RESEARCH PAPER

Radiographic diagnosis patterns and communicability: Analyzing TB and non-TB findings from mobile X-ray screenings in region 2, Philippines

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Abstract

The aim of this study is to analyze the occurrence and trends of radiographic diagnoses, classifying them based on their communicability. The main goal is to assess the occurrence of both infectious and non-infectious disorders among patients examined using mobile X-ray devices during the 2022 active tuberculosis (TB) detection efforts in Region 2, Philippines. This initiative is financially supported by the Global Fund – Philippine Business for Social Progress. The study employs a quantitative descriptive cross-sectional approach, examining secondary data from 15,120 people that were screened. The results indicate that 81% of the radiographs were within the normal range, while 19% exhibited abnormalities, with the bulk of these abnormalities being non-pulmonary tuberculosis (PTB) findings. Non-communicable illnesses were the most common aberrant results, particularly among persons aged 60 and older. Gender analysis revealed a greater incidence of non-communicable diagnoses among females. Isabela was identified as the area with the greatest occurrence of both communicable and non-communicable diseases by spatial analysis. The study also found a notable association between PTB and other non-PTB radiographic abnormalities, such as atheromatous aorta and pneumonia. These findings indicate a pressing requirement for focused public health interventions and allocation of resources to tackle both infectious and non-infectious disorders, especially in locations with high rates of occurrence. Gaining insight into these trends helps optimize diagnostic, preventative, and therapeutic approaches, thereby enhancing public health outcomes as a whole.

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Introduction

Tuberculosis (TB), predominantly caused by Mycobacterium tuberculosis, continues to be a substantial public health issue worldwide, particularly in low- and middle-income countries where more than 80% of cases and fatalities are reported (WHO, 2020). The illness primarily impacts the lungs but has the potential to extend to other organs, resulting in a range of clinical presentations. Timely identification by radiographic screening, namely chest X-rays (CXR), is crucial in the attempts to reduce tuberculosis (TB). The significance of chest X-ray (CXR) in tuberculosis (TB) diagnosis has been underscored once again based on the results of national TB prevalence surveys, which have shown its high sensitivity in identifying pulmonary TB, despite its limited specificity (WHO, 2016). The objective of this study is to ascertain the occurrence rate of radiographic diagnoses based on their communicability (communicable, non-communicable, both, and undetermined) and to analyses the occurrence and co-occurrence patterns among various radiographic findings.

The renewed interest in the practicality of using CXR for TB screening is attributed to its adaptability and very affordable price. In the past, mobile mass radiography was widely utilized throughout the mid-20th century but eventually discontinued in favor of stationary tuberculosis services (WHO, 1974). The significance of radiography technology and computer-aided detection has been revitalized due to recent breakthroughs. For example, the CAD4TB program has demonstrated potential in enhancing the precision and uniformity of CXR interpretation, especially in environments where there is limited availability of qualified radiologists (Guo, 2020). Nevertheless, the extent to which CXR screening is beneficial in identifying other diseases, whether they are communicable or non-communicable, has not been well investigated.

Radiographic data can provide insights into several disorders other than tuberculosis, such as lung cancer, cardiovascular problems, and chronic respiratory conditions. A research done in Kenya revealed that CXR screening has the ability to identify a range of important illnesses other than TB, indicating its potential for wider diagnostic use (Enos et al., 2016). This highlights the need of implementing thorough screening programs that consider both infectious and non-infectious disorders, particularly in areas with a high prevalence of both conditions.

By integrating tuberculosis (TB) and non-communicable disease (NCD) screening programs, it is possible to effectively treat the coexistence of both disorders. This is because TB and NCDs frequently have shared risk factors, such as smoking and unhealthy eating (Creswell et al., 2011).

Integrating TB and NCD screening presents several hurdles, despite the potential advantages. Research conducted in India has demonstrated that integrated screening is both practical and well-received. However, it also results in a higher burden and necessitates the presence of competent personnel and organized reporting mechanisms (Anand et al., 2018). The heterogeneity in the interpretation of radiographic images and the possibility of diagnostic mistakes make these efforts more complex. A study conducted by Aggarwal et al. (2023) found that even seasoned radiologists tended to overlook important findings in around 30% of chest radiographs. This emphasizes the necessity of implementing standardized protocols and providing comprehensive training in order to enhance the precision of diagnostic procedures.

This study aims to address the research gap by conducting a systematic analysis of the incidence and pattern of radiographic diagnoses in a specific community, with a focus on categorizing them based on communicability. Through the analysis of these patterns, our goal is to improve the comprehension of the diagnostic capabilities of CXR screening and provide insights for developing strategies for integrated disease management. This study holds significant relevance in locations such as the

Philippines, where the prevalence of tuberculosis (TB) remains high, and there is an urgent requirement to enhance diagnosis and treatment results (Flores *et al.*, 2022).

The primary goal of this research is to examine the frequency and patterns of radiographic diagnoses, specifically focusing on their categorization according to communicability. The study's main objective is to ascertain the frequency of radiographic diagnoses based on their communicability. It seeks to identify the proportion of cases that are classified as communicable illnesses, non-communicable diseases, both, or situations where the determination cannot be made solely based on radiographic data. In addition, the research aims to examine the frequency and distribution of various radiographic findings, with a focus on identifying the most prevalent diagnoses and understanding how they are distributed among different patient populations. In addition, the study will examine the occurrence of various radiographic findings, determining the frequency at which numerous disorders are detected simultaneously and assessing if there are any notable associations between certain types of radiographic abnormalities. Another important goal is to evaluate any possible temporal trends in the occurrence and co-occurrence of radiography findings, investigating if specific illnesses exhibit seasonal patterns or variations in frequency over time. The research ultimately seeks to gain insights into the possible public health consequences of the observed trends in radiography diagnosis. This includes identifying priority areas for intervention and resource allocation in both communicable and non-communicable illnesses. The research aims to enhance comprehension of illness patterns discovered by radiographic imaging, so facilitating the development of improved diagnostic, preventative, and therapeutic techniques.

Materials and methods

Research design

Using the ACF contractor and mobile van X-ray machines, TB and non-TB CXR results found during the 2022 active TB case-finding activities in Region 2, funded by the Global Fund – Philippine Business for Social Progress, were quantified and described using a quantitative descriptive cross-sectional design through secondary data analysis. The research ran from August 1, 2023, to January 31, 2024, a period of six months.

Sampling technique

Using the ACF contractor and mobile van X-ray machines, the study entailed a complete count of all individuals who received CXR screening as part of the GF-PBSP-funded active TB case discovery in 2022. 15,120 people in total were involved.

Locale of the study

Using information from ongoing TB case-finding initiatives supported by the Global Fund - Philippine Business for Social Progress, the study was carried out in Region 2, Philippines.

Research instruments

The DOH Region 2 NTP Coordinator supplied printed secondary data for the research. This includes the province or city where the CXR was performed, the age and sex of the patients, and the radiographic findings/readings.

Data gathering procedure

The NTP coordinator in DOH Region 2 helped get the data from the PBSP. After eliminating missing data and taking into account just one data entry for those with repeated X-ray exams, the DOH NTP coordinator and staff gave a printed copy of the data. When findings varied, the one with anomalies found was considered. Using the initial CXR result, TB treatment recipients were identified.

Analysis of the data

To ascertain the prevalence of TB and other non-TB CXR diagnoses, the data were analysed. The results were divided into groups based on the anatomical location, coexistence of PTB and other anomalies, and individual profiles. A percentage was computed and used to represent the frequency of diagnosis. The demographic characteristics of the research participants, including

frequencies, medians, and percentages, were presented using descriptive statistics.

Results and discussion

The above figure shows that among the 15,120 patients who availed of the TB Screening done by the PBSP using their mobile X-rays and contracted X-ray facilities, 81% have normal diagnoses and 19% have abnormal findings (Fig. 1).
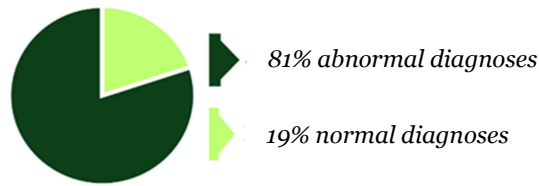
Fig. 1. Percentage of patients with radiographic findings

The majority of the radiographic findings are non-PTB, whereas only a few, or 10%, had PTB findings mixed with non-PTB findings. Majority of the abnormal radiographic findings (53%) are non-PTB. This further indicates that patients who have undergone radiographic procedures with normal radiographic findings still need to be clinically diagnosed (Fig. 2).
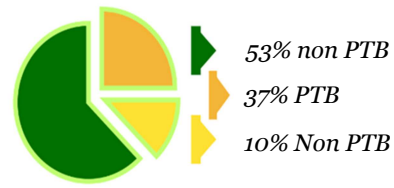
Fig. 2. Category of patients with radiographic findings

The data reveals that the majority of abnormal radiographic findings in individuals aged 60 and above are non-communicable in nature (Table 1a). This suggests that, in late adulthood, the prevalent X-ray findings are predominantly linked to noncommunicable and degenerative conditions. According to Kruk *et al.* (2015), noncommunicable diseases have emerged as the leading causes of death and disability globally. Low- and middle-income countries face significant challenges in providing adequate care for people suffering from cardiovascular diseases, diabetes, cancer, and chronic respiratory conditions.

Above Table 1b shows that there are 2,845 individuals with radiographic findings of either TB, non-PTB and TB mixed with non-PTB. When assessed according to communicability, majority are non-communicable.

Table 1a. Frequency and percentage distribution of the radiographic diagnoses when grouped according to their communicability in terms of age

Age in years	Communicability								Total	
	Non-communicable		Communicable		Both		Undetermined			
	f	%	f	%	f	%	f	%	f	%
1 year old	0	0	0	0	1	0	0	0	1	0
2-12	8	1	7	1	1	0	0	0	16	1
13-17	9	1	17	2	2	1	0	0	28	1
18-39	86	6	142	13	15	7	4	20	247	9
40-59	395	27	384	34	60	27	8	40	847	30
60 and above	991	67	566	51	141	64	8	40	1706	60
Total	1489	100	1116	100	220	100	20	100	2845	100

f=frequency

Due to rapid urbanization, mechanization of the rural economy, and the activities of trans-national food, drink and tobacco corporations, there are associated behavioral changes that increased the risk of chronic non-communicable diseases. These changes include less healthy diet, lower physical activity, tobacco smoking and increased alcohol consumption. As a result, population health profiles are rapidly changing from infectious to noncommunicable diseases.

The data indicates that Isabela has the highest number of radiographic findings, with a notable distribution across communicable, noncommunicable, and mixed categories (Table 1c).

Table 1b. Frequency and percentage distribution of the radiographic diagnoses when grouped according to their communicability in terms of Sex

| Sex | Communicability | | | | | | | | Total | |
| | Non-communicable | | Communicable | | Both | | Undetermined | | | |
	f	%	f	%	f	%	f	%	f	%
Male	550	37	577	52	110	50	7	35	1244	44
Female	939	63	539	48	110	50	13	65	1601	56
Total	1489	100	1116	100	220	100	20	100	2845	100

f=frequency

Table 1c. Frequency and percentage distribution of the radiographic diagnoses when grouped according to their communicability in terms of locality

| Locality | Communicability | | | | | | | | Total | |
| | Non-communicable | | Communicable | | Both | | Undetermined | | | |
	f	%	f	%	f	%	f	%	Freq.	%
Cagayan	262	18	314	28	40	18	0	0	616	22
Isabela	514	35	362	32	88	40	4	20	968	34
Nueva Vizcaya	227	15	72	6	29	13	5	25	333	12
Quirino	361	24	105	9	41	19	11	55	518	18
Tuguegarao	23	2	9	1	1	0	0	0	33	1
Santiago	14	1	178	16	5	2	0	0	197	7
Cauayan	84	6	49	4	12	5	0	0	145	5
Ilagan	4	0	27	2	4	2	0	0	35	1
Total	1489	100	1116	100	220	100	20	100	2845	100

f=frequency

In the context of communicable radiographic findings, Isabela leads, followed by Cagayan, Santiago City, and Quirino. When it comes to noncommunicable findings, Isabela also appears to be the most prevalent locality, with Quirino, Cagayan, and Nueva Vizcaya following. This suggests a significant concentration of both communicable and noncommunicable conditions in Isabela, underscoring a potential area for healthcare focus and resource allocation.

Among the population with radiographic findings of mixed TB (292), 101 were admixed with radiographic findings of atheromatous aorta, while 96 with pneumonia (Fig. 3). There are significant numbers of admixtures with other non-PTB radiographic findings like pleural thickening (22), Fibrothorax (19), and pleural effusion (18). TB comorbidity with noncommunicable diseases (NCDs) and other communicable diseases (CDs) is highly prevalent in TB-endemic regions of the world. Population-attributable TB risk estimates for diabetes, malnutrition, smoking, excessive alcohol use, and HIV infection are high (Matthew *et al.*, 2015).
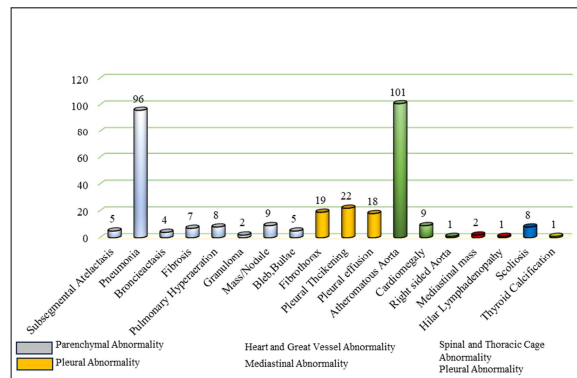
Fig. 3. The pattern of incidence and coincidence of PTB with other non-PTB radiographic findings

Conclusion

The study effectively analyzed the frequency and patterns of radiographic diagnoses, with a specific emphasis on their communicability. Out of the 15,120 individuals that were examined, 81% had normal results on their radiographs, while 19% had aberrant findings. The bulk of the aberrant results were non-communicable, especially among those aged 60 and older, suggesting a high incidence of degenerative and non-communicable illnesses in late adulthood. In terms of gender, non-communicable diagnoses were more prevalent among females, but communicable

diseases were somewhat more common among males. Isabela has the largest number of radiography findings in both communicable and non-communicable categories, based on its geographical location. Furthermore, the study emphasized considerable occurrences of combined TB and non-TB radiographic results, indicating a strong correlation between TB and other non-communicable illnesses. These observations highlight the changing health characteristics from diseases that can be transmitted to diseases that cannot be transmitted, mostly caused by changes in lifestyle and other contributing variables.

Recommendation(s)

Based on the results, a number of suggestions are put up. Given the increased frequency of non-communicable illnesses, particularly among older persons, it is essential to have improved diagnostic techniques. Healthcare practitioners should integrate comprehensive diagnostic techniques that encompass tests for prevalent degenerative diseases in addition to TB screening. Furthermore, it is crucial to customize health interventions in order to effectively target the unique requirements of the groups who are most impacted. Isabela, which exhibited elevated prevalence rates of both communicable and non-communicable diseases, should be prioritized for the allocation of resources and implementation of health education initiatives.

Public health campaigns are crucial in reducing the risk factors linked to non-communicable illnesses, such as unhealthy eating habits, lack of exercise, smoking, and excessive alcohol use. Additional investigation should examine the possible seasonal variations and temporal changes in radiography observations in order to get a deeper comprehension and foresight of healthcare requirements. This would enable more effective planning and allocation of resources. Creating comprehensive treatment models that tackle both tuberculosis and non-communicable illnesses concurrently, particularly in areas with elevated rates of coexistence, can enhance patient outcomes and maximize the use of healthcare resources.

Policymakers should consider these discoveries in order to develop and execute policies with the goal of lessening the impact of both communicable and non-communicable illnesses. These policies should prioritize preventative measures and early detection. By implementing these suggestions, the healthcare system may more effectively handle the simultaneous challenge of both communicable and non-communicable illnesses, thereby enhancing public health results.

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