Original Research

Open access

Celebes Nursing Journal

https://celebesnursingjournal.com/index.php/CNJ

Multidimensional Determinants of Tuberculosis Treatment Completion in GIDA Communities: A Mixed-Methods Analysis

Jhomar Canu-og[1], Cyruz P. Tuppal[1,2,3]

University of Perpetual Help System DALTA, Las Piñas City, Philippines[1]
Institute of Nursing, University of Makati, Philippines[2]
Department of Nursing, Faculty of Medicine, Universitas Diponegoro, Semarang, Indonesia[3]

Corresponding Author:
Name: Cyruz P. Tuppal
Address: University of Perpetual Help System DALTA, Las Piñas City, Philippines
E-mail: drcyruz@gmail.com

Article Info:
https://doi.org/10.70848/cnj.v3i2.73
pISSN 3063-9247
eISSN 3063-9255

Article History:
Received: September 15th, 2025
Revised: April 22nd, 2026
Accepted: May 22nd, 2026

Abstract

Introduction: Tuberculosis (TB) treatment completion remains challenging in Geographically Isolated and Disadvantaged Areas (GIDAs), where geographic, social, and health-system barriers may disrupt continuity of care. Objective: This study examined individual, community, structural, and health-system factors associated with TB treatment completion in selected GIDA barangays of Pangantucan, Bukidnon, Philippines. Methods: An explanatory sequential mixed-methods design (QUAN → QUAL) was used. The quantitative phase combined retrospective review of treatment information with questionnaire data from 220 purposively selected participants. Data were analyzed using descriptive statistics and multivariable binary logistic regression. Open-ended qualitative responses from 25 participants were analyzed using inductive thematic analysis and integrated during interpretation. Results: Greater CHW engagement (*OR* = 1.51, 95% CI: 1.26–1.82), stronger family and social support (*OR* = 1.43, 95% CI: 1.17–1.76), and greater DOTS utilization (*OR* = 1.39, 95% CI: 1.18–1.63) were associated with higher odds of treatment completion, whereas poorer transportation access was associated with lower odds (*OR* = 0.75, 95% CI: 0.60–0.94). The model showed good discrimination (AUC = .819) but suboptimal calibration (Hosmer–Lemeshow χ^2 = 17.90, p = .012). Qualitative findings emphasized the roles of CHWs, family involvement, transportation barriers, financial constraints, stigma, and treatment-related concerns. Conclusion: TB treatment completion in GIDA communities is associated with interacting individual, community, structural, and health-system factors. Community-based follow-up, family-centered support, accessible DOTS services, and transportation assistance may strengthen treatment continuity.

Keywords:
Tuberculosis, Treatment Completion, Community Health Workers, DOTS, Geographically Isolated and Disadvantaged Areas, Philippines

INTRODUCTION

Tuberculosis (TB) is a chronic infectious disease caused by Mycobacterium tuberculosis that primarily affects the lungs but may involve other organs (World Health Organization [WHO], 2025). Despite global control efforts, including Directly Observed Treatment, Short-course (DOTS), treatment completion remains challenging in Geographically Isolated and Disadvantaged Areas (GIDAs). Completion is shaped by interacting socioeconomic, environmental, community, and health-system factors. Although previous studies have examined treatment adherence, context-specific analyses assessing the relative contribution of these determinants in Philippine GIDA communities remain limited (Gebremariam et al., 2010; Munro et al., 2007; WHO, 2025). Locally grounded use of data and evidence is therefore essential for TB program planning and prioritization (WHO, 2021).

The Philippines remains among the countries with a high TB burden (WHO, 2025). Recent Philippine evidence indicates continuing challenges in surveillance, diagnostic access, quality of care, service delivery, and treatment outcomes (Ahson et al., 2026; Chang & Ong, 2026; Castillo et al., 2026; Nwamba et al., 2026; Suelan et al., 2026). Environmental and socioeconomic conditions also shape TB risk and access to care (Tao et al., 2026). In Bukidnon, particularly in Pangantucan, geographic isolation, limited healthcare access, transportation costs, and socioeconomic disadvantage may further hinder service utilization. The national TB strategy consequently emphasizes locally responsive, patient-centered approaches (Department of Health, 2020a; Tola et al., 2016).

Healthcare providers in geographically isolated settings encounter substantial challenges in managing TB, including non-adherence associated with stigma, limited social support, economic hardship, and logistical barriers (Faye et al., 2025). Resource constraints, inadequate infrastructure, and restricted access to diagnostic and treatment services further complicate continuity of care (Munro et al., 2007; WHO, 2022). Examining both patient-level and health-system determinants is therefore necessary to inform responsive, community-based interventions in Pangantucan.

This study examined the individual, community, structural, and health-system determinants of TB treatment completion in GIDA communities of Pangantucan, Bukidnon. It addressed the following primary research question: What factors are significantly associated with TB treatment completion among patients residing in GIDA communities?

To operationalize this inquiry, the study tested the following hypotheses:

1. H1: Community health worker (CHW) engagement is significantly associated with TB treatment completion.
2. H2: Transportation and geographic access (cost and distance) are significantly associated with TB treatment completion.
3. H3: Family and social support are significantly associated with TB treatment completion.
4. H4: Utilization of DOTS is significantly associated with TB treatment completion.
5. H5: Sociodemographic characteristics (e.g., age and sex) are significantly associated with TB treatment completion.

These hypotheses were examined using multivariable logistic regression to estimate the independent association of each predictor with self-reported treatment completion while controlling for age and sex. The conceptual interpretation of the findings was informed by the Health Belief Model, Social Capital Theory, and Donabedian's Structure–Process–Outcome framework, which together explain how individual beliefs, social relationships, care processes, and structural conditions may shape treatment behaviors and outcomes (Donabedian, 1988; Glanz et al., 2015; Kawachi et al., 2008).

METHODS

1. Design

This study employed an explanatory sequential mixed-methods design (QUAN → QUAL). The quantitative phase combined retrospective review of available TB treatment information with cross-sectional questionnaire data. The primary analytic outcome was the participant's response to whether the full six-month treatment had been completed. A "Yes" response was coded as completed (1; *n* = 112); "No" (*n* = 86) and "Not sure" (*n* = 22) responses were combined as not completed or uncertain (0; *n* = 108). Participants who were still receiving treatment remained in the analysis and were classified according to this direct completion response; they were not classified as clinical treatment failures. The outcome therefore represents self-reported full-course completion at the time of the survey rather than an official final treatment outcome assigned according to the Philippine National Tuberculosis Control Program (NTP) Manual of Procedures (Department of Health, 2020b). Broader self-reported treatment-status categories were presented descriptively. The qualitative phase used open-ended responses from a purposively selected subsample to explain and contextualize the quantitative findings, with integration during interpretation.

2. Population and Sample

The study population comprised 816 patients with TB registered in GIDA communities of Pangantucan, Bukidnon. A total of 220 participants, approximately 27% of the eligible population, were selected through purposive sampling to include individuals with direct experience of TB treatment in geographically isolated communities (Collins et al., 2015; Harrell, 2015; Riley et al., 2019). Inclusion

criteria were: (1) residence in a GIDA community; (2) current or previous enrollment in a TB treatment program; (3) age 18 years or older; (4) ability to communicate in Cebuano, Filipino, or English; and (5) provision of written informed consent. Individuals younger than 18 years, those unable to communicate effectively because of severe illness or cognitive impairment, and those who declined participation were excluded.

Purposive sampling was appropriate for reaching participants in geographically isolated communities and for obtaining context-specific evidence; however, it limits statistical generalizability beyond populations with similar characteristics

3. Data Collection Process

Data collection was conducted from June through September 2025 after ethics approval. The quantitative phase combined review of available TB treatment information with face-to-face administration of an adapted structured questionnaire by the trained researcher, with assistance from local healthcare workers in locating eligible participants. The questionnaire was developed from WHO guidance on TB care and support, the Updated Philippine Strategic TB Elimination Plan 1, and previous research on treatment adherence and healthcare access (Alipanah et al., 2018; Department of Health, 2020a; WHO, 2022, 2025). It assessed sociodemographic characteristics, CHW engagement, transportation and geographic access, family and social support, DOTS utilization, treatment status, missed doses, and self-reported completion of the full six-month regimen.

The questionnaire was culturally adapted to the Philippine GIDA context and reviewed by six experts. Item-level content validity index values ranged from 0.83 to 1.00, and the scale-level content validity index using the average approach was 0.96, indicating strong content validity.

The instrument was pilot-tested among eligible respondents from comparable communities outside the study sites to assess clarity, relevance, comprehensibility, and feasibility. Minor revisions were incorporated before administration of the final questionnaire.

Internal consistency was assessed using Cronbach's alpha. The instrument demonstrated excellent reliability (α = .91), exceeding the commonly accepted threshold of 0.70. CHW engagement, family and social support, and DOTS items were rated on a five-point scale (1 = strongly disagree to 5 = strongly agree). Mean scores were interpreted as very low (1.00–1.80), low (1.81–2.60), moderate (2.61–3.40), high (3.41–4.20), or very high (4.21–5.00). For the categorical CHW summary, participant-level means were grouped using equal-width intervals as low (1.00–2.33), moderate (2.34–3.67), and high (3.68–5.00). The transportation-barrier composite averaged two ordinal indicators: distance (<1 km = 1, 1–3 km = 2, 4–6 km = 3, >6 km = 4) and one-way travel cost (≤₱20 = 1, ₱21–40 = 2, ₱41–60 = 3, >₱60 = 4). Higher composite scores indicated poorer transportation access.

Following the quantitative phase, 25 participants were purposively selected to provide maximum variation in treatment completion, CHW engagement, transportation access, family and social support, and sociodemographic characteristics. The trained researcher administered open-ended questions face to face in a private setting, using the participant's preferred language (Cebuano, Filipino, or English), and recorded the responses in writing as closely as possible to the participant's wording. Cebuano and Filipino excerpts selected for publication were translated into English and checked against the original-language responses. Recruitment concluded at 25 participants when review of the later responses yielded no new major thematic categories.

4. Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics version 30 (IBM Corp., Armonk, NY, USA). Frequencies, percentages, means, and standard deviations summarized participant characteristics and study variables. Chi-square tests of independence and Cramer's V were used for exploratory bivariate analyses. Distance and cost were analyzed in four ordered categories; transportation modes were grouped as walking, motorcycle, public vehicle, or other; and follow-up was grouped as yes versus sometimes/no. For the family and social-support analyses, each five-category item was cross-tabulated with the original three-category completion response (Yes, No, Not sure), giving $df = (5 - 1)(3 - 1) = 8$. Binary logistic regression then used the prespecified dichotomous outcome (Yes versus No/Not sure) to identify independently associated factors. Multicollinearity was assessed using variance inflation factors (VIFs), influential observations using standardized residuals and Cook's distance, calibration using the Hosmer–Lemeshow test, and discrimination using the area under the receiver operating characteristic curve (AUC). Odds ratios (*ORs*), 95% confidence intervals (CIs), and p were reported; statistical significance was set at $p < .05$.

Open-ended responses were analyzed inductively. The research team repeatedly read the original-language responses and their English translations, generated initial codes, and compared and refined coding decisions through discussion. Related codes were grouped into categories and refined into themes. The themes were reviewed against the complete response set for coherence, distinctiveness, and support by participant accounts. Quantitative and qualitative findings were integrated through narrative weaving, with the qualitative themes used to explain and expand the statistical findings.

5. Research Ethics

Ethical approval was obtained from the Research Ethics Committee of the University of Perpetual Help System DALTA (IRB No. 2025-062025). Permissions were secured from municipal and barangay authorities before data collection. All participants provided informed consent and were informed that participation was voluntary. Participant

identifiers were replaced with codes, and study data were stored securely with access limited to the researchers.

6. Reporting Guidelines

The quantitative component was reported in accordance with the STROBE Statement, including clear reporting of the design, participants, variables, and statistical analyses (von Elm et al., 2007). The qualitative component was reported transparently with respect to participant selection, analysis, and presentation of translated quotations. Mixed-methods integration was demonstrated by linking quantitative findings with qualitative explanations during interpretation.

RESULTS

Quantitative Findings

1. Sociodemographic Profile of the Participants

Table 1. Sociodemographic Profile of the Participants (*N* = 220)

Variable	*n*	%	*M* ± *SD*
Age (years):			40.93 ± 13.51
18–25	44	20.0	
26–35	39	17.7	
36–45	41	18.6	
46–55	58	26.4	
56 and above	38	17.3	
Sex:			
Male	130	59.1	
Female	87	39.5	
Other	3	1.4	
Civil Status:			
Single	82	37.3	
Married	104	47.3	
Widowed	32	14.5	
Separated	1	0.5	
Prefer not to say	1	0.5	
Educational Attainment:			
No formal education	44	20.0	
Elementary level	49	22.3	
High school graduate	50	22.7	
College level/graduate	72	32.7	
ALS graduate	5	2.3	
Monthly Household Income:			
₱5,000 or below	98	44.5	
₱5,001–₱10,000	69	31.4	
₱10,001–₱15,000	15	6.8	
Above ₱15,000	36	16.4	
Unclassified responses	2	0.9	
Employment Status:			
Unemployed	78	35.5	
Informal work	69	31.4	
Formal employment	52	23.6	
Self-employed	21	9.5	
Household Size (members)			5.24 ± 1.89

Table 1 presents the sociodemographic characteristics of the 220 participants. The mean age was 40.93 years (*SD* = 13.51); the largest age group was 46–55 years (26.4%), followed by 18–25 years (20.0%). Most participants were male (59.1%), followed by female participants (39.5%) and participants who identified their sex as other (1.4%).

Nearly half of the participants were married (47.3%), while 37.3% were single and 14.5% were widowed. Educational attainment varied: 32.7% had reached college level or graduated from college, 22.7% were high school graduates, 22.3% had elementary-level education, 20.0% reported no formal education, and 2.3% were Alternative Learning System graduates. Economic vulnerability was common: 44.5% reported monthly household income of ₱5,000 or below, and 31.4% reported ₱5,001–₱10,000. In employment status, 35.5% were unemployed, 31.4% were engaged in informal work, 23.6% had formal employment, and 9.5% were self-employed. Household size averaged 5.24 members (*SD* = 1.89).

2. Community-Based Factors Related to TB Treatment Experience

2.1 Engagement with Community Health Workers (CHWs)

Table 2 presents CHW engagement scores. The overall mean was 4.15 (*SD* = 0.91). Home visits for medication monitoring obtained the highest mean (*M* = 4.25, *SD* = 0.86), followed by health education or reminders (*M* = 4.18, *SD* = 0.92), emotional support (*M* = 4.10, *SD* = 0.90), and assistance in accessing health services (*M* = 4.05, *SD* = 0.95).

Across all indicators, mean scores exceeded 4.00, and variability was modest (*SD* range = 0.86–0.95), indicating generally consistent participant responses.

2.2 Transportation and Geographic Access to Health Services

Table 3 presents transportation and geographic access characteristics. The largest proportion of participants lived more than 6 km from the nearest TB treatment center (31.8%), followed by those living less than 1 km away (27.7%). Participants living 1–3 km and 4–6 km from a treatment center accounted for 20.5% and 20.0%, respectively.

Motorcycle use was the most frequently reported mode of transportation (49.5%), followed by walking (22.7%) and public transportation such as tricycles or jeepneys (13.6%). Smaller proportions used combined transportation modes, and private vehicle use was uncommon.

The modal one-way transportation cost was ₱100, with reported costs ranging from ₱0 to ₱500. Most participants reported receiving follow-up reminders or visits (80.5%); 14.5% reported occasional follow-up, and 5.0% reported no follow-up.

2.3 Family and Social Support

Table 4 presents family and social support scores. The composite mean was 4.62 (*SD* = 0.62). Family reminders to take medication had the highest

mean (*M* = 4.72, *SD* = 0.54), followed by emotional support from family or friends (*M* = 4.70, *SD* = 0.55).

Accompaniment to medical appointments obtained a mean of 4.62 (*SD* = 0.62), while perceived absence of community discrimination obtained the lowest mean (*M* = 4.45, *SD* = 0.78). All family and social support indicators had mean scores above 4.40, with low-to-moderate variability (*SD* range = 0.54–0.78).

2.4 Utilization of Directly Observed Treatment, Short-course (DOTS)

Table 5 presents DOTS utilization scores. The composite mean was 4.68 (*SD* = 0.59). Understanding the importance of completing treatment had the highest mean (*M* = 4.80, *SD* = 0.45), followed by health-worker supervision of medication intake (*M* = 4.68, *SD* = 0.59).

Receipt of incentives or support under DOTS had a mean of 4.55 (*SD* = 0.72). Overall variability across the three indicators was low to moderate (*SD* range = 0.45–0.72).

3. Perceived TB Treatment Outcomes

Table 6 presents participants' self-reported treatment status and adherence indicators. The most frequently reported status was cured (31.8%), followed by ongoing treatment (27.7%) and treatment completed (15.5%).

Table 2. Community Health Worker Engagement Scores (*N* = 220)

CHW Engagement Statement	*M* ± *SD*	Verbal Interpretation
A CHW visited me at home to monitor my medication	4.25 ± 0.86	Very High
I received health education or reminders from the CHW	4.18 ± 0.92	High
The CHW helped me access health services	4.05 ± 0.95	High
I felt emotionally supported by the CHW	4.10 ± 0.90	High
Overall CHW Engagement Score	**4.15 ± 0.91**	**High**

Table 3. Transportation and Geographic Access Characteristics (*N* = 220)

Variable	*n*	%
Distance to nearest TB treatment center:		
Less than 1 km	61	27.7
1–3 km	45	20.5
4–6 km	44	20.0
More than 6 km	70	31.8
Mode of transportation:		
Motorcycle	109	49.5
Walking	50	22.7
Public vehicle (tricycle/jeepney)	30	13.6
Walking + Motorcycle	14	6.4
Motorcycle + Public vehicle	11	5.0
Walking + Public vehicle	2	0.9
Walking + Motorcycle + Public vehicle	2	0.9
Private vehicle	1	0.5
Jeepney and motorela	1	0.5
Transportation cost (₱, one way):		
Mode	₱100	—
Minimum	₱0	—
Maximum	₱500	—
Follow-up reminders/visits:		
Yes	177	80.5
Sometimes	32	14.5
No	11	5.0

Table 4. Mean Scores of Family and Social Support (*N* = 220)

Statement	Mean ± *SD*	Verbal Interpretation
My family reminded me to take my medication.	4.72 ± 0.54	Very High
I received emotional support from family or friends.	4.70 ± 0.55	Very High
I had someone accompany me to medical appointments.	4.62 ± 0.62	Very High
My community did not discriminate against me.	4.45 ± 0.78	Very High
Composite Mean	**4.62 ± 0.62**	**Very High**

Table 5. Mean Scores of Utilization of Directly Observed Treatment, Short-course (DOTS) (*N* = 220)

Statement	Mean ± *SD*	Verbal Interpretation
A health worker supervised my medication intake.	4.68 ± 0.59	Very High
I understood the importance of finishing my full treatment.	4.80 ± 0.45	Very High
I received incentives or support under DOTS.	4.55 ± 0.72	Very High
Composite Mean	**4.68 ± 0.59**	**Very High**

Table 6. Distribution of Self-Reported TB Treatment Status and Adherence Indicators (*N* = 220)

Category	*n*	%
Treatment Outcome:		
Cured	70	31.8
Ongoing treatment	61	27.7
Treatment completed	34	15.5
Lost to follow-up	22	10.0
Cured and treatment completed	20	9.1
Failed treatment	11	5.0
Lost to follow-up and failed treatment	2	0.9
Missed Any Doses:		
No	151	68.6
Yes	67	30.5
Multiple responses	2	0.9
Completed Full 6-Month Treatment:		
Yes	112	50.9
No	86	39.1
Not sure	22	10.0

Note. The treatment outcome categories reflect participants' self-reported responses rather than official National Tuberculosis Program (NTP) treatment outcome classifications. For binary analyses, completion of the full six-month treatment was coded as completed for "Yes" responses (*n* = 112) and as not completed or uncertain for "No" or "Not sure" responses (*n* = 108). The categories "cured," "treatment completed," and "cured and treatment completed" are presented as reported and should not be interpreted as mutually exclusive clinical outcome classifications (Department of Health, 2020b).

Table 7. Distribution of Treatment Completion by CHW Engagement Level (*N* = 220)

Variable	Category	Completed Treatment *n* (row %)	Not Completed/Uncertain *n* (row %)
CHW Engagement Level	High	85 (77.3)	25 (22.7)
	Moderate	20 (40.0)	30 (60.0)
	Low	7 (11.7)	53 (88.3)

Note. Treatment-completion data were available for all 220 participants. Completed treatment corresponds to "Yes" responses to completion of the full six-month treatment (*n* = 112); not completed/uncertain combines "No" and "Not sure" responses (*n* = 108). Percentages were calculated within each CHW engagement level.

An additional 9.1% selected both cured and treatment completed. For binary analyses, 112 participants (50.9%) were coded as having completed the full six-month treatment, whereas 108 (49.1%) were coded as not completed or uncertain. These categories represent participants' descriptions and are not official NTP clinical outcome classifications.

4. Treatment Completion by CHW Engagement Level

Table 7 presents treatment completion by CHW engagement level using row percentages. Among participants with high CHW engagement, 77.3% (*n* = 85) were coded as having completed treatment and 22.7% (*n* = 25) as not completed or uncertain.

Among participants with moderate CHW engagement, 40.0% (*n* = 20) were coded as having completed treatment and 60.0% (*n* = 30) as not completed or uncertain.

Among participants with low CHW engagement, 11.7% (*n* = 7) were coded as having completed treatment and 88.3% (*n* = 53) as not completed or uncertain.

5. Access to Care and Treatment Completion

Table 8 presents omnibus associations between transportation-related factors and self-reported treatment completion. Distance to the TB treatment center was significantly associated with completion ($\chi^2(3) = 22.16$, $p < .001$; Cramer's V = .317), indicating a moderate association.

Primary mode of transportation was significantly associated with treatment completion ($\chi^2(3) = 15.47$, $p = .001$; Cramer's V = .265). For this analysis, the detailed transportation responses in Table 3 were collapsed into walking, motorcycle, public vehicle, and other.

One-way travel cost was significantly associated with treatment completion ($\chi^2(3) = 20.85$, $p < .001$; Cramer's V = .307), indicating a moderate association.

Follow-up reminders or visits showed the largest association with treatment completion among the access-related factors ($\chi^2(1) = 41.56$, $p < .001$; Cramer's V = .435). For inferential testing, follow-up responses were analyzed as yes versus sometimes/no.

Table 8. Omnibus Associations of Transportation, Distance, Cost, and Follow-Up with TB Treatment Completion ($N = 220$)

Variable	Analytic categories	χ^2 (*df*)	*p*	Cramer's V
Distance to TB treatment center	< 1 km; 1–3 km; 4–6 km; > 6 km	22.16 (3)	< .001	.317
Primary mode of transportation	Walking; motorcycle; public vehicle; other	15.47 (3)	.001	.265
Travel cost (one way)	≤ ₱20; ₱21–40; ₱41–60; > ₱60	20.85 (3)	< .001	.307
Follow-up reminders/visits during treatment	Yes; sometimes/no	41.56 (1)	< .001	.435

Note. The table reports omnibus chi-square tests for the analytic categories shown. Detailed transportation modes and follow-up responses are presented descriptively in Table 3. Transportation modes were collapsed into four categories, and follow-up responses were dichotomized as yes versus sometimes/no. Cramer's V values of approximately 0.10, 0.30, and 0.50 indicate small, moderate, and large associations, respectively.

Table 9 presents associations between the five-category family and social-support responses and the original three-category response to completion of the full six-month treatment (Yes, No, Not sure). The overall association was statistically significant ($\chi^2 = 55.47$, $p < .001$; Cramer's V = .360). Family reminders, emotional support, accompaniment to appointments, and absence of community discrimination were each significantly associated with treatment-completion status (all $p < .001$).

Table 10 presents the multivariable logistic regression results. After adjustment for age and sex, higher CHW engagement (*OR* = 1.51, 95% CI: 1.26–1.82, $p < .001$), stronger family and social support (*OR* = 1.43, 95% CI: 1.17–1.76, p < .001), and greater DOTS utilization (*OR* = 1.39, 95% CI: 1.18–1.63, $p < .001$) were associated with higher odds of treatment completion. Poorer transportation access, represented by the cost-and-distance composite, was associated with lower odds of completion (*OR* = 0.75, 95% CI: 0.60–0.94, $p = .020$). Age was not statistically significant under the prespecified threshold (*OR* = 1.02, 95% CI: 1.00–1.04, $p = .050$), whereas sex was also not significantly associated with treatment completion ($p = .506$).

Table 11 presents model diagnostics. No influential observations were identified using standardized residuals and Cook's distance. VIF values ranged from 2.10 to 2.71, indicating no problematic multicollinearity. The model showed good discrimination (AUC = .819). However, the statistically significant Hosmer–Lemeshow test ($\chi^2 = 17.90$, $p = .012$) indicated suboptimal calibration. The model therefore distinguished completion outcomes reasonably well, but its predicted probabilities should be interpreted cautiously and require validation in other samples.

Qualitative Findings

The qualitative component included 25 participants purposively selected from the quantitative cohort to represent variation in treatment completion, CHW engagement, transportation access, family and social support, and sociodemographic characteristics. The original-language quotations are followed by English translations. The qualitative findings were used to explain and contextualize the quantitative results.

Table 9. Associations of Family and Social Support Indicators with Self-Reported Treatment-Completion Status ($N = 220$)

Family and Social Support Indicator	χ^2 (*df* = 8)	*p*	Cramer's V
Family reminders to take medication	58.77	< .001	0.365
Emotional support from family/friends	54.92	< .001	0.353
Accompaniment to medical appointments	50.16	< .001	0.340
Absence of community discrimination	46.03	< .001	0.324
Overall family and social support	55.47	< .001	0.360

Note. Each chi-square test cross-tabulated a five-category support response with the three-category full-course completion response (Yes, No, Not sure); therefore, *df* = (5−1)(3−1) = 8. χ^2 = chi-square test of independence; $p < .05$ indicates statistical significance. Cramer's V values of approximately 0.10, 0.30, and 0.50 indicate small, moderate, and large associations, respectively.

Table 10. Multivariable Logistic Regression Analysis of Predictors of TB Treatment Completion (*N* = 220)

Predictor Variable	B	SE	Wald χ²	*OR*	95% CI for *OR*	*p*
Age (years)	0.02	0.01	3.84	1.02	1.00–1.04	.050
Sex (Male = 1)	-0.14	0.21	0.44	0.87	0.57–1.33	.506
CHW Engagement Score	0.41	0.09	20.77	1.51	1.26–1.82	< .001
Transportation Access (Cost and Distance Composite)	-0.28	0.12	5.44	0.75	0.60–0.94	.020
Family and Social Support Score	0.36	0.10	12.96	1.43	1.17–1.76	< .001
DOTS Utilization Score	0.33	0.08	17.06	1.39	1.18–1.63	< .001
Constant	-3.21	0.78	16.92	—	—	< .001

Note. *OR* = odds ratio; CI = confidence interval; Wald χ² = Wald test statistic. Outcome: self-reported completion of the full six-month treatment (1 = Yes; 0 = No or Not sure). Statistical significance was set at $p < .05$.

Table 11. Model Diagnostics

Diagnostic Test	*p*	Interpretation
VIF (range)	2.10–2.71	No multicollinearity detected
Hosmer–Lemeshow χ² (*df* = 8)	17.90	Suboptimal calibration
p-value	.012	Poor calibration ($p < .05$)
AUC (ROC curve)	.819	Good discrimination

Note. VIF = variance inflation factor; AUC = area under the receiver operating characteristic curve. The model showed good discrimination but suboptimal calibration.

Eight themes were identified from participants' open-ended responses. Overall, the findings showed that TB treatment adherence in GIDA communities was supported by CHW engagement, family and community assistance, personal motivation, and growing hope and trust in treatment. Conversely, transportation costs, geographic distance, financial hardship, stigma, medication side effects, and misconceptions about early symptom improvement contributed to treatment interruption. Participants also emphasized the need for mobile clinics, stronger CHW outreach, nutritional assistance, sustained patient education, and continued adherence to professional advice.

1. Theme 1: Facilitators of Adherence

Adherence was supported by strong CHW engagement, family support, and personal motivation, reinforced by regular reminders and accompaniment.

> "Ang barangay health worker namin, halos araw-araw dumadaan para siguraduhin na iinumin ko ang gamot ko. Sinasamahan pa ako ng asawa ko papunta sa health center kahit umuulan." *(Our barangay health worker almost came every day to make sure I took my medicine. My spouse even accompanied me to the health center, even when it rained.) (PID 03).*

2. Theme 2: Barriers to Accessing Care

Key barriers included transport costs, distance, and economic constraints, alongside community stigma.

> "Minsan wala akong pamasahe, kaya hindi ako nakakapunta sa health center. May ilan din sa kapitbahay na iniiwasan ako dahil may TB daw ako." *(Sometimes I didn't have money for fare, so I couldn't go to the health center. Some neighbors also avoided me because they said I had TB.) (PID 11).*

3. Theme 3: Role of CHWs

CHWs acted as essential intermediaries providing education, monitoring, and emotional support, fostering trust.

> "Malaki ang tulong ng CHW sa akin kasi tinuturuan niya ako kung paano i-manage ang side effects at lagi siyang nakikinig sa mga hinaing ko." *(The CHW helped me a lot because they taught me how to manage side effects and always listened to my concerns.) (PID 07).*

4. Theme 4: Family and Community Support

Emotional, financial, and logistical support—such as accompaniment to appointments—facilitated adherence.

> "Bukod sa pamilya ko, may mga kapitbahay na naghahatid sa akin sa health center kapag wala si mister." *(Aside from my family, some neighbors take me to the health center when my husband is not available.) (PID 15).*

5. Theme 5: Suggested System Improvements

Participants recommended mobile clinics, enhanced CHW outreach, and nutritional support.

> "Sana po may mobile clinic dito para hindi na kami bumabyahe nang malayo. Maganda rin kung may libreng vitamins at pagkain para sa mga pasyente." *(I wish there were a mobile clinic so we wouldn't have to travel far. It would also be good to provide free vitamins and food for patients.) (PID 21).*

6. Theme 6: Psychosocial Experiences

Participants described initial fear and anxiety, which transitioned into hope and trust over time.

> "Noong una, takot na takot ako na baka hindi gumaling. Pero habang tumatagal, natututo akong magtiwala sa Diyos at sa gamutan." *(At first, I was very afraid that I might not recover. Over time, I learned to trust God and the treatment.) (PID 09).*

7. Theme 7: Treatment Interruption Factors

Non-adherence was linked to side effects, access barriers, and misperception of early recovery.

> "Nang mawala ang ubo ko, akala ko gumaling na ako, kaya tumigil ako sa pag-inom ng gamot. Pero bumalik ang sintomas, kaya bumalik din ako sa gamutan." *(When my cough disappeared, I thought I was cured, so I stopped taking the medicine. When symptoms returned, I resumed treatment.) (PID 18).*

8. Theme 8: Patient Insights

Participants emphasized treatment completion, resilience, and adherence to professional advice.

> "Sa mga may TB, huwag kayong susuko. Kumpletuhin ninyo ang gamutan at makinig sa payo ng health worker. May pag-asa pa habang may buhay." *(To those with TB, do not give up. Complete the treatment and follow the health worker's advice. There is hope as long as there is life.) (PID 25).*

DISCUSSION

This study examined individual, community, structural, and health-system factors associated with TB treatment completion in GIDA communities of Pangantucan, Bukidnon. The quantitative and qualitative findings were interpreted using the Health Belief Model, Social Capital Theory, and Donabedian's Structure–Process–Outcome framework.

CHW engagement, family and social support, and DOTS utilization were independently associated with higher odds of treatment completion, whereas poorer transportation access was associated with lower odds. CHW engagement remained significant after adjustment for age and sex (*OR* = 1.51, 95% CI: 1.26–1.82). This finding supports the role of CHWs as intermediaries who connect patients with treatment monitoring, education, service navigation, and psychosocial support in resource-constrained settings (Afandi et al., 2026; Hamoy et al., 2026). Within Donabedian's framework, these activities represent care processes that may mitigate structural barriers to access (Donabedian, 1988).

Family and social support was also independently associated with treatment completion (*OR* = 1.43, 95% CI: 1.17–1.76). Medication reminders, emotional encouragement, and accompaniment to appointments may strengthen self-efficacy and sustain adherence during prolonged treatment. This interpretation is consistent with Social Capital Theory and the Health Belief Model, which emphasize the influence of relational resources and perceived capability on health behavior (Glanz et al., 2015; Kawachi et al., 2008). The qualitative accounts also indicated that stigma remained present for some participants, supporting the need for community-level education and anti-stigma interventions.

Structural barriers remained important. Greater distance, higher travel costs, and reliance on less accessible transportation were associated with lower treatment completion. Geographic and financial barriers have similarly been linked with delayed care and treatment interruption in low-resource and rural settings (Munro et al., 2007; Olupot et al., 2021; Tanimura et al., 2014). Follow-up reminders and visits showed the largest reported effect size among the access-related analyses, suggesting that active patient tracking may help sustain treatment engagement when routine access is difficult.

DOTS utilization was independently associated with higher odds of treatment completion (*OR* = 1.39, 95% CI: 1.18–1.63). Participants reported strong understanding of the importance of completing treatment and frequent supervision of medication intake. Previous evidence indicates that education, reminder systems, community-based supervision, and psychosocial support can improve adherence and treatment outcomes (Alipanah et al., 2018; Ridho et al., 2022). The comparatively lower score for incentives or material support suggests that social protection may be less consistently available to economically vulnerable patients.

Model diagnostics provided a more cautious perspective on the regression findings. The AUC of .819 indicated good discrimination, but the significant Hosmer–Lemeshow test indicated suboptimal calibration. Discrimination describes how well the model distinguishes participants who reported treatment completion from those classified as not completed or uncertain, whereas calibration reflects agreement between predicted and observed probabilities (Steyerberg et al., 2010; Van Calster et al., 2019). The model should therefore be viewed as an explanatory analysis of associated factors rather than as a validated clinical prediction tool. Further refinement and external validation are required before individual risk prediction is considered (Collins et al., 2015; Riley et al., 2019).

The open-ended qualitative responses contextualized the quantitative associations by describing CHW monitoring, family involvement, transportation difficulties, financial limitations, stigma, treatment side effects, and misconceptions about early symptom improvement. These accounts indicate that adherence is socially and structurally embedded rather than determined solely by individual motivation.

Taken together, the findings support a multidimensional understanding of TB treatment completion in GIDA settings, reflecting the interaction of individual beliefs, social support, care processes, and structural access. Interventions should therefore

combine community-based follow-up, family-centered support, accessible DOTS delivery, transportation assistance, stigma reduction, and clear education on treatment duration and adverse effects.

Implications for Practice and Future Research

The findings have implications for policy, practice, and research in geographically isolated settings. TB programs should strengthen CHW capacity, sustained follow-up, family engagement, decentralized service delivery, and transportation assistance. Mobile clinics, transport subsidies, and appropriately designed social-protection mechanisms may reduce access barriers and treatment-related costs (Mohamoud, 2026; Yassin et al., 2026). Digital adherence technologies, including SMS reminders and video-supported treatment, may also be considered where connectivity, privacy, accessibility, and workforce capacity are adequate; implementation should account for context, training, acceptability, and workflow barriers (Baba & Atinga, 2026; Brubacher et al., 2026; Leddy et al., 2023; Ridho et al., 2022). Future studies should use prospective and longitudinal designs, include clinical and psychosocial variables, conduct in-depth qualitative interviews, and externally validate the regression model across diverse GIDA populations.

Limitations

This study has several limitations. Purposive sampling limits generalizability beyond populations with similar demographic, geographic, and health-system characteristics. The quantitative component combined retrospective treatment information with cross-sectional questionnaire data; consequently, the observed associations do not establish causality. The binary endpoint combined 86 “No” and 22 “Not sure” responses, including participants who were still receiving treatment and had not yet completed six months. These participants were not classified as treatment failures, but their inclusion means that the analysis reflects completion status at the survey date and may underestimate eventual completion. Self-reported treatment status, adherence, social support, and CHW engagement may also have been affected by recall and social desirability bias. Selection bias is possible because individuals who remained engaged with health services may have been more likely to participate than those who discontinued treatment or were lost to follow-up.

The model showed good discrimination but suboptimal calibration, indicating that predicted probabilities did not fully correspond with observed outcomes. Important factors such as comorbidities, mental health, socioeconomic deprivation, stigma, medication adverse effects, health literacy, and local service variation may not have been fully captured. Residual confounding cannot be excluded, and external validation in larger and more heterogeneous populations is required before the model is used for individual prediction (Collins et al., 2015; Riley et al., 2019; Steyerberg et al., 2010; Van Calster et al., 2019).

The qualitative component relied on open-ended responses rather than in-depth interviews or focus groups, which limited the depth of the accounts. Nevertheless, integrating quantitative associations with qualitative explanations provided useful context-specific evidence concerning TB treatment completion in geographically isolated and disadvantaged communities.

CONCLUSION

Tuberculosis treatment completion in GIDA communities was associated with interacting individual, social, structural, and health-system factors. Greater CHW engagement, stronger family and social support, and higher DOTS utilization were associated with greater odds of completion, whereas poorer transportation access was associated with lower odds. Qualitative findings further highlighted the importance of follow-up, family involvement, financial capacity, stigma, treatment-related concerns, and accurate understanding of the need to complete therapy.

The regression model showed good discrimination but suboptimal calibration and should not be used for individual risk prediction without further refinement and external validation. The findings nonetheless support comprehensive, community-centered strategies that strengthen CHW follow-up, accessible and decentralized DOTS services, family-centered support, transportation assistance, and sustained patient education throughout the treatment continuum.

Future research should replicate these associations and externally validate the model in larger and more diverse populations, incorporate additional clinical, behavioral, and socioeconomic variables, and evaluate the effectiveness and feasibility of targeted interventions in GIDA communities.

Author Contributions

Conceptualization: Jhomar Canu-og and Cyruz P. Tuppal; Methodology: Jhomar Canu-og and Cyruz P. Tuppal; Investigation: Jhomar Canu-og; Data Curation: Jhomar Canu-og; Formal Analysis: Cyruz P. Tuppal; Supervision: Cyruz P. Tuppal; Writing – Original Draft: Jhomar Canu-og; Writing – Review & Editing: Cyruz P. Tuppal. Both authors read and approved the final manuscript and agreed to be accountable for all aspects of the work.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest

Cyruz P. Tuppal serves as a member of the International Editorial Board of the Celebes Nursing Journal. To ensure editorial independence and transparency, he was not involved in the editorial assessment, peer-review process, editorial decision-making, or final publication decision for this manuscript. Apart from this editorial role, the authors declare no other conflicts of interest.

Acknowledgments

None.

Funding

This research received no external funding and was conducted independently by the authors.

Declaration of Use of AI in Scientific Writing

Grammarly was used solely to assist with grammar, clarity, and language refinement during manuscript preparation. Artificial intelligence tools were not used for data collection, data analysis, interpretation of findings, or generation of study results. The authors reviewed and approved the final manuscript and take full responsibility for its accuracy, integrity, and scientific content.

REFERENCES

Afandi, A. T., Putri, P., & Rondhianto. (2026). Digital adherence and telemonitoring solutions in tuberculosis care: A scoping review of mHealth-driven management strategies. *Indian Journal of Tuberculosis*. Advance online publication. https://doi.org/10.1016/j.ijtb.2026.04.016

Ahson, M., Gaviola, D. M., O'Connor, S., Gutierrez, A., Apas, M., Eguia, M. A., Pacial, D. R., Zamora, A., Lacson, R., De Guzman, A., & Moonan, P. K. (2026). Evaluating tuberculosis surveillance using global standards and benchmarks in the Philippines: Mixed methods study. *JMIR Public Health and Surveillance*, *12*, e77058. https://doi.org/10.2196/77058

Alipanah, N., Jarlsberg, L., Miller, C., Linh, N. N., Falzon, D., Jaramillo, E., & Nahid, P. (2018). Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. *PLoS Medicine*, *15*(7), e1002595. https://doi.org/10.1371/journal.pmed.1002595

Baba, D., & Atinga, B.-E. (2026). Tuberculosis in low- and middle-income countries: A critical analysis of health system barriers and the promise of artificial intelligence. *The Open Public Health Journal*, *19*, e18749445431680. https://doi.org/10.2174/0118749445431680260121064724

Brubacher, L. J., Oga-Omenka, C., Beggs, B., Bustos, M., Heitkamp, P., Morita, P. P., & Dodd, W. (2026). Profiling digital technologies used to support the tuberculosis care cascade and their implementation across high-burden countries: A systematic scoping review. *Digital Health*, *12*, 1–19. https://doi.org/10.1177/20552076251410991

Castillo, K. A. C., Orolfo, D. D. A., Desacada, J. A. B., Chua, P. G., Francia, M. R. M., & Manansala, F. M. B. (2026). Perceived quality of care and level of satisfaction of patients on tuberculosis directly observed therapy short-course during the postpandemic transition in a rural health unit in the Philippines. *Asian Journal of Public Health Practice,* *3*(1), 26–34. https://doi.org/10.4103/AJPHP.AJPHP_28_25

Chang, J. H. H., & Ong, L. C. Y. (2026). Health-related quality of life and sociodemographic factors as predictors of treatment outcomes in pulmonary tuberculosis patients in a tertiary hospital in Cebu City. *Philippine Journal of Chest Diseases*, *24*(1), 16–22. https://doi.org/10.70172/pjcd.v23i2.13333

Collins, G. S., Reitsma, J. B., Altman, D. G., & Moons, K. G. M. (2015). Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): The TRIPOD statement. *Annals of Internal Medicine*, *162*(1), 55–63. https://doi.org/10.7326/M14-0697

Department of Health. (2020a). *Updated Philippine Strategic TB Elimination Plan 1: 2020–2023*. https://ntp.doh.gov.ph/download/updated-philippine-strategic-tb-elimination-plan-1-2020-2023/

Department of Health. (2020b). *National Tuberculosis Control Program manual of procedures* (6th ed.). Republic of the Philippines. https://ntp.doh.gov.ph/download/ntp-mop-6th-edition/

Donabedian, A. (1988). The quality of care: How can it be assessed? *JAMA*, *260*(12), 1743–1748. https://doi.org/10.1001/jama.1988.03410120089033

Faye, L. M., Hosu, M. C. C., Dlatu, N., Iruedo, J., & Apalata, T. (2025). Predicting treatment adherence in patients with drug-resistant tuberculosis: Insights from socioeconomic, demographic, and clinical factors of patients in the rural Eastern Cape. *Frontiers in Tuberculosis*, *3*, 1659333. https://doi.org/10.3389/ftubr.2025.1659333

Gebremariam, M. K., Bjune, G. A., & Frich, J. C. (2010). Barriers and facilitators of adherence to tuberculosis treatment in patients on concomitant TB and HIV treatment: A qualitative study. *BMC Public Health*, *10*, 651. https://doi.org/10.1186/1471-2458-10-651

Glanz, K., Rimer, B. K., & Viswanath, K. (2015). *Health behavior: Theory, research, and practice*. Jossey-Bass.

Hamoy, G. L., Opina-Tan, L. A., Pamittan, K. G. A., Cedicol, N. C., Jumangit, A. C., III, & Perez, M.

O., III. (2026). Barangay health workers' perceived factors that affect performance in health service delivery in five upland municipalities of Cavite. *Acta Medica Philippina*, *60*(1), 30–37. https://doi.org/10.47895/amp.vi0.10714

Harrell, F. E., Jr. (2015). *Regression modeling strategies: With applications to linear models, logistic and ordinal regression, and survival analysis* (2nd ed.). Springer.

Kawachi, I., Subramanian, S. V., & Kim, D. (2008). *Social capital and health*. Springer.

Leddy, A. M., Babirye, D., & Musinguzi, N. (2023). Barriers and facilitators to implementing a digital adherence technology for tuberculosis treatment supervision in Uganda: Qualitative study. *Journal of Medical Internet Research*, *25*, e38828. https://doi.org/10.2196/38828

Mohamoud, J. H. (2026). Improving tuberculosis treatment outcomes in Somalia: A narrative review of strategies, challenges, and policy recommendations. *Risk Management and Healthcare Policy, 19*, 1–6. https://doi.org/10.2147/RMHP.S595510

Munro, S. A., Lewin, S. A., Smith, H. J., Engel, M. E., Fretheim, A., & Volmink, J. (2007). Patient adherence to tuberculosis treatment: A systematic review of qualitative research. *PLoS Medicine*, *4*(7), e238. https://doi.org/10.1371/journal.pmed.0040238

Nwamba, W. V., Okunola, A. O., Crowder, R., Christopher, D. J., Worodria, W., Yu, C., Palmer, Z., Ndlangalavu, G., Naidoo, D., Mitchell, E. M. H., Marx, F. M., Cattamanchi, A., & Theron, G. (2026). Sputum scarcity and associated factors in people undergoing tuberculosis testing in South Africa, Uganda, India, and the Philippines: An analysis of cross-sectional observational data. *eClinicalMedicine*, *95*, 103977. https://doi.org/10.1016/j.eclinm.2026.103977

Olupot, B., Namuwenge, P. M., Muttamba, W., Nansumba, M., Wambi, W., Kirenga, B., & Okot-Nwang, M. (2021). HIV infection modifies the relationship between distance to a health facility and tuberculosis treatment outcomes in rural eastern Uganda. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, *22*, 100203. https://doi.org/10.1016/j.jctube.2020.100203

Ridho, A., Alfian, S. D., van Boven, J. F. M., Levita, J., Yalcin, E. A., Le, L., Alffenaar, J.-W., Hak, E., Abdulah, R., & Pradipta, I. S. (2022). Digital health technologies to improve medication adherence and treatment outcomes in patients with tuberculosis: Systematic review of randomized controlled trials. *Journal of Medical Internet Research*, *24*(2), e33062. https://doi.org/10.2196/33062

Riley, R. D., van der Windt, D., Croft, P., & Moons, K. G. M. (2019). *Prognosis research in healthcare: Concepts, methods, and impact*. Oxford University Press.

Steyerberg, E. W., Vickers, A. J., Cook, N. R., Gerds, T., Gonen, M., Obuchowski, N., Pencina, M. J., & Kattan, M. W. (2010). Assessing the performance of prediction models: A framework for traditional and novel measures. *Epidemiology*, *21*(1), 128–138. https://doi.org/10.1097/EDE.0b013e3181c30fb2

Suelan, L. D. E., Fajutagana, N. S., Ciño, K. C., Genzon, J. E., Corvera, C. B., Tomanan, K. J. L., & Taruc, A. G. (2026). Challenges and adaptations of TB-DOTS services during the COVID-19 pandemic in South Cotabato Province, Philippines: A mixed-methods study. *Acta Medica Philippina*, *60*(5), 46–67. https://doi.org/10.47895/amp.vi0.13500

Tanimura, T., Jaramillo, E., Weil, D., Raviglione, M., & Lönnroth, K. (2014). Financial burden for tuberculosis patients: A systematic review. *European Respiratory Journal*, *43*(6), 1763–1775. https://doi.org/10.1183/09031936.00193413

Tao, Y., Zhao, J., Cui, H., Liang, Z., Li, J., Ren, J., & Zhu, H. (2026). Data-driven model analysis of the impact of environmental and socioeconomic factors on tuberculosis incidence. *Infectious Disease Modelling*, *11*(3), 930–946. https://doi.org/10.1016/j.idm.2026.02.002

Tola, H. H., Tol, A., Shojaeizadeh, D., & Garmaroudi, G. (2016). Psychological and educational factors associated with tuberculosis treatment adherence. *Patient Preference and Adherence*, *10*, 1977–1986. https://doi.org/10.2147/PPA.S112056

Van Calster, B., McLernon, D. J., van Smeden, M., Wynants, L., & Steyerberg, E. W. (2019). Calibration: The Achilles heel of predictive analytics. *BMC Medicine*, *17*, 230. https://doi.org/10.1186/s12916-019-1466-7

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *PLoS Medicine*, *4*(10), e296. https://doi.org/10.1371/journal.pmed.0040296

World Health Organization. (2021). *Compendium of data and evidence-related tools for use in TB planning and programming*. https://www.who.int/publications/i/item/9789240022843

World Health Organization. (2022). *WHO consolidated guidelines on tuberculosis: Module 4: Treatment—tuberculosis care and support*. https://www.who.int/publications/i/item/9789240047716

World Health Organization. (2025). *Global tuberculosis report 2025*. https://www.who.int/publications/i/item/9789240116924

Yassin, M. A., Rashid, A., & Wandwalo, E. (2026). Can we optimise the TB response amid funding constraints using evidence-based, cost-effective strategies? *IJTLD Open*, *3*(4), 200–207. https://doi.org/10.5588/ijtldopen.25.0771