symptomatic questionnaires in the door-to-door visits of outreach workers. In the same screening radius of 50 meters toward the TB indexes, the study conducted in 2011-2015 in urban districts had NNS at 313, while the one conducted from 2017 to 2019 in poor urban districts produced NNS at 282 per TB case. Both studies were conducted in Ho Chi Minh City.

4.3.2. Community-scale ACF for older adults worldwide

In total, ten ACF reports from different projects and the following countries were included in this section. Of 10 intervention reports, three had their targeted population that matched my study subject of interest (aged 55 years old and above) (42)(43)(44). Two papers focused on ACF among the elderly (≥ 65 years old) (45)(46). Four articles reported community-based ACF results that had available data involving older age groups (≥ 55 or ≥ 65 years old) (47)(48)(49)(50). And the last paper was related to active TB detection for diabetic elderlies in the community (51). Mobile chest X-ray camps at the designated areas were only organized in 8 studies. A variety of screening algorithms were applied through ten studies. Details are summarized in Table 7 in Annex 6.

Characteristics of TB in ACF interventions for people aged above 54

In this part, I reviewed the characteristics of TB among older adults in ACF interventions in other countries. Through TB related-symptomatic, potential factors from ACF for people aged above 54 in other countries, a better understanding of TB among the old aged was suggested.

Asymptomatic phenomenon showed high rate among TB cases aged above 54. In an ACF activity for older adults in rural districts in Cambodia, the results showed that among TB cases, 28.42% reported coughing, of which 16.59% of TB cases coughed more than two weeks. Asymptomatic TB cases comprised 20% of all TB cases. Cough with sputum or hemoptysis were spotted in only 3.11% of the TB detected (44). Meanwhile, TB detection among diabetic patients aged above 64 in Taiwan reported that coughing more than two weeks presented among 8.33% of active TB diagnosed. Besides, one-third of the TB cases in this research reported having sputum, and 8.33% of TB cases reported chest pain (51).

Three studies reported that the odds of being infected with TB were higher males than females (44)(46)(51). In ACF activity for older adults in rural Cambodia, Camelique et al. specified that men had a three times higher chance of active TB diagnosis than their female counterparts (44). This odds ratio was highest in the ACF program for diabetes seniors in Taiwan, at 5.44 (51). Historical TB treatment also increased the higher chance of TB infection. In the early TB detection for people above 54 organized by the Camelique team, people with previous TB treatment faced 1.8 times higher chance of TB infection than those without historical TB diagnosis (44).

Algorithm designs and the NNS

Overall, the algorithms which produced a high yield of TB for early detection for the older adults involved CXR for all participants (screening phase) and Xpert assay for all screening positive (testing phase). The highest TB yield was found in the community-based ACF by Sengai et al. The extracted data showed that TB yield for screening the older adults was 2.63%. However, NNS's deviation between research could be ascribed for the difference of TB burden in each designated area.

The ACF that included CXR as the main element in the screening phase yielded higher TB cases than the one using suggestive TB symptoms in the first selection step. In comparing two ACF for older adults in the rural setting in Cambodia, Richard James et al. only provided CXR for older adults with suggestive TB symptoms confirmed by trained HCWs, while Camelique et al. provided CXR for all participants regardless of their symptoms, presumptive TB was determined as positive in symptomatic review or/and abnormal CXR. As a result, NNS in Richard James's research was considerably higher than one in Camelique's results, at 173 (43) and 46 (44), respectively. The corresponding TB yields were 2.17% and 0.58%. This difference was also witnessed in the results of ACF in two provinces in China and Taiwan. Studies using the combination of CXR and symptomatic review for screening (in Yunnan province and Taiwan) (50)(51) showed significantly higher TB yield than study, which ruled out people without TB symptoms in the first stages (in rural Sichuan province) (45). TB yield was 0.44%, 0.39% and 0.15%, respectively.

In the testing phase, the study combining Xpert with smear sputum test yielded more TB cases than using Xpert alone. Two projects in Zimbabwe, one named ZimbabFIT ACF by Machejera et al. and the other named Tas4TB by Sengai, were all conducted high TB burden districts in the same year (2017). These two studies also applied the same techniques in the screening phase (combining symptomatic checkup and CXR). However, the Tas4TB programme, which used both microscopy and Xpert for sputum test, showed lower NNS than ZimbabFIT ACF, which used Xpert solely. NNS for the population aged above 64 was 38 in the former (48), while it was 68 in the latter algorithm (47). The corresponding yield percentages were 2.63% and 1.47%.

5. Chapter 5: Discussion

5.1. Characteristic of TB among older adults from subnational data – Binh Chanh district

In this section, I compared characteristics of TB among older adults in Binh Chanh to other outcomes from other ACF for older adults. From the comparison, the potential reasons can be suggested as evidence for recommendations in Chapter 6.

Sex distribution

In the ACF in Binh Chanh, although the number of male participants the ACF were lower than the number of females, percentage of positive TB among males were higher than among females, and the odds of TB infection were 3.5 times higher among males than females. This result is consistent with the notification rate between sex groups in Binh Chanh district. Notification data in 2017 of the district reported that TB notification rate among male tripled the rate for females (222/100,000 males and 73/100,000 females). Likewise, the second national TB prevalence survey in Vietnam also revealed that the weighted prevalence of TB among males was 4.3 times higher than the figure for females (26).

In the neighbor country of Vietnam – Cambodia, an ACF in 2015-2017 targeting people 55 years of ages and older also delivered the similar association, with the OR=3 (44). This study was organized in rural areas in a high-prevalence TB country. Interestingly, study among elderly with diabetes in Taiwan showed the chance of TB positive was 5 times higher among men than women, suggesting that co-morbidity might exaggerate the sex difference of TB infection.

The explanation behind this skewed sex distribution of TB is still argumentative because there are several suggested determinants such as biological structure, socio-cultural elements, or behavioral practices, which can be attributable to this discrepancy. Several animal experiments proved that male hormones or genetic effects emphasize TB susceptibility among males (52)(53)(54). However, behavioral factors such as smoking, alcohol, hazardous vocational exposure, or dietary habits also play roles in differentiating immunological responses to TB in each sex group generally (55). In Vietnam, men tend to work in more polluted environments such coal mines, construction, or outside crowded areas (motor drivers), which brought in higher risk of TB transmission among them.

In the latest TB prevalence survey in Vietnam, TB gender gap grows with age of participants (26), proposing that accumulative TB risk factors related to life-time habits may institute the gender gap of prevailing TB proportion in men (26)(55). For example, long-term smoking, which can heighten TB infected through lung damages (56), was seen much higher among men than in women according to the prevalence of tobacco smoking in Vietnam in 2015 (57).

Age distribution

My study showed that the percentage of TB diagnosed reduced with age (from 2.25% to 1.1% followed by 3 age groups). This trend contrasts to the results in the aforementioned ACF in Cambodia in 2015-2017, which resulted in the increasing trend of TB detected from the youngest age group (55-64) to the oldest age group (≥ 75), the odd ratios of contracting TB also increased in each older age group ($p < 0.05$) (44). Potential explanation for the age distribution in Binh Chanh could be the burden of multi-morbidity increasing by age which lead to higher mortality rate of TB among the older age in Binh Chanh. Alternatively, the younger age group (55-64) may have

higher mobility time in the community than the senior which elevate their chance of TB transmission. However, due to the lack of information on health situation among older adults in Binh Chanh, more studies should be conducted to gain the stronger evidence for this trend.

Residential status

In ACF in Binh Chanh, participants who possessed temporary resident permit of the district (intra-province temporary – RP2 and long-term extra-province – RP3) showed higher probability of TB infection than the permanent residents (RP1). This results is accordant with the ACF for TB contacts in an urban district of HCMC in 2014, which pointed that people with temporary residency status were more vulnerable with TB than the local residents (31). Economic migrants in terms of crossing the provincial borders has been attracting public health's concern through time. The temporary migrants exhibited their vulnerability with transmission of infectious diseases due to the tendency of lower socioeconomic status, the poor living conditions and obstacles to access health services (58)(59)(60). In the setting of emerging urbanization, these elements escalate TB risk factors and exacerbate TB infections in this such sub-community (60)(61)(62).

Financial access to services

The early detection for older adults in Binh Chanh showed that parentage of TB positive among health insurance owners was statistically lower than the number for people without HI (3.11% and 1.8%, respectively), however, there is no association between HI possession with TB ($p>0.05$). In Vietnam, the NTP offered TB free services for all people with HI subscription, however, among people with HI, TB seeking-care delay still happened because of lacking information on these policies (63). On the other hand, health insurance coverage of the older adults in ACF in Binh Chanh reached 89.43%, older adults without HI were just the minority in this study. These components might explain the results in HI and TB pattern in this study.

Moreover, in the setting of urbanization in young population structure, health information and services usually more focus on the the youth, shaping the barriers between older adults with the health systems (64). Thus, although Vietnam NTP provide considerable financial supports for the beneficiaries, generally, the old adults are inclined to be marginalized in the health system compared to the younger (63).

Co-morbidities (diabetes)

The cross-sectional study among TB patients in Hanoi - Vietnam found that older age groups (from 55 and older) got a higher chance of TB-diabetes co-infections (65). However, my study did found the association between diabetes and TB among older adults. Data in diabetes status was missing in 26.42% of the participants, and 43.5% of TB detected cases didn't have this information reported. Moreover, diabetes data was collected based on self-reported, which might evoke potential bias in the certainty of non-diabetes confirmation among participants.

History of TB treatment

Previous TB treatment increased three times the odds of TB infections among older adults in the ACF in Binh Chanh. This result is consistent with the result from the study by Camelique et al. In this 2-year ACF for older adults in rural Cambodia, the odds ratio of TB for people with historical TB treatment was 1.8 times higher than one without previous TB treatment (44).

5.2. From subnational data and findings used for prioritizing high impact intervention for older adults in Vietnam

In this section, the efficiency of ACF intervention for older adults in Binh Chanh was discussed through the comparison of NNS and algorithm uses with other ACF outcomes from the literature review. Besides NNS and notification impacts also collated through temporal trend, geographical patterns to assess the effectiveness of the intervention in local TB programme. Based on the discussion in efficiency and effectiveness of ACF intervention for older adults in Binh Chanh, the prioritizing high impact interventions for older adults in Vietnam were formulated and specified in the Recommendation – Chapter 6.

From NNS/TB yield to ACF strategic prioritization

In terms of ACF in Vietnam, all of the included studies resulted in higher NNS compared with NNS from my research – the ACF for older adults in Binh Chanh (51.5 per one TB case) (Table 5). The greatest NNS was reported in community-wide screening in Ca Mau province from 2014 to 2018 (1002 per one case) (39). Although its impact on reducing TB prevalence was strongly verified through a randomized trial, this NNS outcome again highlighted significant limitations of mass community screening in sustainable TB strategies in LMIC as Vietnam, which is the excessive demands in human resources and budget. Thus, systematic screening for HRGs should be put in prioritization (24)(25)(66). In Vietnam, published reports of ACF for HRGs based in residential approach only targeted in TB contacts. For these HRGs, NNS ranged from 74.3 to 136 for household contact tracing (19,41) and from 282 to 313 for door-to-door screening TB contacts (household and neighboring contacts) (31,32). These NNSs are higher than in my study, although TB contact posed a higher risk of TB than older adults (66). This suggested that ACF for older adults had a promising impact on accelerating TB detection in Vietnam since the budget to detect one TB case may be lower compared with other HRGs. However, it may be inaccurate to make a direct comparison of NNS between my study (ACF for older adults) and ACF for other HRGs in Vietnam because of the difference in diagnosis algorithms and screening organization (tracing contacts, door-to-door screening, CXR camps).

For active TB detection of older adults in different studies, the NNS in my study is concordant with results from ACF conducted in 2012-2014, which is also among 30 countries with a high burden of TB (67). This study employed the same algorithms as my study. Extracted data from ACF in Philippine showed that NNS in poor urban settings was 45 older adults per one TB case (49). CATA program in Cameliq's publication, which conducted active detection for older adults in rural Cambodia in 2 years, delivered the NNS at 46 per TB case (44).

In algorithm prioritization in ACF for older adults, CXR should be considered to undergo for all participants. In ACF in Binh Chanh, if CXR was only offered to participants with suspected symptoms, 15% of TB cases would have been omitted from the screening for older adults in Binh Chanh and the NNS would increase to 61 per TB case. A bigger gap of NNS was seen in the comparison between two ACF for older adults in rural Cambodia. One using the symptomatic review as the first gate of screening (43) produced higher NNS to one providing CXR for all participants (46) (173 and 46, respectively).

In the testing phase, although Xpert assays acquire high specificity in detecting TB up to 99.9% (68), TB diagnosis for older adults shouldn't depend on Xpert solely in high prevalence settings (1). Without the smear test, the ACF in Binh Chanh would have left out 9,7% TB cases, which

expand the NNS of the study. Outcomes from two ACF for the elderly in Binh Chanh also proved that activity having both Xpert and microscopy for testing yielded more cases (2.63%) (48) than one using Xpert only (1.47%) (47).

From notification impacts to ACF strategic prioritization

If the NNS conveyed the capacity and efficiency during ACF implementation, notification impacts might give a more insightful evaluation of the activity contribution to the TB epidemiology of the areas. Overall, ACF intervention for older adults increased TB cases notification by 6.8% on average, compared to the only PCF. In quarter 3 of 2019, the screening was accelerated with the highest number of participants (Figure 9) and brought in the greatest contribution for the local notification rate in the whole period (Figure 12). This trend suggested that if the ACF were consolidated the approach for the entire population, the additional contribution would be magnified since the participation rate in the ACF only accounted for 6.12% of the estimated older adult population in Binh Chanh.

Vinh Loc A and Vinh Loc B had the biggest population size, yet the number of CXR camps was also higher in the areas to meet the demands for these populations. However, the TB yields and notification rate before and after the intervention were still lower than other communes, which brought in the ideas that population size had no impacts on TB transmission in the district. Instead, the difference in coverage and quality of TB services, demography, or socioeconomic statuses in each commune should be put into consideration.

Tan Tuc, where DTU was located, showed a great notification rate in both before and after the intervention. However, the percentage of notification increase in the commune is not high, which could suggest that the rate of undetected TB cases aged ≥ 55 in the commune is low. This pattern also was observed in the neighboring commune – An Phu Tay. As diagnosis for TB was only provided from DTU to higher levels in the TB health system, all TB patients have to be diagnosed in DTU first before referred to commune health stations for DOTS (Directly observed treatment, short-course). Thus, a potential hypothesis is that the availability and accessibility of the TB diagnosis services in each commune may affect TB undetected among older adults. Moreover, the TB communication campaigns to promote early TB detection might be more extensive and vigorous in the proximity of the DTU, which brought in more TB cases enrolled in the system and reduced TB undetected rate. This hypothesis explains the higher notification rate and the lower TB yield in these communes.

On the other hand, commune Pham Van Hai had the smallest population size in the district (Figure 1). However, the spatial data showed that the commune had a very high burden of TB as its TB yield and notification impacts were at a high level in the spectrums in all the maps. On the other hand, Pham Van Hai stretches in a wide area and has a long distance to the District TB Unit, but the only governmental health facility was located near the border with Le Minh Xuan. From the aforementioned hypothesis, it is suggested that Pham Van Hai might be marginalized in the TB health system. However, with the lack of information in demography or socioeconomic statuses in each commune, the study can not affirm the definite reasons behind the varying trends of TB results from ACF. Thus, further evaluation in TB health services in Binh Chanh should be put into prioritization to have stronger evidence for building local TB strategies.

5.3. Limitations

My study had limitations. In this section, limitations of the secondary data analysis were specified to understand the needs, the gaps, the weaknesses of ACF for older adults in Binh Chanh district were indicated. Besides, the limitations from the literature review was also indicated to develop recommendations for further TB ACF interventions for older adults in general.

The needs, the gaps, the weaknesses of ACF for older adults in Binh Chanh

Firstly, since the interventions covered about 6.12% of the estimated older adult population, the additional notification rate for TB detection in Binh Chanh can not elucidate the actual magnitude and burden of undetected TB aged above 54. Thus, the efficiency and effectiveness of the ACF might be underestimated. Also, results might not be accurately representative of the actual characteristics and distribution of undetected TB cases aged above 54. However, to mitigate the problems, the intervention tried to cover the maximal population by organizing communication campaigns with multiple means of approach, establishing many CXR camps following the population size of the communes.

The ACF was not regularly implemented during the project time; the majority of participants were screened in the third quarter of 2019. Therefore, the temporal assessment of TB yield and notification impacts was hindered.

The local notification data in the last quarter of ACF in Binh Chanh was unavailable, yet the notification impact from ACF can not be comprehensively appraised in the whole implementation time.

The study used secondary data for analysis, hence, it can not assure the quality control of data collection. Many participants from the original data were outside the frame of the project protocol. The study had to exclude 18.8% of the enumerated data because of the erroneous inclusion to criticize the choice of diagnosis algorithms. Besides, smear data only available among 25% of lab tests, which may result in missing out TB cases, which were negative in Xpert. This missing data also obstruct an accurate evaluation of the algorithm used.

Also, although co-morbidity is a noteworthy topic in TB among older adults, assessing this is beyond the study's capacity because of missing data on diabetes and the HIV status of the participants. The data on diabetes also based on self-report, which may result in potential bias.

Finally, the study encountered some obstacles to gain a better understanding of geographic risk factors of TB for older adults in Binh Chanh. First, missing or inaccurate data in personal address and CXR screening location was seen in around more than 40% of the participants. This omission limited the spatial analysis in identifying precise TB hotspots among older adults. Besides, the detailed data in local demography, socioeconomic status are unavailable, which hindered the effort to explain the patterns of TB distribution in the areas before and after the ACF.

In the literature review

Publishing bias can be taken into account. Because of the restriction to access governmental documents in Vietnam, the study could not include all literature related to the study topic to have a comprehensive comparison between ACF in other HRG and ACF for older adults in Binh Chanh.

The comparison between NNS in different ACF interventions in Vietnam might be inaccurate since each ACF applied different diagnosis algorithms and screening organization (tracing

contacts, door-to-door screening, CXR camps). The comparison of ACF for older adults between Vietnam and other countries also scoped the same problem because of the variation of TB settings in each country.

6. Chapter 6: Conclusion and recommendations

6.1. Conclusion

Despite the limitations, the study proved the paramount importance of the ACF for older adults regarding the acceptability and feasibility to expand to interventions to other areas in Vietnam. The results of this study highlight the huge difference in TB burden between males and females in Binh Chanh, which can be easily extrapolated to the sex difference in Vietnam. In contrast to the increasing trend of TB over age groups found in national TB prevalence surveys, the TB burden in Binh Chanh decrease with age. This could be related to TB mortality and health insurance, warranting further research. Those with temporary residency are more vulnerable to TB than the permanent residents, and health insurance owners are less likely to have TB than those without health insurance. Those with previous TB treatment history and co-morbidities have more risk of TB than those without these conditions. These results could contribute greatly to TB health policy implementation in Binh Chanh and Vietnam, to focus on the high-risk groups, which can further decrease the TB burden, toward TB elimination in Vietnam in 2035.

The ACF activities in Binh Chanh and other high-burden areas globally suggest that prioritizing ACF on older adults might be more cost-effective to detect TB than other high-risk groups. Chest X-ray should be considered to be the initial screening method rather than rely on symptom screening, as chest X-ray was proved to increase TB yield in ACF activities. In community settings like Binh Chanh, Xpert MTB/Rif assays should not be the sole diagnostics, as it could leave out a percentage of TB cases. Instead, other bacteriological tests should be applied along with Xpert, such as sputum smear microscopy or culture. Prioritizing these suggestions would improve the quality of ACF activities in the communities.

The risk of TB may not be related to population size, instead, the difference in TB services coverage and quality and socioeconomic status of each community should be considered to assess the risk of TB transmission. TB detection and notification is better when communities are close to the DTUs, so campaigns to promote TB detection should be focused on areas which are far distant from DTUs.

6.2. Recommendations for prioritizing high impact ACF interventions among older adults

The results from ACF in Binh Chanh suggested that conducting ACF targeted in older adults aged above 54 suburban areas can be an effective option for national TB strategies, especially among temporary residents and historical TB patients. In Vietnam, although evidence pointed out the highlighted burden of TB among these age groups, focused TB interventions for them were still neglected. Thus, the study strongly recommends the expansion of TB ACF for older adults in the countries to gain an extensive understanding of this subgroup as well as contribute to END TB endeavor of the country.

The outcomes in ACF in Binh Chanh and the literature review exhibited that TB programs can be improved by alleviating sexual inequality in TB in the population. Male-focused communication should be prioritized to increase TB service utilization among males. Besides, to build specific TB interventions by gender, more studies focused on gender-related influencing factors should be developed in Vietnam. The evidence on potential factors such as occupational risks, lifestyle habits, or health-seeking behaviors is still limited.

For the screening algorithm, CXR exhibited its surpassing advantage for TB detection among older adults. Therefore, the study advocates that CXR should be the primary tool to detect TB presumptive TB for further diagnostic tests. Furthermore, combining Xpert with smear microscopy showed its merit in intensifying TB detection for the ACF in this study. However, due to the missing data of laboratory results, my research can not confirm this hypothesis, further experiments should be developed to gain comprehensive assessments on this.

Reinforcing communication strategies targeted in older adults should be prioritized in Vietnam. Besides heightening awareness of TB risk factors among older adults, the campaigns should aim to introduce TB service and facilitate healthcare-seeking behaviors among older adults in the community.

Reinforce TB re-examination for older adults with historical TB treatment each year. Results from ACF among adults in Binh Chanh showed a very high chance of TB relapse for those previously treated with TB. Thus, encouraging re-examination among previous patients by keeping following up, financial supports will help to reduce the chance of TB infection and transmission in the community.

The study also advocates developing the cost-effectiveness assessment for ACF interventions. Although the ACF for older adults in Binh Chanh showed a promising NNS for saving resources to detect a TB case, the actual cost-effectiveness compared to other ACF interventions in Vietnam may differ due to the difference in organizing methods and used algorithms. Thus, a thorough economic evaluation should be conducted to achieve more robust evidence in ACF prioritization and reinforce TB detection in Vietnam.

For the TB program in Binh Chanh, the study recommends that a thorough evaluation of TB health services in Binh Chanh should be put into prioritization. The assessment should focus on the quality and coverage of TB service and its effects on the older adults in each commune to develop specific plans for the areas. The association between TB or diagnosis delay among older adults and distance to DTUs should be verified in further studies in Vietnam. This potential factors might be valuable evidence contributing to the national TB strategy. I strongly recommended facilitating TB service and communication for older adults in some commune, which concentrated high undetected TB cases, such as Pham Van Hai, Quy Duc, Da Phuoc.

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Acknowledgement

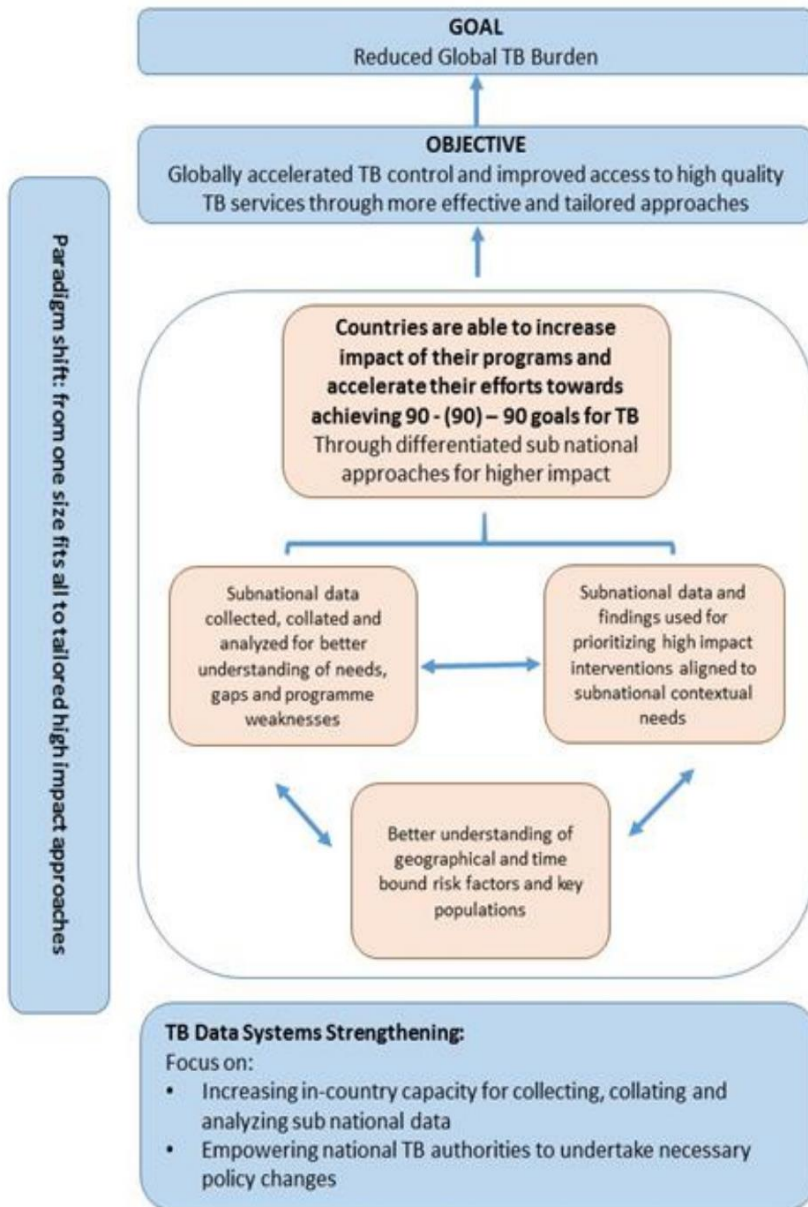
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Annex 1: Framework “The Theory of Change” behind MATCH



Annex 2: Summary of the original ACF programme by FIT

In collaboration with each district's People Committee, District Health Centers, District TB Units (DTUs), Commune Health Stations, retirement associations, civil society organizations and TB patient networks, FIT sensitized the community about TB and the availability of upcoming mobile CXR camps. The camps were marketed as a general health screening to ensure high acceptability. FIT also organized a gender-sensitive communications campaign (radio spots, banners/billboards, announcements in markets, etc) in conjunction with the aforementioned community outreach to reach additional older people and reinforce the dates of mobile CXR camps. All residents aged 55 years and over in our evaluation area were invited to attend, regardless of their actual or perceived health status. s

FIT aimed to screen 32,100 older people with CXR and a TB symptom questionnaire loaded on a mHealth app. CXR images were read on the spot by an X-ray tech to make rapid decisions about who needs a follow-on diagnostic testing. Anyone with an abnormal CXR was then coached on how to provide a good-quality sputum sample using instructional aides. Every sample was tested with a molecular assay. Samples collected on the spot were transported to laboratories for testing and those who are not able to provide sputum on the spot were followed up in their home to attempt collecting a morning sample. All diagnosed TB patients were initiated on treatment at the District TB Units or Commune Health Stations in the wards where they lived with support from the project team to minimize loss to follow up. Symptomatic, Bac- individuals were referred to District TB Units or the Provincial Lung Hospitals for further evaluation and care. When a person with TB is not initiated on treatment, FIT worked with the same patient networks and civil society partners FIT engaged to promote the CXR camps for tracing these individuals and linking them to treatment. People started on anti-TB treatment in the existing NTP program has an average treatment success rate of 92%.

X-ray techs intentionally over read CXR images, meaning when the tech was not sure whether an image is normal/clear or abnormal, it was always classified as abnormal. To ensure interpretation quality, all abnormal and 10% of normal images were reread by an external radiologist and all images will be scored using CAD4TB software. When a normal CXR, was reclassified as abnormal after rereading, FIT collected sputum samples in the community and transport them to the laboratory for testing.

Symptomatic people and household contacts of TB patients who are aged 0-54 years were still likely come to our mobile CXR camps. Even though this age group was not the focus of this project (due to their lower TB prevalence rates), FIT still screened these individuals in order to increase overall yields. Sex-disaggregated process indicators and targets had been developed to monitor project activities in both the target and non-target populations.

Annex 3: Chain of search term and combination

Table 4

Chain of search term and combination

Place	Conditions	Topics
‘Vietnam’ and ‘Southeast Asia’ and ‘Asia’ ‘developing countries’ or ‘middle-income countries’ or ‘lower-middle-income countries’	‘TB’	‘prevalence’ or ‘incidence’ or ‘vulnerable populations’ or ‘rural’ or ‘urban’ or ‘disadvantaged areas’ or ‘disadvantaged population(s)’ or ‘rural’ or ‘suburban’
	‘Tuberculosis’	
	‘older adults’	‘active case finding’ or ‘early detection’ or ‘screening’ or ‘case detection’
	‘elderly’	
	‘senior’	‘algorithm’ or ‘strategy’ or ‘strategies’ or ‘protocol’ or ‘prioritization’ or
	‘high risk groups’	
		‘risk factor(s)’ or ‘determinant(s)’ or ‘predictor(s)’ or ‘demographic’ or ‘social class’ or ‘socioeconomic status’ or ‘socio-economic status’ or ‘socioeconomic’ or ‘co-morbidity’ or ‘residential status’ or ‘gender’ or ‘sex’ or ‘diabetes’
	‘policy’ or ‘policies’ or ‘intervention’ or ‘evaluation’ ‘effectiveness’ ‘efficiency’	
	“Conceptual framework” or “model” or “frame work”	

**Vietnamese keywords for searching have the same meaning as in English. Keywords were searched with a combination or separately to find the most appropriate materials. “and” is used to connect the words in each column during searching.*

Annex 4: Table of Demographic description and general TB result of ACF among the older adults in Binh Chanh district

Table 5

Demographic description and general TB result of ACF among the older adults in Binh Chanh district

General information	Total eligible participants (total: 6,389)		Screening positive (by chest x-ray)			Confirmed TB of all forms				
	Total	No	% in total	No.	% in each group	p-value	No.	% in each group	95%CI	p-value
Sex										
Female	3,553	55.61	241	6.78	<0.0001 ^p	27	0.76	0.47-1.05	<0.0001 ^p	
Male	2,836	44.39	715	25.21		97	3.42	2.75-4.1		
Age										
55-64	3,061	47.91	434	14.18	0.05 ^t	69	2.25	1.8-2.84	0.017 ^t	
65-74	2,110	33.03	321	15.21		42	1.99	1.47-2.68		
>=75	1,218	19.06	201	16.50		13	1.07	0.62-1.83		
Commune										
An Phu Tay	205	3.21	25	12.20	<0.001 ^d	1	0.49	0.07-3.43	0.563 ^d	
Binh Chanh	444	6.95	61	13.74		6	1.35	0.6-2.98		
Binh Hung	415	6.50	67	16.14		14	3.37	2-5.63		
Binh Loi	251	3.93	25	9.96		3	1.20	0.38-3.67		
Da Phuoc	342	5.35	55	16.08		9	2.63	1.37-4		
Hung Long	320	5.01	41	12.81		7	2.19	1.04-4.53		
Le Minh Xuan	355	5.56	69	19.44		6	1.69	0.76-3.72		
Pham Van Hai	378	5.92	65	17.20		11	2.91	1.61-5.19		
Phong Phu	376	5.89	60	15.96		7	1.86	0.89-3.87		
Quy Duc	513	8.03	52	10.14		7	1.36	0.65-2.84		

Tan Kien	364	5.70	51	14.01		9	2.47	1.29-4.70	
Tan Nhut	426	6.67	57	13.38		7	1.64	0.78-3.15	
Tan Quy Tay	296	4.63	50	16.89		5	1.69	0.70-4.01	
Tan Tuc	343	5.37	67	19.53		7	2.04	0.97-4.23	
Vinh Loc A	744	11.65	96	12.90		12	1.61	0.92-2.82	
Vinh Loc B	617	9.66	115	18.64		13	2.11	1.23-3.60	
Residential status									
Permanent (RP1)	5,577	87.29	769	13.79	<0.001 ^d	96	1.72	1.41-2.1	<0.001 ^d
Intra-province temporary (RP2)	161	2.52	35	21.74		8	4.97	2.49-9.69	
Long-term extra-province (RP3)	164	2.57	49	29.88		10	6.10	3.29-11.03	
Short-term extra-province (RP4)	50	0.78	19	38		3	6.00	1.87-17.61	
N.A	437	6.84	84			7			
Health insurance									
Yes	5,714	89.43	813	14.23	<0.0001 ^p	103	1.80	1.46-2.15	0.001 ^p
No	675	10.57	143	21.19		21	3.11	1.8-4.4	
Diabetes									
Yes	768	12.02	80	10.42	0.001 ^p	12	1.56	0.69-2.44	0.43 ^p
No	3,933	61.56	576	14.65		58	1.47	1.1-1.85	
N.A	1,688	26.42	300			54			
Previous TB treatment									
Yes	506	7.92	323	63.83	<0.0001 ^p	34	6.72	4.5-8.9	<0.0001 ^p
No	5,877	91.99	633	10.77		80	1.53	1.22-1.85	
N.A	6	0.09	0			0			

*^p: *p*-value for the different of the proportion between 2 groups in one variable, obtained by Tests of proportions

^d: *p*-value for the difference of the proportions between each group in one variable, obtained by Pearson chi-square's test

^t: *p*-value for trend, obtained by Cuzik's test.

Annex 5: Table of contribution of ACF among older adults through time of intervention in Binh Chanh districts from Q4-2017 to Q3-2019

Table 6

Contribution of ACF among older adults through time of intervention in Binh Chanh districts from Q4-2017 to Q3-2019 (n=708,181)

Quarter	Notification rate from PCF solely (per 100,000 population)	Total notification rate (PCF+ACF) (per 100,000 population)	Percentage of additional notification from ACF
Q4-2017	32	33	4.0
Q1-2018	30	31	3.3
Q2-2018	29	30	3.9
Q3-2018	33	34	3.4
Q4-2018	30	32	5.2
Q1-2019	29	30	4.9
Q2-2019	31	33	6.4
Q3-2019	30	37	23.9
In all 8 quarters	244	260	6.8

Annex 6: Summary results from Literature review

Table 7

Summary results from Literature review

No	Authors/ Project	Algorithms	Year	Location/p opulation characteris tics	Country	Using mobile CXR vehiclse	Study subject	NNS	TB yield (%)
ACF interventions in Vietnam									
1	Guy B. Marks et al.	Door-to-door screening (symptoms review + sputum collected + clinical review) → Xpert (HCWs reviewed TB symptoms at household, collected and transferred available sputum to the laboratory for Xpert test)	2014-2017	Sub-urban areas	Vietnam	o	General population	1002	0.1%
2	Gregory Fox et al.	Contact investigation → symptomatic review+CXR → smear → clinical review (Contact with household members of enrolled TB cases by phone to invited in TB examination at local DTU in 6, 12, 24 months)	2009-2011	Rural and urban districts (pop=545)	Vietnam	o	Household contacts	136	0.7%
3	Gregory Fox et al.	Contact investigation → symptomatic review+CXR → smear → clinical review	2010-2013 (2.5 years)	Rural and urban districts	Vietnam	o	Household contacts	74.3	9.4%

		(Contact with household members of enrolled TB cases by phone to invited in TB examination at local DTU every 6, 12, 24 months)		(pop=10,069)					
4	Luan Vo et al.	<p>HCWs invited participants to local DTUs for TB examination</p> <p>- Household contacts → DTU: CXR → Xpert+smear</p> <p>- Neighbors: symptomatic review (by trained HCWs) → DTUs → CXR → Xpert+smear</p>	2017-2019	Poor urban areas	Vietnam	0	Household and neighboring contacts	282	0.35%
5	Luan Vo et al.	<p>HCWs invited participants to local DTUs for TB examination</p> <p>- Household contacts → DTU: CXR → Xpert+smear</p> <p>Neighbors: symptomatic review (by trained HCWs) → DTUs → CXR → Xpert+smear</p>	2011-2015	Urban areas	Vietnam	0	Household and neighboring contacts		
ACF for or involving older adults/the elderly in other countries									
1	Richard James et al.	1.1. Symptomatic screening → CXR → Xpert → clinical review	2013-2014	05 Rural districts	Cambodia – high burden of TB	x	≥55	173	0.58
2	Andrew Codlin et al.	1.1. symptomatic screening → CXR → Xpert → clinical review	2013-2014	04 rural districts	Cambodia – high	x	≥55	NA	NA

					burden of TB				
3	Canyou Zhang et al.	1.2. symptomatic screening (door-to-door screening by HCWs) → CXR → smear + culture → clinical review	2017	Rural areas in Sichuan Province	China – high burden of TB	o	≥65	683	0.15
4	Machekera et al. - ZimbabFIT ACF Project	2.1. symptomatic screening + CXR → Xpert → clinical review	2017	Areas with the high-prevalence of undiagnosed TB	ZimbabFIT – high burden of TB	x	≥55 (extracted data from community-based ACF)	67.3	1.49
							≥65 (extracted data from community-based ACF)	68	1.47
5	Sengai et al. Tas4TB Programme	2.2. symptomatic screening + CXR → Smear + Xpert → clinical review	2017	Areas with the high-prevalence of undiagnosed TB	ZimbabFIT – high burden of TB	x	≥65 (extracted data from community-based ACF)	38	2.63
6	Camelique et al.	2.3. symptomatic screening + CXR → culture + Xpert → clinical review	2013-2015	Rural districts	Cambodia – high	x	≥55	46	2.17

	(CATA intervention)			burden of TB				
7	Jin-Ou Chen et al. 2.4. symptomatic screening + CXR → smear → clinical review	2013-2015	Yunnan province	China – high burden of TB	o	≥65 (extracted data from community-based ACF)	226	0.44
8	Yung-Hsiang Lin et al. 2.5. symptomatic screening + CXR → smear + culture → clinical review	2012	All patients with type 2 diabetes mellitus (inpatient and outpatient departments of the local health facilities)	Taiwan – low burden of TB	x	≥65 (diabetes patients)	257	0.39
9	Fukushi Morishita et al. 3.1. CXR → Xpert + smear → clinical review	2012-2014	poor rural areas	Philippine – high burden of TB	x	≥55 (extracted data from community-based ACF)	42	2.35
			poor urban areas				45	2.23
			indigenous communities				27	3.74

10	Hyunwoo Kim et al.	3.2. CXR → smear + culture → Xpert (for those with negative smear results)	2017	Jeollanam- do province	South Korean – low burden of TB	x	≥65	775	0.13
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