SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 8204-8223
Open Access. Online & Print

DOI: 10.5281/zenodo.19746749

DEVELOPMENT OF COMPETENCY INDICATORS FOR PUBLIC HEALTH PROFESSIONALS ACCORDING TO COMMUNITY PUBLIC HEALTH PROFESSIONAL STANDARDS

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Received: 11/03/2026
Accepted: 25/04/2026

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ABSTRACT

To examine and develop competency indicators for PHPs that align with the CHPS practice, and to assess the CFA model of these indicators by juxtaposing it with empirical data. The mixed-methods study aimed to establish performance indicators and assess the alignment of the structural model of public health competence indicators with empirical data derived from the Community Health Professional Standards (CHPS). The study was executed in three stages. Phase 1 entailed formulating the conceptual framework through a synthesis of pertinent literature and comprehensive interviews with five subject-matter experts. Phase 2 focused on formulating the competency indicators by soliciting insights from 17 experts using a three-round modified Delphi Technique. Phase 3 involved validating competency indicators. The validation used empirical data from a nationally representative sample of 1,125 public health professions (PHPs), selected via a multi-stage sampling technique. Descriptive statistics, including percentages, means, standard deviations, medians, and interquartile ranges (IQR), were used to examine the data. The confirmatory factor analysis (CFA) was conducted utilizing statistical tools to validate the structural model. The competency indicators for PHPs, derived from the CHPS, comprise six core components, 33 subcomponents, and 225 indicators. Results: The CFA model of the competency indicators exhibited a robust alignment with the empirical data. The statistical outcomes indicated: $\chi^2 = 484.080$, $df = 259$, CMIN/DF = 1.869, $p = 0.135$, RMSEA = 0.03, GFI = 0.97, AGFI = 0.94, CFI = 0.99, and RMR = 0.01. The factor loadings ranged from 0.34 to 0.51, and the factor weights ranged from

0.54 to 0.92, with all values statistically significant ($p < .01$). Conclusion: Establishment of Indicators for Public Health Competency confirms that the six core components are essential elements aligned with CHPS.

KEYWORDS: Indicator, Public health professionals (PHPs), Competency, Community health professional standards (CHPS), Thailand

1. INTRODUCTION

The Community Health Professional Act B.E. 2556 (2013) defines the "community health profession" as a professional practice involving interactions among individuals, families, communities, and environments, encompassing health promotion, disease prevention and control, primary disease assessment and primary treatment, care, assistance, rehabilitation, occupational health, and environmental health. The primary objective of the Act is to mitigate community health risks by applying scientific principles. The scope of practice explicitly excludes the healing arts governed by the Healing Arts Act and other medical or public health professions regulated under separate legislation. The enactment of this law represents a significant institutional milestone, as it formally recognizes community health as an independent profession and establishes legally defined boundaries of professional practice (Secretariat of the Cabinet, 2013).

The Act delineates professional practice in community health as a continuum of public health interventions directed toward individuals, families, communities, and environmental contexts. These interventions include: (1) facilitating education, providing guidance, and offering counselling in health promotion, disease prevention and control, primary treatment, and rehabilitation through an integrated, continuous, and holistic approach; (2) applying scientific principles in occupational and environmental health to prevent disease-causing factors and reduce health risks; (3) conducting primary disease assessment, providing primary treatment, care, and assistance, enhancing immunity, and delivering family planning services in accordance with criteria established by the governing committee; and (4) assessing illness and supporting referrals based on prescribed standards (Secretariat of the Cabinet, 2013).

To ensure service quality and protect public health, the Act establishes the Community Health Council as the regulatory authority responsible for supervising professional practice and enforcing national standards. These standards impose legally binding obligations and ethical responsibilities on practitioners, ensuring that community health services are delivered competently and consistently across the country (Secretariat of the Cabinet, 2013).

Accordingly, public health professionals (PHPs) are required to possess knowledge, competencies, and practical skills aligned with Community Health Professional Standards (CHPS), including competencies in health promotion and community health; disease prevention and control, epidemiology, statistics, and public health research; primary disease assessment, primary treatment, care, rehabilitation, and referral; occupational and environmental health; public health administration and law; and professional ethics. Together, these domains form the foundational framework that enables practitioners to perform their professional roles effectively and provides a basis for regulation, supervision, and quality assurance in community health practice.

Despite clear legislative and regulatory frameworks, empirical evidence indicates persistent competency gaps among practitioners. Several studies report that PHPs lack competencies consistent with established standards and the evolving demands of the health system (Rungruang et al., 2016; Changyai et al., 2013; Jitaram, 2020). Moreover, there remains a shortage of clearly defined competency indicators to guide practitioners in fulfilling their roles in accordance with professional standards.

Based on these gaps, the research hypothesizes that a structural model of competency indicators for PHPs will demonstrate strong alignment with empirical data, reflect professional norms for community health practice, and provide a systematic framework for competency development. The study evaluates the elements of the draft professional practice standards stipulated under the Community Health Professional Act B.E. 2556 (2013), integrates expert perspectives, and tests the structural validity of the proposed competency indicator model. The findings are expected to contribute to the development of a comprehensive competency framework that strengthens PHPs' professional capacities, supports compliance with recognized standards, and ultimately enhances health and well-being among the Thai population.

1.1. Conceptual Framework

The researcher reviewed relevant principles, concepts, theories, policy documents, and empirical studies, including the Community Health Professional Act B.E. 2013 and the Community Health Professional Standards (CHPS) Practice B.E. 2020, to synthesize the competency indicator components for public health practitioners in accordance with CHPS practice (Community Public Health Council, 2020). The synthesis process identified six main competency domains comprising thirty-three sub-competencies. Abbreviations were used to denote each principal domain and sub-domain as follows:

CPS: Public Health Professional according to Community Health Professional

HPC competencies: Community health promotion competency

PER competencies: Disease prevention, disease control, epidemiology, statistics, and public health research competency

AFR competencies: Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency

EOS competencies: Environmental health and Occupational health

PAL competencies: Public health administration and law competency

MPE competencies: Professional characteristics competency

Sub-components:

A1: Health communication

A2: Health skills development activities

A3: Participatory health policy implementation

A4: Community health

B1: Disease and health hazard prevention and control

B2: Epidemiology

B3: Statistics

B4: Public health research

C1: Primary disease assessment

C2: Primary treatment

C3: Patient care and assistance

C4: Referral

C5: Rehabilitation

C6: Family planning

C7: Immunization services

D1: Environmental quality surveillance

D2: Food sanitation

D3: Public building sanitation

D4: Vector control

D5: Wastewater and sewage treatment

D6: Hazardous waste management

D7: Air pollution control

D8: Noise and vibration control

D9: Nuisance abatement

D10: Health and environmental impact assessment

D11: Occupational health

E1: Public health administration

E2: Environmental health law

E3: Occupational health law

E4: Community health professional law

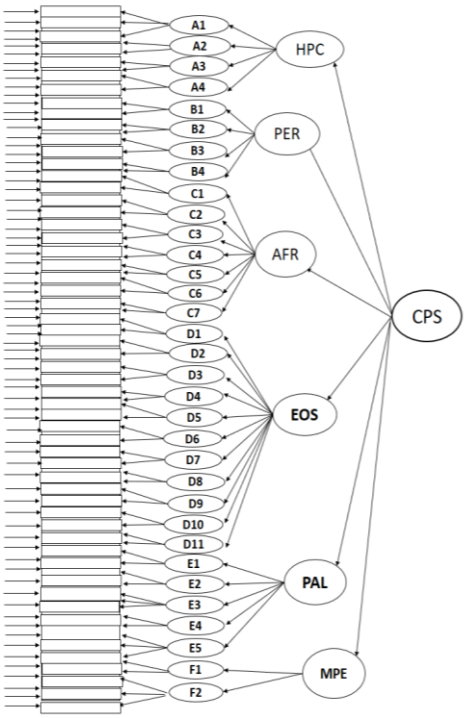
E5: Public health administration law

F1: Morality and ethics

F2: Professional ethics

These components constitute the conceptual framework for developing competency indicators for PHPs in accordance with the CHPS practice, comprising six major domains and thirty-three sub-domains, as illustrated in Figure 1.

Figure 1: The six major domains and thirty-three sub-domains.



2. METHOD

2.1. Study Design

The study employed a research and development (R&D) strategy utilizing a sequential mixed-methods approach. The methodology began with the collection of qualitative data to define the components of competency indicators for public health practitioners, grounded in the CHPS practice. The qualitative findings were then validated using quantitative research methods. The research was conducted in three phases, as shown below:

Phase 1: Development of the Conceptual Framework and Initial Theoretical Competency Elements

The stage involved synthesizing relevant concepts, theories, and research through content analysis. Thorough semi-structured interviews were conducted with five experts selected by purposive sampling. The panel of experts included two national public health officials, one academic faculty member, one provincial or bureau-level public health administrator, and one representative from a professional organization. The data were analyzed and interpreted using a thematic analysis. The data

were later used to formulate the core components, subcomponents, and the first competency indicators.

Phase 2: Development of Competency Indicators Utilizing the Modified Delphi Method

A three-step modified Delphi technique was employed to achieve expert consensus. Seventeen specialists, each with at least 10 years of experience in community health, were deliberately selected, comprising both scholars and practitioners (Phunthai, 2022)

Step 1 used a checklist-style questionnaire (agree/disagree) alongside open-ended questions to allow experts to provide additional comments. Data were evaluated using percentages, and items attaining at least 80% consensus were included in subsequent rounds. Steps 2 and 3 used a five-point Likert-scale questionnaire. Data were assessed using the median (Mdn > 3.50) and interquartile range (IQR < 1.50) to determine consensus. Indicators demonstrating substantial relevance and consistency in step 3 were retained to formulate the questionnaire for the next round.

Phase 3: Empirical Validation of the Structural Model of Competency Indicators

The population consisted of directors or PHPs employed at all Subdistrict Health Promoting Hospitals nationwide, totaling 9,887 individuals (one person per institution). The sample included 1,238 directors or public health officers from Subdistrict Health Promoting Hospitals around the nation. The sample size was determined based on the criteria set out by Hair et al. (2010) for factor analysis, which requires a minimum of 100 participants and a sample-to-parameter ratio of 5:1. The necessary sample size was 1,125, including 225 parameters, with an additional 10% added to account for non-response. A multi-stage random sampling technique was employed, dividing the sample into six zones to ensure national representation.

2.2. Research Tools

The study instrument comprised a questionnaire assessing the skills of PHPs, which had been verified by experts using the third step of the Modified Delphi procedure. The questionnaire consisted of 235 items utilizing a five-point Likert scale. It was partitioned into two segments: Section 1: Demographic Information of Participants (10 Items), and Section 2: Competency Indicators for Public Health Practitioners According to CHPS Practice (225 Items)

2.3. Data Evaluation

Data were collected via a Google Form, yielding 1,025 responses, for a response rate of 91.11%. The CFA was conducted using a statistical software application to assess the goodness-of-fit between the structural model of competency indicators and the empirical data. The assessment of model fit adhered to the standard criteria proposed by Diamantopoulos and Siguaw (2000)

Table 1: Criteria for Assessing Model Fit.

Fit Index	Acceptable Level
χ^2	Non-significant ($p > 0.05$)
χ^2 / df	< 2.0
Comparative Fit Index: CFI	> 0.90
Goodness of Fit Index: GFI	> 0.90
Adjusted Goodness of Fit Index: AGFI	> 0.90
Root Mean Square Residual: RMR	< 0.05
Root Mean Square Error of Approximation: RMSEA	< 0.05

3. RESULTS

The formulation of competency indicators for PHPs, grounded on the CHPS practice, yielded six primary competency domains, encompassing 33 sub-domains and 225 indicators. 1) Community health promotion competency: Four sub-domains, thirty-eight indicators, 2) Disease prevention, disease control, epidemiology, statistics, and public health research competency: 4 sub-domains, 32 indicators, 3) Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency: 7 sub-domains, 50 indicators, 4) Environmental health, and Occupational health competency: 11 sub-domains, 60 indicators, 5) Public health administration and law competency: 5 sub-domains, 25 indicators, 6) Professional Characteristics Competency: Two sub-domains, twenty indicators.

The organized framework provides a robust foundation for evaluating and enhancing PHP's competencies in line with professional standards.

2. Outcomes of the Evaluation of Model Fit for the Competency Indicator Framework of PHP in Accordance with CHPS

3.1. Demographic Attributes of Participants

The examination of respondents' fundamental data indicated that the predominant gender was female (56.8%). The predominant age group was 40–50 years, at 55.12%, whilst individuals under 35 years represented the least proportion at 3.30%. The majority of respondents (81.6%) held a bachelor's degree and had 10–15 years of experience in community health practice (87.41%), while individuals with fewer than 5 years of experience

accounted for the smallest percentage (2.90%). Most participants were members of the Community Health Council (86.2%), while 13.8% were in the process of obtaining licensure as community health professionals.

3.2. Appropriateness of Competency Indicators

The indicators received a good suitability rating. The mean scores for each domain, listed in descending order, were: professional characteristics ($\bar{X}$ = 4.50), primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral ($\bar{X}$ = 4.06), community health promotion ($\bar{X}$ = 4.05), disease prevention, disease control, epidemiology, statistics, and public health research ($\bar{X}$ = 3.91), public health administration and law ($\bar{X}$ = 3.87), and environmental health, occupational health, and safety($\bar{X}$ = 3.77). The mean score was 4.03, with a standard deviation of 0.56, skewness of -0.213, and kurtosis of 0.36. All indicators satisfied the specified requirements and were considered appropriate for the CFA.

3.3. Examination of Indicator Component Construction via the CFA

Before the analysis, the researcher assessed the correlations among all 225 indicators. The findings revealed that the correlations within each model were statistically significant at the 0.01 level ($p < .01$), indicating that the models were appropriate for component analysis, as shown in Table 2.

According to Table 2, the assessment of the appropriateness of the correlation matrices prior to the CFA indicated that the matrices for the variables deviated substantially from the identity matrices across all six domains. The domains encompassed include 1) Community health promotion competency, 2) Disease prevention, disease control, epidemiology, statistics, and public health research competency, 3) Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency, 4) Environmental health and Occupational health competency, 5) Public health administration and law competency, and 6) Professional characteristics competency. The Bartlett's Test of Sphericity values for the six domains were 40,110.89; 41,247.73; 66,629.31; 97,268.10; 39,644.40; and 33,701.82, respectively, with all models yielding p-values of .000 (< .01), indicating statistically significant relationships. The Kaiser-Meyer-Olkin (KMO) Measures of Sampling Adequacy (MSA) were 0.983, 0.979, 0.985, 0.985, 0.975, and 0.979, all surpassing 0.50 and nearing 1, indicating that all six sub-models were appropriate for confirmatory factor analysis.

Table 2: Displays the results of Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure for the model used to develop competency indicators for community health professionals in accordance with professional standards.

Models	Bartlett's test of Sphericity	p	Kaiser-Mayer-Olkin Measures of Sampling Adequacy)MSA(
1) Community health promotion competency (HPC competencies)	40110.89	.000	0.983
2) Disease prevention, disease control, epidemiology, statistics, and public health research competency (PER competencies)	41247.73	.000	0.979
3) Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency (AFR competencies)	66629.31	.000	0.985
4) Environmental health and Occupational health (EOS competencies)	97268.10	.000	0.985
5) Public health administration and law competency (PAL competencies)	39644.40	.000	0.975
6) Professional characteristics competency (MPE competencies)	33701.82	.000	0.979

*****Statistical Significance at the 0.01 Level (p < .01).***

The CFA results validated that the constructed structural model of competency indicators for

community health professionals aligned with the empirical data across all six models. Analysis of the factor loadings revealed that all 225 indicators were significant measures of their corresponding 33 subcomponents. The findings of the first-order confirmatory factor analysis, as presented in Table 3, demonstrated that all indicators within each component aligned with the empirical data. Every component exhibited statistically significant factor loadings, indicating that all indicators were crucial to their respective components. Additionally, the χ^2/df ratio was below 5.00, and the model fit indices, such as the Goodness-of-Fit Index (GFI) and the Adjusted Goodness-of-Fit Index (AGFI), neared 1. The Root Mean Square Error of Approximation (RMSEA) was below 0.05, indicating that the competency indicators for CPPs, in accordance with CHPS, demonstrated robust structural validity (see Table 3).

Table 3: First-Order CFA Results.

A Model of Competency Indicators for PHPs	Goodness-of-Fit Statistics					
	χ^2	χ^2/df	GFI	AGFI	RMSEA	RMR
1) Community health promotion competency (HPC competencies)	820.032	1.680	0.96	0.94	0.02	0.01
2) Disease prevention, disease control, epidemiology, statistics, and public health research competency (PER competencies)	490.528	1.528	0.97	0.95	0.02	0.01
3) Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency (AFR competencies)	1573.505	1.838	0.94	0.91	0.03	0.01
4) Environmental health and Occupational health (EOS competencies)	1918.380	1.599	0.94	0.91	0.02	0.02
5) Public health administration and law competency (PAL competencies)	169.914	1.867	0.99	0.96	0.03	0.01
6) Professional characteristics competency (MPE competencies)	169.914	1.867	0.99	0.96	0.03	0.01

3.4. Evaluation of the Structural Model Fit of Indicators

The formulation of the indicators was grounded in the component scale of public competences, in accordance with CHPS, and employed second-order confirmatory factor analysis.

According to Table 4, before performing the CFA, the Bartlett's Test of Sphericity was assessed. The outcome yielded a value of 41,741.461, with $p < .01$, indicating that the correlation matrix substantially deviated from an identity matrix at the .01 level. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.918, indicating that the model explains 91.8% of the variance and demonstrates exceptional sampling adequacy. Consequently, the data were considered suitable for advancing with the CFA.

Table 4: Displays the Kaiser-Meyer-Olkin (KMO) statistic and the outcomes of Bartlett's Test of Sphericity.

Metrix correlation		
Kaiser-Meyer-Olkin of Sampling Adequacy		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	41741.461
	df.	4950
	Sig.	0.000

3.5. Results of the Second-Order Confirmatory Factor Analysis

A second-order CFA was performed to establish a measurement model comprising 33 components. The findings demonstrate that the six primary domains, which represent exogenous latent variables, constitute the essential competencies required of PHPs as defined by CHPS. All domains exhibited positive factor loadings between 0.54 and 0.92, which were statistically significant ($p < .01$). All domains exhibited an acceptable degree of factor loading (greater than .30). The domains, arranged from highest to lowest factor loading, are as follows: Public health administration and law competency (PAL competency) at 0.92, Community health promotion competency (HPC competency) at 0.90, Disease prevention, disease control, epidemiology, statistics, and public health research competency (PER competency) at 0.89, Environmental health and Occupational health competency (EOS competency) at 0.88, Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency (AFR competency) at 0.87, and Professional characteristics competency (MPE competency) at 0.54.

All 33 subcomponents, which represent observed variables of the latent constructs, were confirmed as valid indicators of public health competency in accordance with CHPS. The factor loadings were positive, ranging from 0.76 to 0.96, and were statistically significant ($p < .01$). All subcomponents achieved the acceptable threshold for factor loading (> .30) and exhibited predictive coefficients (R^2)

ranging from approximately 65% to 92%.

The 225 individual indicators demonstrated factor loadings exceeding 0.30 and were statistically significant, confirming that each indicator adequately assessed its corresponding subcomponent. The predictive coefficients (R^2) demonstrate minimal measurement error in these results.

The components and indicators of public health competency demonstrated strong construct validity, affirming that all indicators are suitable for assessing the intended competency constructs.

3.6 Model Fit of the Structural Model for Public Health Competency Indicators Based on CHPS

The assessment of model fit indicated that the structural model of public health competency indicators fit the empirical data well. The chi-square value (χ^2) was 484.084 with 259 degrees of freedom, resulting in a χ^2/df ratio of 1.869, which is below the acceptable threshold of 5. The Goodness-of-Fit Index (GFI) was reported at .97, while the Adjusted Goodness-of-Fit Index (AGFI) was .94. The Root Mean Square Error (RMSE) was 0.03, suggesting a strong model fit.

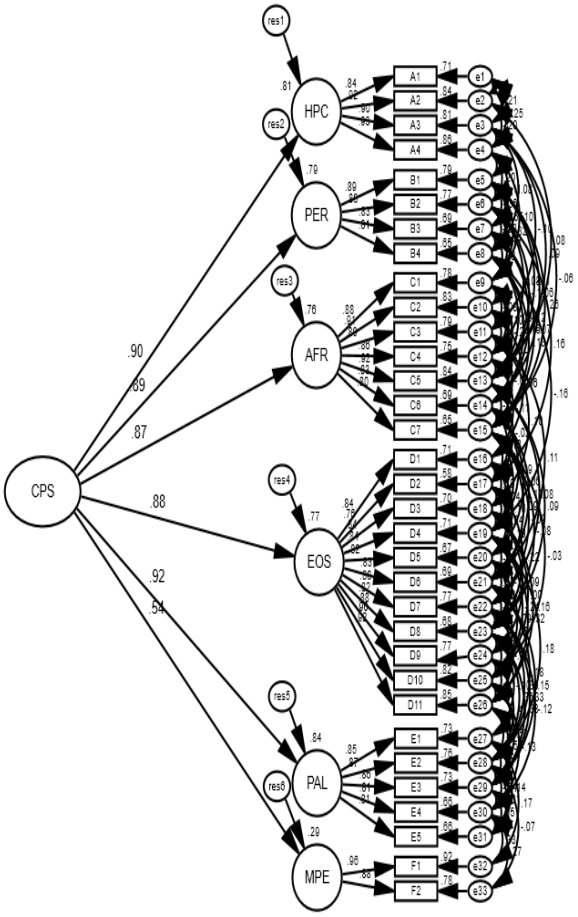
The structural equation representing the competency model is articulated as follows:

CPS is calculated as follows: CPS = 0.92(PAL) + 0.90(HPC) + 0.89(PER) + 0.88(EOS) + 0.87(AFR) + 0.54(MPE). The results presented in Table 5 and depicted in Figure 2 demonstrate that the model aligns with the empirical data.

Table 5: Presents the findings from the second-order CFA aimed at establishing competency indicators for PHPs aligned with CHPS.

Subcomponent	The second-order CFA for PHPs aligned with CHPS.			
	Factor Loading (β)	Predictive Coefficient (R^2)	Factor Score Coefficient (FS)	Indicator Error Term (e)
The first stage				
HPC competencies				
A1	0.84	0.71	0.14	0.08
A2	0.92	0.84	0.18	0.05
A3	0.90	0.81	0.16	0.06
A4	0.93	0.86	0.29	0.04
PER competencies				
B1	0.89	0.79	0.39	0.06
B2	0.88	0.77	0.16	0.07
B3	0.83	0.69	0.10	0.13
B4	0.81	0.65	0.17	0.19
AFR competencies				
C1	0.88	0.78	0.17	0.07
C2	0.91	0.83	0.09	0.06
C3	0.89	0.79	0.13	0.07
C4	0.86	0.75	0.05	0.11
C5	0.92	0.84	0.21	0.06
C6	0.83	0.69	0.05	0.11
C7	0.80	0.65	0.10	0.13
EOS competencies				
D1	0.84	0.71	0.09	0.14
D2	0.76	0.58	0.01	0.17
D3	0.84	0.70	0.08	0.15
D4	0.84	0.71	0.17	0.13
D5	0.82	0.67	0.01	0.20
D6	0.83	0.69	0.03	0.14
D7	0.88	0.77	0.19	0.14
D8	0.82	0.68	0.01	0.24
D9	0.88	0.77	0.08	0.13
D10	0.91	0.82	0.10	0.11
D11	0.92	0.85	0.28	0.08
PAL competencies				
E1	0.85	0.73	0.19	0.13
E2	0.87	0.76	0.18	0.13
E3	0.86	0.73	0.11	0.14
E4	0.81	0.66	0.15	0.14
E5	0.81	0.66	0.06	0.18
MPE competencies				
F1	0.96	0.92	0.73	0.03
F2	0.88	0.78	0.28	0.07
the second stage				
HPC	0.90	0.81	-	-
PER	0.89	0.79	-	-
AFR	0.87	0.76	-	-
EOS	0.88	0.77	-	-
PAL	0.92	0.84	-	-
MPE	0.54	0.29	-	-
Chi - Square = 484.08, df = 259, CMIN/DF = 1.869, CFI = 0.99, GFI = 0.97, AGFI = 0.94, RMSEA = 0.03, RMR = 0.01				

Based on Table 5, a structural model of public health competency indicators aligned with the CHPS can be constructed, as illustrated in Figure 2.



Chi – Square =484.080, df = 259, CMIN/DF =1.869, CFI =0.99,

GFI =0.97, AGFI =0.94, RMSEA =0.03, RMR =0.01.

Figure 2: The Competency indicator model for PHPs in accordance with CHPS

4. DISCUSSION

The researcher outlined the principal findings and analyzed the results in accordance with the research methodologies as follows:

4.1. Establishment of Indicators for Public Health

Competency, in accordance with the standards set forth for PHPs, found that the development process results indicated that all constructed indicators were highly appropriate and exhibited a high level of consistency. The finding confirms that the six core components 1) Community health promotion competency, 2) Disease prevention, disease control, epidemiology, statistics, and public health research competency, 3) Primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral competency, 4) Environmental health and Occupational health competency, 5) Public health administration and law competency, and 6) Professional characteristics competency—are essential elements of public health competency aligned with CHPS. The results are consistent with the conceptual framework and research hypotheses. The researcher adhered to a systematic approach for indicator development, aligned with the frameworks established by Professional Association of Public Health (2015). The process encompasses defining the objectives of indicator development, data collection, indicator construction, quality assessment, and result reporting. The developed public health competency indicators are high-quality and appropriate for practical application. Additionally, validation through a national sample of PHPs improved the reliability and applicability of the indicators in practical settings. This approach is consistent with Johnstone (1981) emphasis on engaging end users in indicator development, thereby mitigating the limitations of traditional methods that rely exclusively on expert input. Involving practitioners in the evaluation process ensures that the indicators accurately represent actual work conditions, enhances acceptance, and improves the feasibility of practical implementation.

4.2. Results of the Second-Order CFA of Competency Indicators for PHPs.

The findings from the second-order CFA indicated that the researcher's competency indicator model provided an exceptional fit to the empirical data. All factor loadings were statistically significant, corroborating the premise that the research model is consistent with empirical evidence. Of the six principal components, public health administration and law demonstrated the highest factor loading (0.92), succeeded by community health promotion (0.90), disease prevention, disease control, epidemiology, statistics, and public health research competency (0.89), Environmental health and occupational health (0.88), primary disease assessment and primary treatment, care, assistance, rehabilitation, and referral (0.87), with Professional characteristics exhibiting the lowest loading (0.54).

These findings indicate that practitioners prioritize public health administration and law abilities, as these areas are intricately linked to management, planning, and resource optimization. This aligns with previous studies indicating that administrative abilities substantially affect the quality and outcomes of health care (Juran and Gryna, 1993; Frenk et al., 2010).

Moreover, an analysis of each element revealed that the competency indicator model for PHPs, grounded in the six core components, aligns with the

theoretical frameworks and empirical evidence presented by academics and researchers, as shown below:

1). Public Health Administration and Law Competencies (PAL competencies)

The CFA results for the Public Health Administration and Law component indicated a strong fit between the model and the empirical data. All components demonstrated positive correlations with PHPs' competencies. The component with the highest factor loading was Environmental Health Legal Standards (b = .87), followed by Occupational Health and Law Standards (b = .86). These findings underscore the necessity of compliance with legal frameworks for the prevention and control of disease in community health, aligning with the assertions of Frenk et al. (2010), who highlighted the significance of law as a foundation for health service delivery.

The Public Health Administration component (b = .85) further emphasizes the importance of planning, resource management, supervision, and evaluation in the effective delivery of health services. This is consistent with the views of Juran and Gryna (1993) and the Professional Association of Public Health (2015), which underscore the significance of efficient management of public health resources, including personnel, budgets, and materials.

Similarly, the components related to Public Health Professional Legal Standards (b = .81) and Public Health Administration Legal Standards (b = .81) highlight the importance of legal knowledge and professional ethics. These findings are consistent with the Council on Linkages Between Academia and Public Health Practice (2021), which identifies "Policy Development and Program Planning" and "Public Health Laws and Regulations" as essential competencies for PHPs. In addition, Doherty et al. (2023) and the Community Public Health Council (2020) contend that the application of legal principles directly influences service quality and the sustainability of health systems.

However, the competencies identified in this study diverge from the CDC's Public Health Law Competency Model (PHLCM version 1.0), which delineates the knowledge, skills, and abilities required across professional tiers and positions, positioning law as the cornerstone of governmental public health practice (Ransom, 2020). In alignment with this perspective, Leethongdissakul et al. (2024) recognize administration and law as one of the five essential competencies for PHPs, emphasizing personnel management, budgeting, and legal frameworks. Furthermore, Ransom et al. (2019) expand legal competency to include public health emergency law, public health law, and legal epidemiology, all of which require proficiency in policy mapping and legal evaluation.

Legal capacity underpins effective resource management and public health functions, as highlighted by Huang et al. (2023), who argue that legal mechanisms enhance state core capacities. Nevertheless, gaps remain. Brînzac et al. (2025) report that early-career personnel frequently demonstrate deficiencies in leadership, systems thinking, law, and ethics, corroborating earlier findings regarding insufficient legal knowledge within the workforce. Similarly, Iskandar et al. (2022) found that ministry staff scored higher in "Law, Policies, and Health Services," whereas less-experienced workers achieved significantly lower scores.

These findings indicate the need to align workforce development with the Legal Epidemiology Competency Model to strengthen Essential Public Health Services. To address these gaps, Withers et al. (2019) propose multiple strategies to enhance legal competencies, including coursework, practicums, research, mentorship, and evaluation. In addition, Wright et al. (2000) emphasize the role of competency-based leadership in establishing performance standards, while Sandhu et al. (2023) highlight the importance of multisectoral collaboration and adaptive governance for sustainable workforce development.

2) Community Health Promotion Competencies (HPC competencies)

The CFA results for the Community Health Promotion model indicated a strong alignment with the empirical data, confirming that all four components were significant indicators of PHPs' skills. The Community Health component (b = .93) exhibited the highest factor loading, highlighting the importance of comprehensive community health assessment, analysis, and development. The components related to Health Skills Development Activities (b = .92) and Participatory Health Promotion Policy Advocacy (b = .90) underscore the significance of community empowerment and intersectoral collaboration. These findings are consistent with the World Health Organization's emphasis on community-oriented health promotion (World Health Organization, 2018).

The Health Communication component (b = .84) supports Nutbeam's (2000) assertion that health literacy enhances individuals' capacity to make informed health decisions. Overall, the findings suggest that public health practitioners must possess comprehensive competencies in health planning,

development, and communication. This is in line with the Ottawa Charter for Health Promotion, which asserts that effective health promotion requires the active involvement of individuals, families, and communities in problem analysis, decision-making, and collective action (World Health Organization, 1986). In this context, PHPs function as communicators, facilitators, negotiators, and capacity builders, empowering communities to manage health determinants and improve their well-being (World Health Organization, 1986).

Furthermore, effective health promotion extends beyond individual behavior change to encompass community participation, empowerment, and local policy action. Community Health Promotion competencies therefore transcend traditional health education by integrating public health communication, skills development, and participatory policy processes—dimensions that are often underrepresented in conventional competency frameworks. Compared with the Core Competencies for Public Health Professionals, which define eight domains including Communication, Community Partnership, and Leadership and Systems Thinking (Council on Linkages Between Academia and Public Health Practice, 2021), the HPC framework demonstrates strong alignment with communication and community collaboration, while also addressing gaps in citizen engagement and policy translation.

The HPC framework illustrates that effective health promotion requires interdisciplinary competencies, including community partnership, policy advocacy, planning, communication, research, and ethical foundations, consistent with HPC components A1–A4 (Barry et al., 2012). Complementary evidence suggests that the development of health promotion competencies necessitates multisectoral collaboration to ensure that interventions and policies are responsive to community contexts (Dempsey et al., 2010; Dempsey et al., 2011). Evidence from Thailand further indicates that although nurses and primary care personnel play a central role in health promotion, their competency levels remain basic, revealing substantial gaps in research, knowledge management, and systems analysis—key domains within global health promotion competency standards.

Advancing Community Health Promotion Competencies requires an integrated framework that combines communication, community engagement, health skills development, policy action, and evaluation. Such a framework should draw upon HPC principles and those of the Public Health Foundation, while being adapted to local contexts, such as Thailand, to strengthen community health systems sustainably.

3) Disease Prevention, Disease Control, Epidemiology, Statistics, and Public Health Research Competencies (PER competencies)

The CFA results for the model encompassing Disease Prevention and Control, Epidemiology, Statistics, and Public Health Research demonstrated an adequate fit with the empirical data, thereby confirming the validity of the competency structure for PHPs. The Disease and Health Hazard Prevention and Control component exhibited the highest factor loading (b = .89), highlighting the critical role of frontline personnel in managing diseases and health threats. These findings are consistent with guidance from the World Health Organization and related agencies, which emphasize strengthening surveillance systems and community-level emergency response capacities (Centers for Disease Control and Prevention, 2021; World Health Organization and the Global Fund, 2020; World Health Organization Regional Office for Europe, 2014). Similarly, the U.S. Centers for Disease Control and Prevention underscores the importance of robust surveillance and response systems (CDC, 2021).

Empirical studies further reinforce that epidemiological surveillance and disease control constitute essential competencies for PHPs, particularly in developing countries, encompassing disease monitoring, risk management, and emergency communication (Abbas et al., 2025; Koh et al., 2020). Effective disease control competencies substantially reduce the likelihood of community-level outbreaks. The Epidemiology component (b = .88) reflects the application of evidence-based information for analysis and planning, aligning with Thacker and Berkelman (1988), who identified epidemiological surveillance as a foundational element of public health systems.

Although the Statistics (b = .83) and Public Health Research (b = .81) components demonstrated comparatively lower factor loadings, they remain critical tools for assessing and improving service quality. This observation is consistent with evidence indicating that statistical and research competencies enhance decision-making and advance public health practice (Friis and Sellers, 2020; Green and Glasgow, 2006).

Competencies within the PER domain—including disease prevention and control, epidemiology, statistics, and public health research—are recognized as core functions of the public health workforce within the Essential Public Health Functions (EPHFs)

framework. Accordingly, these competencies should be fully integrated into curriculum design, training systems, and performance assessment (World Health Organization, 2024). Practice-oriented epidemiology frameworks, such as the ECDC core competencies, emphasize data collection, analysis, interpretation, and dissemination, thereby strengthening disease surveillance systems (European Centre for Disease Prevention and Control, 2009).

The One Health paradigm has further shaped learning outcomes through supervised practicums, mentoring, and integrated assessments to prepare professionals to investigate and respond to health events affecting humans, animals, and the environment (Muehlen et al., 2025). Synthesis studies on practice-based competencies provide comprehensive frameworks for infectious disease epidemiology, including surveillance, outbreak investigation, data analytics, risk communication, and policy support (Plymoth et al., 2023). These frameworks inform B-domain curricula and the objectives of the Field Epidemiology Training Program (FETP). Evaluations of FETP initiatives highlight the importance of behavioral outcomes, outbreak response readiness, and evidence-informed policy-making, underscoring the value of integrating field-based skills with systematic evaluation (Al Nsour et al., 2024; Flint et al., 2025).

Contemporary competency frameworks also emphasize cross-cutting skills such as systems thinking, intersectoral coordination, laboratory collaboration, and the application of digital data tools (Al Nsour et al., 2024). These skills are particularly relevant to B2–B4 competencies in the context of emerging diseases and complex environmental risks (Laing et al., 2023; Frankson et al., 2016). Evidence further suggests that integrating coursework with supervised fieldwork, research projects, and structured mentorship or continuing professional development enhances practical competencies (Withers et al., 2019; Plymoth et al., 2023). Overall, aligning PER competencies with national and international standards, including standardized FETP indicators, strengthens coherence, continuity, and effectiveness in workforce development for disease prevention, disease control, and public health research.

4) Primary Disease Assessment and Primary treatment, Care, Assistance, Rehabilitation, and Referral Competencies (AFR competencies).

The CFA revealed that the model demonstrated a robust fit with the empirical data, and all seven components functioned as significant indicators of public health expertise. The components with the highest factor loadings were rehabilitation (b = .92) and primary treatment (b = .91), underscoring the importance of continuity of care, including primary treatment, follow-up, and functional restoration to achieve optimal health outcomes. These findings are consistent with the framework proposed by the Professional Association of Public Health (2015), which emphasizes the importance of evaluation and patient assistance competencies in facilitating effective referral processes.

Furthermore, Van Dijk et al. (2023) and the World Health Organization and the Global Fund (2020) advocate for comprehensive primary healthcare services that ensure continuity of primary treatment and reduce the burden on tertiary care institutions. The patient care and support component (b = .89) and the assessment component (b = .88) highlight the role of public health personnel in screening, prevention, and primary treatment. Similarly, the referral component (b = .86) underscores the importance of service integration between primary and secondary care levels to enable timely access to appropriate medical services.

The family planning (b = .83) and immunization promotion (b = .80) components further emphasize the role of primary prevention and health promotion, consistent with national policies and international frameworks, including WHO-supported Expanded Programmes on Immunization. Substantial evidence indicates that strengthening the competencies of primary healthcare workers—particularly in initial assessment, primary treatment, and referral coordination—is essential for improving the quality of care for children and the general population (Nguyen et al., 2013). Meta-analytic findings demonstrate that Integrated Management of Childhood Illness (IMCI) training significantly improves accurate disease classification and enhances performance in medication administration, vaccination, and nutritional counselling (Nguyen et al., 2013).

Recent evidence also suggests that electronic IMCI (eIMCI) systems improve diagnostic accuracy and adherence to clinical guidelines compared with traditional paper-based algorithms (Horwood et al., 2024). In the context of chronic disease management, proficiency in early diagnosis, primary treatment, and referral processes is critical to maintaining continuity and quality of care (Michielsen et al., 2023). Distance-based IMCI (dIMCI) has been shown to achieve outcomes comparable to conventional training while improving access in remote and underserved areas (Abayneh et al., 2020).

Complementary services, including health

promotion, immunization, and family planning, also benefit from task-sharing models that enhance service accessibility in resource-limited settings (Yankam et al., 2023; World Health Organization, 2017). In addition, competency development in rehabilitation is increasingly recognized as essential. The WHO Rehabilitation Competency Framework delineates universally relevant competency domains and behavioral indicators for the rehabilitation workforce (Mills et al., 2021) and has informed workforce planning and policy reforms in multiple countries (Mills et al., 2023).

Overall, these findings underscore that clearly defined competencies in diagnosis, primary treatment, referral, rehabilitation, and essential primary healthcare functions are fundamental to the development of high-quality, resilient, and context-responsive primary healthcare systems.

5) Environmental Health and Occupational Health Competencies (EOS competencies).

The CFA results for the environmental and occupational health competencies model demonstrated a robust alignment with the empirical data. All eleven indicators exhibited substantial factor loadings, with occupational health (b = .92) and environmental health impact assessment (b = .91) showing the highest values, underscoring their critical roles within public health competency. These findings are consistent with the competency framework proposed by the Council on Linkages Between Academia and Public Health Practice (2021), which identifies environmental public health and occupational health as core competencies required for PHPs to support safe and sustainable health systems.

The Environmental and Occupational Safety (EOS) competency framework comprises eleven subdomains (D1–D11), encompassing essential functions such as environmental quality surveillance, food and public facility control, waste management, pollution prevention, and health–environment impact assessment. This framework emphasizes the need for environmental and occupational risk assessment skills across all levels of service delivery. These domains correspond closely with the World Health Organization (2024), which recognizes health protection—including environmental and occupational health—as a fundamental public health capacity. Similar priorities are reflected in European public health frameworks (European Centre for Disease Prevention and Control, 2009).

In addition, the Public Health Foundation (2021) highlights competencies related to environmental risk assessment, hazard management, and the prevention of occupational diseases, aligning with international public health guidance (World Health Organization, 2024; American Public Health Association, 2001). The American Public Health Association (2001) further defines essential skills for protecting community health, including surveillance, monitoring, risk communication, and legal knowledge.

This orientation is also consistent with the Basic Occupational Health Services (BOHS) model for primary care units proposed by Siriruttanapruk and Praekunatham (2022), which emphasizes workforce training, workplace visits, systematic health recording, and referral mechanisms—principles endorsed by joint ILO/WHO initiatives aimed at expanding occupational health service coverage, particularly for vulnerable workers. Furthermore, Jagals and Ebi (2021) propose competency frameworks to address climate- and environment-related health challenges, highlighting risk assessment and emergency preparedness as essential capabilities.

International evidence supports the integration of occupational health services into primary care systems. Buijs et al. (2012) demonstrate that primary care settings can effectively deliver basic occupational health services through targeted training and network-based approaches. Similarly, van Dijk and Moti (2023) report that integrating BOHS improves access to occupational health services, although sustained resources and policy support are required. The involvement of specialized professionals, such as occupational therapists, further enhances prevention and rehabilitation capacities (Donnelly et al., 2013).

Complementary evidence from local pilot initiatives, such as those reported by Alfers and Samantrakul (2019) for WIEGO, indicates improved access to occupational health services among informal workers and highlights the importance of stable funding and supportive administrative structures. Collectively, these findings align with the WHO–ASPHER framework, which emphasizes practice-based training, continuous professional development, and systematic competency evaluation as foundations for strengthening environmental and occupational health capacity (World Health Organization, 2020).

6) Professional Characteristic Competencies (MPE competencies).

The CFA of the Professional Characteristic Competencies demonstrated a strong alignment with the empirical data. The indicator with the highest factor loading was morals and ethics (b = .96),

followed by professional conduct (b = .88). These findings emphasize that morals and ethics constitute a fundamental foundation for public health professionals (PHPs), particularly within the Thai socio-cultural context, which places substantial value on compassion and equity. This result is consistent with prior studies indicating that ethics and empathy directly influence trust, cooperation, and community engagement (Lillefjell et al., 2018; Dine and Rondeau, 2024).

The comparatively lower salience of professional conduct competencies may reflect the relatively recent implementation of formal professional conduct standards by the Community Health Council, which require time for full institutionalization and professional internalization. These standards serve as a regulatory framework that guides professional behavior in accordance with established norms. This interpretation aligns with the arguments of Smith (2023) and Gopichandran et al. (2025), who contend that professional conduct competencies protect citizens' rights, reduce ethical violations in health services, and ultimately enhance public confidence and satisfaction.

Moreover, these findings support the Core Competencies for Public Health Professionals framework, which designates "Ethical Practice" as a core competency essential for delivering principled and sustainable public health services (Council on Linkages Between Academia and Public Health Practice, 2021). A substantial body of evidence further indicates that ethical competence is a central component of health professions education and can be systematically developed through assessment tools, structured learning, and reflective practice. For example, Orathai et al. (2023) validated the Moral Virtue Scale among Thai nursing students, demonstrating its effectiveness in measuring moral virtues and strengthening ethics-focused curricula. Similarly, Katayama et al. (2022) reported that the Ethical Care Competence Scale is a reliable instrument for evaluating ethical care in clinical practice.

Conceptual advancements by Koskenvuori et al. (2019) identify moral sensitivity, moral reasoning, and responsible decision-making as core dimensions of ethical competence. Educational research further emphasizes that effective ethics education requires integrating ethical theory, reflective practice, and authentic professional scenarios (Andersson et al., 2022; Moreira et al., 2021). Insights from Hemberg and Hemberg (2020) suggest that ethical competence emerges through the interaction of knowledge, practical skills, and supportive organizational environments that encourage ethical deliberation.

At the system level, Tulchinsky and Flahault (2012) highlight the inherent complexity of public health ethics, which requires balancing collective benefits with individual rights. In response, Batt et al. (2021) propose a systematic six-step model for strengthening moral and professional competencies. Ethical scholarship further emphasizes that virtue, responsibility, integrity, and justice are foundational elements of professional identity (Brody and Doukas, 2014; Lee, 2018). In the context of health research, Tackett et al. (2022) demonstrate that robust ethical competency frameworks are critical for protecting research participants and promoting transparency. Collectively, this body of evidence indicates that the assessment and development of moral and professional ethical competencies are essential for ensuring service quality, strengthening ethical decision-making, and reinforcing public trust in health systems.

4.3. Limitations and Implications

4.3.1. Stage One Research Limitations

Data obtained from expert interviews were inherently subjective and dependent on participants' individual experiences. The researcher's professional background in community health education may have introduced potential bias in data interpretation and synthesis. Consequently, the findings are specific to this study and may differ if replicated by other researchers. Additionally, the large number of questions employed in Phases 2 and 3, which involved data collection from multiple sources, may have affected data quality and study outcomes.

5.2 Software and Modeling Constraints

A third-order CFA could not be performed due to software limitations. Instead, second-order factor analysis and scale component construction were applied to develop the competency indicators. This analytical approach was deemed appropriate and conceptually consistent with third-order CFA methodologies.

4.3.2. Contextual Applicability

The developed competency indicators are specific to community health professionals working in primary care settings in Thailand and may require adaptation before application in other health systems or national contexts.

5. CONCLUSION

The development of the PHPs indicators indicated that all indicators created by the researcher exhibited a high degree of appropriateness and robust internal

consistency. They were identified as critical elements of public health competencies aligned with the PHPS. The second-order CFA of the PHP indicators indicated that the proposed model provided an excellent fit to the empirical data, with all parameter estimates statistically significant, thereby supporting the hypothesized structure. The empirical data revealed that the highest factor loading was associated with PAL competencies (0.92), followed by HPC (0.90), PER (0.89), EOS (0.88), AFR (0.87), and MPE (0.54).

Upon analysis of the six competency components, the highest-loading indicator for each domain is identified as follows: (1) Environmental Health Law Standards (b = .87) for PAL competencies; (2) Community Health (b = .93) for HPC competencies; (3) Disease Prevention and Health Hazard Control (b = .89) for PER competencies; (4) Rehabilitation (b = .92) for AFR competencies; (5) Occupational Health and Safety (b = .92) for EOS competencies; and (6) Moral and Ethical Conduct (b = .96) for MPE competencies.

Research ethics: The study was approved by the Human Research Ethics Committee of Walailak University (Approval No. WUEC-24-235-01) on July 3, 2024. Written informed consents were obtained from participants included in the study.

Declaration of competing interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence. The work reported in the paper.

CRediT authorship contribution statement

Rattawan Somporn: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization, Araya Prasertchai: Conceptualization, Writing – review & editing, Methodology, Formal analysis, Data curation, Visualization, Validation, Supervision, Phiman Theraratanasunthon: Data curation, Formal analysis, Methodology., Writing – review & editing. Sanhawat Chaiwong: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Acknowledgement: The authors gratefully acknowledge the support of the Excellent Center for Public Health Research (EC for PHR), Walailak University, Nakhon Si Thammarat, Thailand, for providing institutional and academic resources. Their continuous encouragement and scholarly environment significantly contributed to the successful completion of this work. The authors sincerely appreciate the center's commitment to advancing public health research and academic excellence.

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