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Psychometric of Triple Elimination Knowledge Questionnaire for Healthcare Workers: A Pilot Study

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Abstract

Background: The Triple Elimination Programme was established to reduce mother-to-child transmission of HIV, syphilis, and hepatitis B. Therefore, the assessment of health workers knowledge about these infections is essential for monitoring the success of the programme.
Objective: This study aims to evaluate the psychometric properties of the Triple Elimination Knowledge Questionnaire using Classical Test Theory and Structural Equation Modelling to ensure reliability and validity.
Methods: A 42-person cross-sectional study was conducted. The analysis included item difficulty, internal consistency, concept validity, and reliability. Factor loadings, AVE, CR, Cronbach alpha, and rho-A coefficients were used to assess construct validity, while HTMT was used to measure discriminant validity. Structural equation modelling tested predictive linkages among knowledge domains.
Results: The results showed that item difficulty varied widely, and most corrected item–total correlations exceeded 0.30. The KR-20 coefficients ranged from 0.661 to 0.733, with an overall reliability of 0.848. Construct validity was generally supported, though some domains had AVE < 0.50. Moreover, CR values exceeded 0.70, confirming internal consistency. HTMT values below 0.90 indicated discriminant validity. Structural modelling showed that triple-elimination knowledge significantly predicted HIV, syphilis, and hepatitis knowledge domains ($\beta = 0.613–0.805$, $p < 0.001$).
Conclusion: The questionnaire demonstrated strong reliability and validity, supporting the potential as a tool for assessing health workers knowledge in triple elimination programme.

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INTRODUCTION

The global initiative to eliminate mother-to-child transmission (MTCT) of HIV, syphilis, and hepatitis B is referred to as the triple elimination programme, and represents a crucial public health objective.[1] Achieving these ambitious objectives requires a multifaceted approach, including robust healthcare infrastructure, accessible diagnostic, treatment services, and, most importantly, a well-informed healthcare workforce. As frontline providers, healthcare workers are essential in implementing the triple-elimination cascade, from initial screening and counselling to treatment and follow-up care. Consequently, knowledge about these diseases, transmission pathways, and the recommended prevention as well as treatment protocols is a direct determinant of the programme success.[2-4]

In Indonesia, national guidelines mandate routine screening for HIV, syphilis, and hepatitis B during antenatal care, but challenges remain regarding implementation. Suboptimal testing coverage, shortages of diagnostic resources, and gaps in provider knowledge have been identified as barriers to the effective delivery of the programme.[3,5,6] Previous studies have shown that although HIV-related awareness is relatively higher, healthcare workers often demonstrate limited understanding of syphilis and hepatitis B, underscoring the need for systematic assessment of knowledge domains to support capacity building.[4,7] However, existing studies in Indonesia have largely relied on descriptive assessment of non-standardised measures, limiting the ability to systematically identify knowledge gaps and evaluate training needs across healthcare settings. Currently, there is no psychometrically validated instrument specifically designed to assess healthcare workers knowledge of the integrated triple elimination strategy within the Indonesian context.

To effectively identify and address knowledge gaps among healthcare workers, a valid and reliable assessment tool is indispensable. Psychometric evaluation ensures that the tool provides accurate, consistent, and meaningful measurements of knowledge. Item analysis, internal consistency testing, and construct validation using metrics such as factor loadings, Average Variance Extracted (AVE), Composite Reliability (CR), and discriminant validity (e.g., HTMT ratio) are widely recommended approaches in scale validation studies.[8-10] A psychometrically sound questionnaire allows not only for accurately diagnosing knowledge gaps, but also for monitoring the effectiveness of training programme and informing the development of targeted educational interventions within maternal and reproductive health services.

Based on the discussion above, this pilot study aims to perform a psychometric evaluation of the newly developed Triple-Elimination Knowledge Questionnaire, designed to assess the knowledge of healthcare workers regarding the triple elimination strategy. By applying both Classical Test Theory (CTT) and Structural Equation Modelling (SEM), key properties of the

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instrument were assessed, including item performance, internal consistency, construct validity, and reliability. The results will be used to refine the questionnaire, ensuring the utility as a robust and accurate tool for measuring healthcare worker knowledge. As an initial pilot evaluation, the objective is to provide foundational evidence on the measurement properties of the instrument before application in larger-scale validation investigations. By contributing a context-specific, psychometrically evaluated questionnaire, this study addresses an important methodological gap and supports ongoing efforts to strengthen healthcare workforce capacity and advance the goal of triple elimination in Indonesia.

METHODS

This pilot study used a cross-sectional, descriptive design to conduct a psychometric evaluation of the Triple-Elimination Knowledge Questionnaire. The location was in the city of Bandung, and the study was conducted between May and June 2025. Ethical approval was received from the Universitas Aisyiyah Bandung Research Ethics Board (Reference number: 1209/KEP. 01/UNISA-BANDUNG/IV/2025).

Participants

The population comprised healthcare workers from various professional backgrounds, including physicians, nurses, and midwives working at public or private health facilities in Bandung City, West Java, Indonesia. The primary method for recruiting participants was through convenience sampling, leveraging existing social media networks. A link to the online questionnaire, hosted on Google Forms, was distributed to a WhatsApp group members of the university alumni. Inclusion criteria for participation were healthcare workers aged 18 years and older, who have been working for more than six months, and those who provide care to pregnant women and newborns. All participants provided informed consent before data collection. A total of 42 healthcare workers participated in this pilot study.

Sample size considerations

This study was designed as a pilot psychometric evaluation, hence, a formal sample size calculation for confirmatory SEM was not performed. The sample size was determined pragmatically to allow preliminary assessment of item performance, internal consistency, and construct structure. In accordance with recommendations for pilot studies and early-stage instrument development, a sample size in the range of 30–50 participants was considered sufficient to identify problematic items, assess feasibility, and inform questionnaire refinement. The results are intended to guide future large-scale validation studies with adequate sample sizes.

Instruments

The primary instrument used was a newly developed, self-administered, 40-item Triple Elimination Knowledge Questionnaire, designed to assess knowledge across four key domains, including knowledge on Triple Elimination Programme, HIV transmission and treatment, Syphilis and Hepatitis B. Each item was scored dichotomously as either correct (1) or incorrect (0). Detailed information on domains, items and codes is shown in **Table 1**.

Data Analysis

Psychometric properties of the questionnaire were evaluated using CTT in SPSS version 26 and SEM using SMART-PLS 3.0.

1. CTT

Item analysis was performed to evaluate the difficulty and discrimination of each item. (1) Item Difficulty: The proportion of correct responses (p) for each item was calculated. (2) Item Discrimination: Corrected item-total correlations (rit) were calculated to assess how well each item contributed to the overall score. Items with rit values below 0.30 were considered for potential revision or deletion. (3) Internal Consistency: The reliability of each domain and the overall questionnaire was assessed using the Kuder-Richardson Formula 20 (KR-20), an appropriate measure for dichotomously scored items. A KR-20 coefficient of 0.70 or higher was considered acceptable for study purposes.[11]

2. SEM

SEM was used to evaluate the questionnaire construct and discriminant validity. Given the pilot nature of the study and the limited sample size, SEM analyses were conducted using a Partial Least Squares (PLS) approach and interpreted as exploratory rather than confirmatory. The use of PLS-SEM was considered appropriate for early-stage instrument development and small-sample contexts. The results were used to provide preliminary evidence of construct structure and to support questionnaire refinement, rather than to establish definitive model fit.

In the construct validity process, Confirmatory Factor Analysis (CFA) was used to test the hypothesised four-factor structure of the questionnaire. Factor loadings were examined to determine the extent to which each item loaded onto the intended construct. Items with factor loadings below 0.40 were considered problematic. Subsequently, the process continued to examine the Convergent and Discriminant Validity by calculating the Average Variance Extracted (AVE) and Composite Reliability (CR) for each construct. Convergent validity was supported by AVE values greater than 0.50 and CR values higher than 0.70. Discriminant validity was assessed using the Heterotrait–Monotrait Ratio (HTMT). Furthermore, HTMT values below the recommended threshold of 0.90

were used to confirm that the domains were distinct from one another.[12] A final step was building a structural model specified to evaluate the relationships between the "Triple Elimination Knowledge" latent variable and the sub-domains. The significance of the structural paths was assessed using t-statistics and p-values, with a significance level of $p<0.05$.

RESULTS

Item Analysis and Internal Consistency

Table 2 shows the results of the item analysis and internal consistency for the *Triple-Elimination Knowledge Questionnaire*. The proportion of correct responses (p) ranged widely across items, indicating variability in item difficulty. Several items, such as TE02, TE04, and KS01, were answered correctly by fewer than 30% of respondents, suggesting the items may be relatively difficult. Meanwhile, other items such as TE06 and KS10 showed high endorsement (>90%), suggesting relatively easy.

Corrected item–total correlations (rit) mostly exceeded the recommended threshold of 0.30, supporting the homogeneity of items within each domain. However, a few items, such as TE10, HT01, HT04, KH04, and KH05, had rit values below 0.30, indicating limited contribution to the scale internal consistency. The KR-20 reliability coefficients for each domain ranged from 0.661 to 0.733, and the overall reliability across domains was 0.848, which is considered good. These results indicate that the questionnaire demonstrates satisfactory internal consistency, although some items may require revision in future applications. In the context of this pilot study, items with lower discrimination indices were retained to preserve content coverage across key knowledge domains and to allow further evaluation and refinement in subsequent validation investigations.

Construct Validity and Reliability

The construct validity and reliability analysis results are shown in **Table 3**. Most factor loadings exceeded the recommended cut-off of 0.40. In terms of convergent validity, the Average Variance Extracted (AVE) values were above 0.50 for some constructs (e.g., HIV Transmission and Treatment, Knowledge about Hepatitis), supporting adequate convergence. However, AVE values for knowledge of the Triple Elimination Programme, and knowledge about Syphilis domains fell below the recommended 0.50 threshold. Despite this, Composite Reliability (CR) values for most domains exceeded 0.70, indicating that the constructs are still reliable in terms of internal consistency. Cronbach alpha and rho-A coefficients generally confirmed the reliability of the domains. These results suggest that although the overall instrument demonstrates acceptable construct reliability, specific items and domains may require refinement to enhance convergent validity.

The lower AVE values observed for the Triple Elimination Programme Knowledge and Syphilis Knowledge domains may reflect several underlying factors. This includes the heterogeneous nature of programme-level knowledge and the broad scope of clinical and public health concepts covered within the domains. In addition, the limited sample size and the dichotomous scoring format may have constrained the shared variance among items, contributing to lower AVE estimates. In line with recommendations for early-stage instrument development, constructs with AVE values below 0.50 were retained because composite reliability values exceeded the acceptable threshold, indicating adequate internal consistency despite lower convergent validity. This approach is considered acceptable in pilot psychometric studies where the primary aim is instrument refinement rather than definitive validation.

Discriminant Validity

Table 4 shows the HTMT ratio test of the Triple Elimination Knowledge Questionnaire discriminant validity. The HTMT values for the four constructs, namely Triple Elimination Programme, HIV Transmission and Treatment, Syphilis, and Hepatitis B Knowledge, ranged from 0.320 to 0.529, all of which were below the suggested level of 0.90. These results show that each construct measures a different part of knowledge within the Triple Elimination framework. The highest HTMT ratio (0.529) was found in Hepatitis B and Syphilis Knowledge, suggesting that there is some shared understanding as to how to prevent infections and screen pregnant women. On the contrary, the lowest ratio (0.320) between the Syphilis as well as HIV Transmission and Treatment Knowledge shows that there was no sufficient overlap between these two areas. In general, the HTMT results show substantial evidence of discriminant validity. This supports the questionnaire multidimensional structure and shows that respondents were able to identify the difference between general programme and disease-specific knowledge areas.

Structural Model Results

The structural relationships between the constructs are presented in **Table 5**. The results show that *Triple Elimination Knowledge* significantly predicted HIV Transmission and Treatment ($\beta = 0.613$, $t = 6.171$, $p < 0.001$), Hepatitis ($\beta = 0.805$, $t = 9.066$, $p < 0.001$), Syphilis ($\beta = 0.781$, $t = 9.279$, $p < 0.001$), and Triple Elimination Programme Knowledge ($\beta = 0.777$, $t = 10.322$, $p < 0.001$). These strong and statistically significant paths demonstrate the central role of *Triple Elimination Knowledge* in explaining variance in other domains. Based on information in Table 5, the recommendation for the Triple Elimination Knowledge instrument is to retain the supported dimensions (HIV Transmission and Treatment, Hepatitis, Syphilis, and Triple Elimination Programme Knowledge).

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Given the pilot nature of this study, the structural model results should be interpreted as preliminary and primarily informative for scale development rather than as confirmatory evidence of causal relationships. The retention of all four constructs was justified based on theoretical relevance, acceptable reliability indices, and the importance for comprehensive assessment of healthcare workers knowledge within the integrated triple elimination framework. Further refinement and validation using larger and more diverse samples are warranted to strengthen convergent validity and confirm the stability of the measurement model.

Tables

Table 1. Domains, items and codes in the 40-item Triple Elimination Knowledge Questionnaire

Item	Code
Triple Elimination Programme Knowledge	TE
The regulation governing the Triple Elimination Programme is the Minister of Health Regulation of the Republic of Indonesia No. 52 of 2017.	TE01
The implementation guideline for the Triple Elimination Programme was developed by the Ministry of Health of the Republic of Indonesia in 2018	TE02
The Triple Elimination Programme is an effort to detect early transmission of infectious diseases that can be passed from mother to child through blood	TE03
The Triple Elimination programme includes HIV and hepatitis B screening for pregnant women	TE04
Syphilis screening for pregnant women is also part of the Triple Elimination Programme	TE05
Pregnant women are required to undergo HIV, syphilis, and hepatitis B testing at least once during pregnancy	TE06
Pregnant women are encouraged to participate in the Triple Elimination Programme when preparing for delivery	TE07
One of the objectives of the programme is to eliminate all forms of disease-related stigma and discrimination	TE08
The Triple Elimination Programme uses rapid tests for HIV, syphilis, and hepatitis B, allowing results to be obtained quickly	TE09
If any of the rapid test results for HIV, syphilis, or hepatitis B in a pregnant woman are positive, treatment will be initiated immediately	TE10
HIV Transmission and Treatment Knowledge	HT
HIV can be transmitted through syringes	HT01
HIV cannot be transmitted from mother to child during pregnancy	HT02
HIV can be transmitted from mother to child during breastfeeding	HT03
HIV transmission cannot be prevented by consuming nutritious food	HT04
The period between the entry of HIV into the body and the appearance of detectable HIV antibodies is called the infection period	HT05
The risk of mother-to-child HIV transmission without any preventive measures or interventions ranges from 20% to 50%.	HT06
The first pillar of the Prevention of Mother-to-Child Transmission (PMTCT) programme is the prevention of HIV infection among women of reproductive age.	HT07
Women living with HIV/AIDS are not prohibited from becoming pregnant or having children.	HT08
Treatment for people living with HIV/AIDS (PLHIV) involves antibiotic therapy can reduce the amount of virus in the blood.	HT09
Long-term antiretroviral therapy can reduce the risk of mother-to-child HIV transmission to between 5% and 15%.	HT10
Syphilis Knowledge	KS
Syphilis is caused by the bacteria called *Treponema pallidum*	KS01

Item	Code
Early congenital syphilis occurs when transplacental transmission takes place, causing the baby to show signs of syphilis infection at birth	KS02
Early congenital syphilis is asymptomatic in 50–70% of cases	KS03
Babies born to mothers with syphilis receive examination and treatment at the Community Health Centre (*Puskesmas*) or a referral hospital with ARV initiation or satellite ARV services	KS04
A non-reactive RPR/VDRL test result in a pregnant woman is sufficient to establish a diagnosis of syphilis	KS05
Babies born to mothers with syphilis do not need to be examined if the mother has been treated before delivery	KS06
Syphilis can only be transmitted through sexual contact and cannot be transmitted through blood transfusion	KS07
In the Triple Elimination Programme, syphilis testing is conducted only for pregnant women at high risk	KS08
A single dose of penicillin is sufficient for all stages of syphilis	KS09
Education for pregnant women spouse is necessary regarding syphilis testing and test results	KS10
Hepatitis B Knowledge	KH
All pregnant women should undergo HBsAg testing	KH01
Prevention of mother-to-child transmission of hepatitis B can be achieved through the administration of the HB0 vaccine within 24 hours after birth	KH02
Hepatitis B immunisation in infants born to HBsAg-reactive mothers can prevent more than 90% of transmissions	KH03
HBeAg testing and viral load examination are not part of the official Triple Elimination Programme policy	KH04
Healthcare workers are not required to explain HBsAg results to pregnant women, as they are considered technical	KH05
Administration of Hepatitis B Immunoglobulin (HBIg) should be carried out within seven days after birth	KH06
The Triple Elimination Programme does not include education for pregnant women regarding hepatitis B	KH07
A positive HBsAg test result in a pregnant woman indicates acute hepatitis B infection	KH08
The hepatitis B vaccine for infants is administered in four doses	KH09
Mothers with high hepatitis B viral loads (>200,000 IU/mL) should receive antiviral therapy during pregnancy	KH10

Tabel 2. Item Analysis and Internal Consistency of the Triple Elimination Knowledge Questionnaire (n=42)

Domain	Item Code	Proportion Correct (p)	Corrected Item–Total Correlation *(rit)*	KR-20 per Domain
Triple Elimination Programme Knowledge	TE01	52.4	0.604	0.705
	TE02	21.4	0.550	
	TE03	90.5	0.723	
	TE04	11.9	0.430	
	TE05	90.5	0.723	
	TE06	95.2	0.381	
	TE07	35.7	0.509	
	TE08	78.6	0.455	
	TE09	90.5	0.681	
	TE10	35.7	0.219*	
HIV Transmission and Treatment Knowledge	HT01	73.8	0.312*	0.733
	HT02	76.2	0.380	
	HT03	71.4	0.664	
	HT04	81.0	-0.190*	
	HT05	78.6	0.415	

Domain	Item Code	Proportion Correct (p)	Corrected Item–Total Correlation *(rit)*	KR-20 per Domain
	HT06	71.4	0.458	
	HT07	71.4	0.282*	
	HT08	73.8	0.584	
	HT09	76.2	0.660	
	HT10	76.2	0.467	
Syphilis Knowledge	KS01	14.3	0.281*	0.665
	KS02	92.9	0.409	
	KS03	76.2	0.647	
	KS04	64.3	0.467	
	KS05	28.6	0.481	
	KS06	71.4	0.717	
	KS07	38.1	0.509	
	KS08	71.4	0.488	
	KS09	54.8	0.574	
	KS10	97.6	0.385	
Hepatitis B Knowledge	KH01	81.0	0.264*	0.728
	KH02	83.3	0.397	
	KH03	78.6	0.557	
	KH04	38.1	0.231*	
	KH05	88.1	0.209*	
	KH06	54.8	0.553	
	KH07	81.0	0.366	
	KH08	78.6	0.308	
	KH09	76.2	0.397	
	KH10	66.7	0.547	
All Components	Total	-	-	0.848

*The items were deleted.

Tabel 3. Construct Validity and Reliability of the Triple Elimination Knowledge Questionnaire (n = 42)

Domain/ Construct	Item Code	Factor Loading	AVE	Composite Reliability (CR)	Cronbach's α	ρA
Triple Elimination Programme	TE01	0.630	0.325	0.805	0.734	0.763
	TE02	0.637				
	TE03	0.468				
	TE04	0.434				
	TE05	0.641				
	TE06	0.331				
	TE07	0.504				
	TE08	0.720				
	TE09	0.646				
HIV Transmission and Treatment Knowledge	HT02	0.928	0.561	0.891	0.846	0.864
	HT03	0.824				
	HT05	0.939				
	HT06	0.369				
	HT08	0.451				
	HT09	0.613				
	HT10	0.889				
Knowledge about Syphilis	KS02	0.233	0.286	0.769	0.679	0.706
	KS03	0.679				
	KS04	0.397				
	KS05	0.370				
	KS06	0.718				
	KS07	0.474				

	KS08	0.569				
	KS09	0.630				
	KS10	0.552				
Knowledge about Hepatitis	KH02	0.452	0.583	0.896	0.848	0.917
	KH03	0.927				
	KH06	0.292				
	KH07	0.914				
	KH08	0.974				
	KH09	0.945				
	KH10	0.506				

Tabel 4. Discriminant Validity of Constructs (HTMT Ratio) of the Triple Elimination Knowledge Questionnaire

Construct	HT	KH	KS	TE
HIV Transmission and Treatment (HT)	0.749			
Knowledge about Hepatitis (KH)	0.348	0.764		
Knowledge about Syphilis (KS)	0.320	0.529	0.535	
Triple Elimination Programme (TE)	0.350	0.499	0.466	0.570

Tabel 5. Structural Model Results of the Triple Elimination Questionnaire

Path	β	t-Statistic	p-Value	Decision
Triple Elimination Knowledge -> HIV Transmission and Treatment	0.613	6.171	<0.001	Supported
Triple Elimination Knowledge -> Knowledge about Hepatitis	0.805	9.066	<0.001	Supported
Triple Elimination Knowledge -> Knowledge about Syphilis	0.781	9.279	<0.001	Supported
Triple Elimination Knowledge -> Triple Elimination Programme	0.777	10.322	<0.001	Supported

DISCUSSION

This study aimed to evaluate the psychometric properties of the Triple-Elimination Knowledge Questionnaire by examining item analysis, internal consistency, construct validity, and structural model. Overall, the results show that the instrument possesses acceptable reliability and validity, while also underlining areas for refinement.

Item Analysis and Internal Consistency

Item analysis showed broad variability in difficulty. Some items were rarely answered correctly (TE02, TE04, KS01), while others exceeded 90% accuracy (TE06, KS10). A similar spread is recommended in scale development to capture a full range of ability, but may reduce discrimination when extreme.[8,13] Items with low corrected item–total correlations, such as TE10 and KH05, contributed little to internal consistency, reinforcing results in other Indonesian validation studies.[14-16] KR-20 coefficients across domains (0.661–0.733) and an overall value of 0.848 fall within

recommended reliability levels (>0.70) for health knowledge tools.[9,17] These results indicate that the items collectively measure knowledge consistently while allowing sufficient variability to detect differences among respondents.

Items with low discrimination or extreme difficulty were retained at this stage to preserve theoretical content coverage across the triple elimination domains. In a pilot context, retaining these items allows for further qualitative review, potential rewording, and reassessment in subsequent validation studies rather than premature exclusion.

Construct Validity and Reliability

Most items loaded above 0.40, supporting construct validity, though weak or negative loadings in the HIV Comprehensive domain suggest poor alignment, consistent with challenges reported in similar Indonesian instrument validations.[18,19] Although AVE values for some domains fell below 0.50, Composite Reliability values exceeded 0.70, confirming internal consistency.[10,20] Cronbach alpha and rho-A coefficients provided further evidence of stability, in line with other validation studies in Southeast Asia.[21] The validated dimensions of this questionnaire, which cover programme-specific, disease prevention and transmission knowledge, reflect the conceptual intent of measuring the cognitive readiness of the healthcare workers, both in implementing and advocating the Triple Elimination Programme.

From a theoretical perspective, the retention of constructs with AVE values below 0.50 is justified by the multidimensional and heterogeneous nature of knowledge related to integrated public health programme. Triple elimination knowledge covers policy awareness, clinical decision-making, and prevention practices, which may not show high shared variance at the early stages of instrument development. In this context, composite reliability is considered a more appropriate indicator of construct adequacy, particularly in pilot studies focused on scale refinement rather than confirmatory validation.

Discriminant Validity

All HTMT ratios were below 0.90, confirming that each domain measured a distinct construct. The highest HTMT (0.529) between Hepatitis B Knowledge and Syphilis Knowledge indicate the presence of some overlap between infection prevention and maternal screening. The lowest ratio (0.320) between Syphilis and HIV Transmission and Treatment Knowledge shows that there is a slight overlap. These numbers are significantly lower than the stricter 0.85 threshold, which further supports discriminant validity.[22] Similar results of adequate discriminant validity have been reported in health literacy and KAP tools adapted for Indonesia.[14]

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Structural Model and Predictive Validity

The structural model confirmed theoretical expectations, showing that general Triple Elimination Knowledge strongly predicted each disease-specific domain (β = 0.613–0.805). These results underscore the centrality of programme-wide knowledge, in line with previous evidence that broad awareness enhances domain-specific understanding.[23] The strength of these paths suggests that improving healthcare workers general knowledge may simultaneously elevate disease-specific expertise, as reported in elimination mother-to-child transmission of HIV, syphilis and hepatitis B (EMTCT) studies in Indonesia.[5,24] This pattern supports the conceptual framework underlying the questionnaire, where integrated programme knowledge functions as a foundational construct that informs disease-specific competencies required for effective service delivery.

Implications for Practice and Research

This questionnaire is a promising tool for assessing healthcare worker knowledge in the triple elimination context. Weak items should be revised or removed, consistent with recommendations from similar psychometric work. The poor performance on syphilis-related items reflects persistent gaps noted in Indonesian studies and suggests that training should prioritise syphilis and hepatitis content alongside HIV. However, this instrument has distinctive characteristics because it combines general programme understanding with disease-specific knowledge areas, which is not an aspect most of the currently available instruments provide. Emphasising and improving the most important parts of each validated dimension will make both the theory and the practice stronger. Psychometric evaluation also supports broader cross-cultural adaptation. Similar to other Indonesian validation studies[18,21], refinement and re-testing with larger and more diverse samples are recommended. Cross-setting validation will ensure generalisability, while longitudinal research could examine whether knowledge improvements translate into practice.[10,19]

By providing an integrated measurement of programme-level and disease-specific knowledge, this instrument directly supports the operationalisation of the triple elimination programme. It enables systematic identification of knowledge gaps among healthcare workers, informs targeted training interventions, and facilitates monitoring of programme integration across antenatal and maternal health services. As such, the questionnaire contributes a practical and theory-driven tool to strengthen the implementation and integration of triple elimination efforts in Indonesia.

Limitations

The main limitations include the small sample (n = 42) and reliance on self-report, which may have introduced social desirability bias. These challenges are typical of pilot psychometric studies. Despite these, the results provide a strong foundation for scale refinement and contribute to the

literature on EMTCT programme evaluation in Indonesia. Additionally, lower AVE values observed in some constructs should be interpreted as a limitation of this pilot study and underscore the need for further item refinement and validation using larger samples.

CONCLUSION

In conclusion, the Triple Elimination Knowledge Questionnaire demonstrated good internal consistency, acceptable construct validity, and strong predictive relationships among domains. Although some items require refinement, the overall results suggest that the instrument is a useful tool for assessing knowledge related to the triple-elimination programme. By identifying specific strengths and weaknesses in respondents knowledge, the questionnaire can guide the development of targeted educational strategies aimed at supporting the global elimination of mother-to-child transmission of HIV, syphilis, and hepatitis. However, several constructs demonstrated limitations in convergent validity, as reflected by AVE values below the recommended threshold. Although the instrument is considered usable and informative in the current form, it should be applied with caution, particularly when used for evaluative or comparative purposes. Further refinement of items and validation using larger and more diverse samples are required to strengthen convergent validity and to confirm the stability of the measurement model in future studies.

RECOMMENDATION

Future studies should focus on editing and retesting items with poor discriminating indices to enhance the instrument precision and applicability. To enhance the generalisability of the results, extensive validation with larger and more diverse samples from various regions is needed. Health authorities and training institutions may include this questionnaire in routine monitoring and training programme to identify knowledge gaps among healthcare professionals. The instrument could serve as a prototype for creating similar instruments in other contexts to assess and enhance ability in maternal infection prevention and control.

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Declarations

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